Economic geographies of large-scale renewable energies development in Kenya

Financing, governance and infrastructures

Dissertation

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Summary

Energy transition theories and studies have made important contributions to our knowledge of the challenges and possibilities for achieving sustainable energy transition and more sustainable societies. However, this body of work can be enhanced through the incorporation of geographical perspectives and power relations as forces shaping the development and materialization of energy transition projects in practice. This thesis applies a geographic lens, as part of its analytical framework, to study the actor constellations, processes and linkages involved in the development of large-scale renewable energy (LSRE) projects in Kenya. It focuses on the key arrangements thereof, namely, financing, governance and infrastructures. The research questions of the study are answered through dedicated research contained in six chapters of the dissertation. The analysis is based on a mixed-method approach consisting of empirical fieldwork conducted in Kenya (2018-2021) as well as document and media information gathered from secondary sources. I conducted 120 expert and informal interviews, visited key field sites across Kenya (particularly in Nairobi, Nakuru and Baringo counties), and observed industry conferences and events. The findings from the fieldwork are complemented by results from the analysis relevant policy, regulatory and legal reports, and online media and archives.

Large-scale renewable energy infrastructures in Kenya are mainly driven by Kenya's Vision 2030, an ambitious plan to transform Kenya into a newly industrializing, middle-income country. The Government of Kenya identifies energy as the critical enabler for unlocking these economic growth and industrialization visions. As result, the country's energy sector has gone through processes of neoliberal reforms, including the privatization of previously public entities, private sector participation and devolution in energy sector governance and development. These changes have allowed for the involvement and participation of multifaceted actors and stakeholders at international, national, sub-national and community levels in the country's energy sector development. The development of large-scale renewable energy projects in Kenya is governed by rules and processes of interactions and cross-scalar linkages among these various stakeholders, broadly classified in this dissertation as investors and communities. The various investor and community groups have different strategic roles, represent different interests and have divergent and sometimes conflicting expectations. The financing for these projects comes from public finances from international and national sources, as well as private equity finance from private firms and industries. Due to the capital-intensive and high-risk features of these projects, the highest percentage of financing for the projects

comes from international development financial institutions in the forms of concessional loans, grants and mezzanine, and directed towards risk mitigation and market-readiness. Climate mitigation financing in the form of specialized funds and green bonds used for blended financing and carbon offsetting also play important catalytic roles in crowding-in investors, especially at the pre-completion phases of the projects. Due to the large and influential roles of the public sector financiers and the involvement of private developers and industries, processes of financialization are so far not observed in the financing landscape of large-scale renewable energy projects in Kenya.

The challenge in the development ('future-making') of these large-scale energy projects lies in connecting and balancing out the divergent 'futures' of the involved multi-actors. The divergent interests, aspirations and expectations among different investor and community groups lead to contestations and protests, which when escalated and left unmanaged can stop the progress of 'future-making' in this context. This is where cross-scalar consultations and negotiations among stakeholder groups become necessary. Investors are often faced with sustainability dilemmas and tensions as they attempt to simultaneously apply the sustainability triad (economic, social and environment) in LSRE projects development. Due to the complexities in managing this situation, the investors often implement these projects using a process of strategic selectivity, notwithstanding the existence of certain unresolved issues, especially regarding land and compensation. Given that most projects are pursued and advanced notwithstanding the existence of some unresolved issues (especially regarding land and compensation), national and international agencies and investors often implement Corporate Social Responsibility (CSR) infrastructure projects and activities, such as the provision of drinking water for people and their livestock in the communities, to smoothen relation with host communities. However, some of these endeavours fail to fully and sustainably address the socio-economic concerns of local communities, especially the project-affected persons (PAPs).

Dedication

To my Parents, Late Prof. Anthony Nweke Eze and Prof. Peace Onyema Eze; and to my son, Chinua Stefan Nweke-Eze

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Acronyms

ACC	African Conservation Centre
AEDC	Africa Energy Development Corporation
AEF	Africa Energy Forum
AFD	Agence Française de Développement (French Development Bank)
AfDB	African Development Bank
ANT	Actor-Network Theory
ARGeo	African Rift Geothermal Development Facility
ATIDI	African Trade and Investment Development Insurance
AUC	Africa Union Commission
CAC	Community Advisory Council
CC	County Commissions
CCD	Climate Change Directorate
CDCF	Community Development Carbon Fund
CDM	Clean Development Mechanism.
CER	Certified Emission Reduction
CG	County Government
CIDP	County Integrated Development Plans
CIO	Climate Investor One
CO2	Carbon dioxide
COP27	Conference of Parties 27
CRC	Collaborative Research Centre
CSG	Civil Society Groups
CSO	Civil-Society Organisation
CSR	Corporate Social Responsibility
CTA	Constructive Technology Assessment
CTF	Clean Technology Fund
CWP	Community Water Points
DEG	Deutsche Investitions- und Entwicklungsgesellschaft

DFG	German Research Foundation (Deutsche Forschungsgemeinschaft)
DFI	Development Financial Institutions
DH	District Heating
DIDPs	Development Induced Displaced Persons
EADB	East African Development Bank
EAIF	Emerging Africa Infrastructure Fund
EAPP	East Africa Power Pool.
ECDC	Early Childhood Development Centres
EIA	Environmental Impact Assessment
EIB	European Investment Bank.
EKF	Eksport Kredit Fonden of Denmark (Danish Export Credit Bank)
EMCA	Environment Management and Coordination Act
EPRA	Energy and Petroleum Regulatory Authority
ERC	Energy Regulatory Commission
ERPA	Emission Reductions Purchase Agreement
ESGPG	Energy Sector Development Partners Group
ESIA	Environmental and Social Impact Assessment
EU ETS	European Union Emissions Trading System
EU-AITF	European Union Africa Infrastructure Trust Fund
EXIM	Export and Import Bank.
FGD	Focused Group Discussion
Finnfund	Finnish Fund for Industrial Cooperation
FITs	Feed-in-Tariffs
FMO	Financierings-Maatschappij voor Ontwikkelingslanden (Dutch Entrepreneurial Development Bank)
GCF	Green Climate Fund
GCPPB	Green and Climate Policy Performance Bonds
GDC	Geothermal Development Company
GDO	Geothermal Development Office
GDP	Gross Domestic Product

GEERF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GETRI	Geothermal Energy Research and Training Institute
GHG	Greenhouse Gas
GoK	Government of Kenya
GRMF	Geothermal Risk Mitigation Facility
HGNP	Hell's Gate National Park
HIC	Heterogenous Infrastructure Configurations
IBRD	International Bank for Reconstruction and Development
IC	Independent Consultant
ICCF	Interact Climate Change Facility
IDA	International Development Association
IEA	International Energy Agency
IEP	Independent Evaluation Panel
IET	International Emission Trading
IFC	International Finance Corporation
IFU	Investeringsfonden for udviklingslande (Danish Investment Fund for Developing Countries)
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
JCF	Japan Carbon Finance Limited
JGI	Joint Geophysical Imaging
JICA	Japan International Cooperation Agency
KAM	Kenya Association of Manufacturers
KenGen	Kenya Electricity Generation Company.
KEPSA	Kenya Private Sector Alliance
KETRACO	Kenya Electricity Transmission Company
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)

KM	Kilometres
KNBS	Kenya National Bureau of Statistics
KP&P Africa	Kemperman Paardekooper & Partners Africa
KPLC	Kenya Power and Lighting Company
KRV	Kenya Rift Valley
KSh	Kenyan Shilling
KWS	Kenyan Wildlife Service
LAPSSET	Lamu Port-South Sudan-Ethiopia Transport Corridor
LCPDP	Least Cost Power Development Plans
LDCF	Least Developed Countries Fund
LMCP	Last Mile Connectivity Program
LSRE	Large-Scale Renewable Energy
LTS	Large Technical Systems
LTWP	Lake Turkana Wind Power
MDGs	Millennium Development Goals.
MLP	Multi-Level Perspective
MoE	Ministry of Energy
MoEN	Ministry of Environment and Natural Resources
MoTW	Ministry of Tourism and Wildlife
MRI	Mutual Reliance Initiative
MSLR	Moi South Lake Road
MTCO2e	Metric tonnes of carbon dioxide equivalent
MTPs	Medium Term Plans.
MW	megawatts
NCCAP	National Climate Change Action Plan
NCCC	National Climate Change Council
NDA	National Designated Authorities
NDC	Nationally Determined Contributions
NEMA	National Environment Management Authority
NGO	Non-Government Organization

NLC	National Land Commission
Norfund	Investeringsfond for næringsvirksomhet i utviklingsland (Norwegian Investment Fund for Developing Countries)
NT	National Treasury
OECD	Organisation for Economic Co-operation and Development
OPIC	Overseas Private Investment Corporation
PAC	Park Action Committee
PAPs	Project-Affected Persons
PATRP	Power Africa Transactions and Reforms Program
PD	Project Development companies
PDD	Project Design Documents
PISSA	Project Implementation and Steam Supply Agreement
PPA	Power Purchase Agreement
PPIAF	Public Private Infrastructure Advisory Facility.
PPP	Public Private Partnership
PROPARCO	French private sector development bank
RAP	Resettlement Action Plan
RAPIC	Resettlement Action Plan Implementation Committee
REA	Rural Electrification Agency
REIPPPP	Renewable Energy Independent Power Project Procurement Programme
RERAC	Renewable Energy Resources Advisory Committee
REREC	Rural Electrification and Renewable Energy Corporation
SACCO	Savings and Credit Cooperative Organization
SAGS	Steam-field Above Ground System
SCCF	Strategic Climate Change Fund
SCOT	Social Construction of Technology
SEZ	Special Economic Zone
SMGPL	Kenyan Sosian Menengai Geothermal Power Limited
SPV	Special Purpose Vehicle
SREP	Scaling-up Renewable Energy Program.

SSA	Sub-Saharan Africa
STI	Socio-Technical Imaginaries
STS	Socio-Technical Systems
TBL	Triple-Bottom-Line
tCO2	Total Carbon dioxide
TDB	Trade and Development Bank
TFSC	Transforming Financial Systems for Climate
TIS	Technological Innovation Systems
ToT	Training of Trainers
UGEAP	Universal Green Energy Access Program
UN	United Nations
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme.
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization.
USAID	United States Agency for International Development.
USD	United State Dollars
USTDA	United States Trade and Development Agency.
WBCFU	World Bank Carbon Finance Unit
WPC	Water Point Committees

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Chapter 1
Introduction

1.1 Background of study

In the context of rising global concerns about climate change, calls for quicker and more comprehensive energy transition have grown apace. The United Nations Framework Convention on Climate Change (UNFCCC) became the first treaty in history to have its main global effort, the Paris Agreement, ratified by all nations (UNFCCC 2015). The agreement reflects commitments by 172 countries to pursue climate change mitigation through renewable energy development at the national, state, or provincial level (UNFCCC 2015, REN21 2021). As a result of this commitment, the discourse on the deployment of large renewable energy systems, as part of climate mitigation actions, has also accelerated (IPCC 2014, Ngô & Natowitz 2016). However, the prevailing discourse has not sufficiently addressed the actor constellation, processes and linkages in the development of these large-scale renewable energies systems, especially in African and Global South contexts (Owusu & Asumadu-Sarkodie 2016, Briggle 2021).

Africa has large untapped renewable energy potentials that can help in keeping greenhouse gas emissions at low levels, while simultaneously achieving energy access for all and catalyzing industrialization and socio-economic development. More than 600 million Africans, or approximately 43 per cent of the region's population, live without access to energy, most of them in sub-Saharan Africa (IEA 2022, AfDB 2017). Closing this energy access gap is critical for the continent’s economic growth, for improving the quality of life of its people, and for the growth of its business and industrial sectors. Additionally, it is estimated that increased and rapid urbanization and migration to cities in Africa (ca. 500 million people by 2050) will prompt further energy demand for transport and in buildings, coupled with increased need for cooling services as atmospheric temperatures continue to rise (OECD, UNECA & AfDB 2022).

These trends and forecasts as well as call for accelerated and large-scale development of energy supply systems to meet increasing demand for electricity, fuel, and construction materials in the continent, led the International Energy Agency (IEA) to state that the energy pathway chosen by African countries will have a global impact and will significantly influence the time it takes to achieve global carbon-neutral energy sector (IEA 2019). However, the development of large-scale renewable energy projects requires complex arrangements in financing, governance and infrastructures, involving multi-level and multifaceted actors, intricate processes of mobilization and structuring as well as governance of several socio-economic, political and environmental linkages (Napp et al. 2014). I draw from energy transition theories and studies to theoretically frame these multi-dimensional realities in the development of large-scale renewable energies.

1.2 Theoretical framework: Energy transition studies

As the environmental problems of climate change and biodiversity and resource depletion have worsened in recent decades, calls for substantive changes or “transitions” in energy, transport and agri-food systems have grown (Van den Bergh 2011, Sovacool 2017). Energy transition has many and non-uniform definitions in literature, albeit with converging connotations. In attempt to offer a broad definition, Sovacool (2016: 1) defines energy transition as involving “a change in an energy system, usually to a particular fuel source, technology, or prime mover”. Hirsh & Jones (2014) and Abraham-Dukuma (2021:2) conceptualize it as change or modification in fuels and ancillary technologies, such as “from wood to coal, coal to oil and gas, and oil and gas to renewables”. O’Connor (2010) and Fouquet & Pearson (2012), alluding to its potential impacts, describe it as changes to energy systems or energy use patterns in society and economy, with major impacts on resources, mediums and activities. Additionally, Smil (2010), alluding to its temporal dimension, defines energy transition as the time interval between the emergence of a new main energy source and its market domination. While these definitions of energy transition provide the foundations with which to make sense of the concept, they do not explain the changes in drivers, players, markets, user practices, policies and norms which are often associated with energy transitions. Recognizing that these changes exist alongside changes in both technological and social systems has brought about the addition of the term ‘socio-technical’ to the transition literature (Geels 2004).

In the context of sustainable development, socio-technical transition broadly refers to interactive processes and embeddings among sustainable technologies, technical systems and society. Socio-technical considerations are crucial in the energy transition debate. Energy transition to renewables involves multi-faceted shifts and changes that need to occur in the process of energy system transformation (Hess & Sovacool 2020). It presupposes changes in policies, institutions, politics, business models, societies and cultures, which are manifest in core aspects in energy governance, financing and infrastructures (Markard, Raven & Truffer 2012). These changes play huge roles in how the development of large-scale renewable energy fits into energy transition (Bayulgen 2020, Bazilian et al. 2020, Gründinger 2017, Huh et al. 2019). Furthermore, managing these changes inherent in energy transition requires a governance system drawing from multidisciplinary studies (Boumakani et al. 2020, Pastukhova & Westphal 2020).

Energy transition governance, as used in this dissertation, refers to the overall policy and socio-political architecture for enabling and driving transition from traditional fossil fuels to cleaner sources of energy (Hoppe & Miedema 2020, Pastukhova & Westphal 2020, Valkenburg & Cotella 2016, Wagemans et al. 2019). This transition requires simultaneous shifts in socio-technical regimes (such as sectoral policies, markets, cultural transformations, and infrastructure development) as well as in technological niches (Hess & Sovacool 2020, Verbong & Loorbach 2012). The shifts are mainly driven by three global energy challenges: ensuring that all peoples have access to modern energy, guaranteeing energy security for all countries, and mitigating the effects of climate change (Cherp et al. 2011).

The global energy transition governance architecture, like that of the global climate governance regime (Ayling & Gunningham 2017, Piggot 2018), is fragmented and multileveled. It consists of several state and non-state actors at international, national and local community levels. International regime actors driving the energy transition through research, consulting and advocacy include the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), and the Renewable Energy Policy Network for the 21st Century (REN21). Different sovereign nations have established national regulatory and policy frameworks that influence regional and local policies (Hamman 2019, Nochta & Skelcher 2020, Rutherford & Coutard, 2014, Svobodova et al. 2020). While private energy and climate governance initiatives play important roles in the energy transition and greenhouse gas emissions reduction, their actions will be insufficient in the absence of extensive governmental regulatory and policy interventions at national and sub-national levels (Gilligan & Vandenbergh 2020). Government and policy makers at the national and sub-national levels shape the dynamics of the climate governance regime by providing important incentives and favourable laws, which enable the smoother participation of international and private actors (Klagge & Nweke-Eze 2020, Nweke-Eze 2021). In the same vein, community leaders and organizations play important roles in energy transition governance by garnering grassroots support and facilitating community acceptance of technical projects, especially large-scale ones (Nweke-Eze & Kioko 2021, Klagge et al. 2020). All these actors occupy pivotal positions in energy transition governance to enable rapid and multifaceted shifts in socio-technical energy systems.

1.2.1 Actors, processes and linkages in energy transition studies

Energy transition studies have benefited from multi-disciplinary concepts, theories and perspectives in making sense of the three main facets involved in the shift from traditional fossil fuels to cleaner sources of energy: actors, processes and linkages (Malerba 2006, Geel 2010, Meadowcroft 2011, Beck et al. 2021). Concepts, theories and perspectives under the energy transitions studies addressing these facets include the multi-level perspective (MLP), socio-technical systems (STS), social construction of technology (SCOT), actor-network theory (ANT), constructive technology assessment (CTA), the technological innovation systems (TIS), socio-technical imaginaries (STI), and Large Technical Systems (LTS), as well as other perspectives from the transition, sustainability, innovation, natural resource governance, and science and technology studies literatures. I discuss these literatures and their contributions to understanding the actors, process and linkages involved in energy transition in the following paragraphs.

The transition literature offers some useful perspectives for understanding energy transition, and its associated actors, processes and linkages. It seeks to explain when, where and how transitions to low carbon socio-technical systems can take place (Newell & Philips 2016, Meadowcroft 2011). These transitions, especially in early stages, are often flexible, uncertain and driven by radical innovations (Newell & Philips 2016). Transitions speed up when socio-cognitive actors and processes converge into common perspectives and consensus over the optimal course of action. Advocates of transition management (Rotmans et al. 2001, Voss et al. 2009) propose that multi-stakeholder learning procedures, participatory visioning exercises, and societal discussions all help to facilitate societal agreement and shared views. In this context, transitions may also depend on the extent to which the beliefs of the incumbent actors can change. Strategically reorientating these actors towards ground-breaking niche innovations requires challenging and upending pre-existing belief systems and adjusting into new ways of thinking and routines (Lant & Mezias 1992, Ingram et al. 2015).

The multi-level perspective (MLP) framework is one approach to understanding sustainability transitions (Rip & Kemp 1998, Geels & Schot 2007). The MLP provides a comprehensive view of the multifaceted complexity and changes in socio-technical systems. It proposes that transitions are shifts in regimes, occurring through processes and interactions between three analytical levels. These three analytical levels consist of niches (the protective space for path-breaking innovations where the innovation force emerges), socio-technical regimes (locked-in, fixed, stabilized and already existing systems), and the exogenous socio-technical landscape (the external factors and conditions in which the system operates) (Rip & Kemp 1998, Geels & Schot 2007). Transitions under this framework do not come about easily because of already existing established and locked-in regimes, which need to be systematically dismantled through incremental and persistent innovations at the niche level, while also attempting to control or influence relevant exogenous factors (Geels & Schot 2007). Dedicated actors work together, across levels, to bring about disruptive innovations that produce pressure to break through socio-technical regimes (Geels 2014, Raven et al. 2015). This pressure can be intensified with the alignment of external landscape developments to condition the systems environment for regime dismantling (Fuenfschilling & Truffer 2014). The struggle between niches and regimes is driven by dedicated actors who push the transition by debating, advocating, negotiating and grouping on multiple dimensions, including markets, financing, regulations, policies and infrastructures (Raven et al. 2015). Notwithstanding the MLP's acceptance as a helpful framework, subsequent research has expressed concerns about its inadequacy and offered ideas for expansion, citing the need for more focus on agency and the role of power in socio-technical transformations (Smith et al. 2010). This research goes on to suggest the incorporation of ideas from the social construction of technology (SCOT), actor-network theory (ANT), constructive technology assessment (CTA), the technological innovation systems (TIS), socio-technical imaginaries (STI), and Large Technical Systems (LTS) frameworks in its analysis (Genus & Coles 2008, Markard & Truffer 2008, Meadowcroft 2011, Hoffman 2013, Sovacool 2017, Beck et al. 2021, Magnusson & Grundel 2023).

The technological innovation systems (TIS) framework, another approach within transitions studies, is used to analyze the dynamics of emerging technological fields. Its origin and emergence can be traced to Carlson & Stackiewicz (1991). The TIS framework focuses on the dynamic network of actors who interact within a specific institutional framework and within an economic and industrial context to participate in the "creation, dissemination, and exploitation of technology" (Carlsson & Stankiewicz 1991:3, Quitzow 2015, Esmailzadeh et al. 2020). It can be used to explain the "emergence, growth, and diffusion of technology", including new energy, in a system or society (Hekkert et al. 2007, Markard, Hekkert & Jacobsson 2015, Esmailzadeh et al. 2020:3). TIS has become widely adopted, albeit with the criticism that it is inward and internally oriented, thereby diminishing the significance of external contexts and structures; and that it does not sufficiently address the role of geography and politics (Bening et al. 2015, Markard, Hekkert & Jacobsson 2015). Additionally, the social construction of technology (SCOT) approach to systems transition contends that social groups tend to attach diverse meanings to new technologies, which sparks conflicting viewpoints and contentious discussions that impede policymakers, investors, and consumers from making firm commitments, thereby creating uncertainty (Kline 2015). The SCOT approach emphasizes social need priority and the flexibility of technologies to be adapted for purposes beyond the original intentions of the inventors (Norcliffe 2020). For SCOT proponents, the real act of innovation typically occurs in a social context, when a group of researchers collaborate to produce a breakthrough and then disseminate the new understanding across networks of related research groups (Kline 2015).

Technology assessment approaches have also been increasingly applied to understand socio-technical transitions, including in the energy sector. The most prominent approach is the constructive technology assessment (CTA). Developed in the Netherlands (Rip et al. 1995) with the participation of researchers from the University of Twente (Robinson 2010, Te Kulve 2011), the CTA approach is concerned with the forward-looking design of technology and other areas of innovation, including their actors, processes and implementation conditions (Fisher and Rip 2013). It emphasizes the role of the participation, engagement and interaction of diverse group of participants in facilitating learning on diverse impacts of technology and their decision-making processes (Robinson 2010, Te Kulve 2011). CTA is useful in energy transition and governance studies because of its focus on providing useful contributions to the design of new technologies and their social embedding in or with the system (Rip 2011, Bijker 2014).

Science and technology studies (STS) is another approach for understanding dynamics and processes in energy transition studies. Actor–network theory (ANT), which emerged in the 1980s, is one STS-rooted perspective that is useful in understanding energy transition and its associated actors, processes and linkages. It focuses on the processes of ordering and connections that are being made and remade between human and material elements or other non-human entities and their roles in achieving a societal order (Cadman 2009, Dankert 2012). The ANT perspective alludes to the many relations and interactions among actors, who can also transform one another, in a process called translation. These translations often result in the formation of established networks that block the entry of new actors and relations, thus creating opportunities for accumulation (Jóhannesson & Bærenholdt 2009). By seeking to describe the processes through which various actors demonstrate agency, the ANT approach makes it possible to address questions of agency in theories of energy transition (Muniesa 2015).

Another STS approach, socio-technical imaginaries (STI), seeks to capture the multi-dimensional and temporal processes of energy transition. Jasanoff & Kim (2015: 4) define STIs as “collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology”. The STI perspective provides an interpretative lens through which to examine normative, although frequently implicit, rationales and explanations for policy decisions regarding the governance of emerging technologies and the allocation of their benefits and risks (Andersson & Westholm 2019). Research framed by STIs considers how visions of sustainable futures might expand or contract the range of political action for social change and transformation, which could either speed up or slow down the search for new or alternative transformational options or strategies (Delanty 2020, Ngô & Natowitz 2016).

Large Technical System (LTS) research dates to the 1980s, when it was first focused on the processes of system development and setup, particularly how these processes often take place in phases (Hughes 1986, Magnusson & Grundel 2023). Subsequent research in LTS has explained aspects of system evolution and transformation (Summerton 1994). Sovacool, Lovell & Ting (2018) and Magnusson & Grundel (2023:1) describe how mature systems move through stages of “reconfiguration”, “contestation”, and, in some situations, “stagnation” and “decline”. Most of these studies adopt an analytical perspective that examines systems, such as electricity, gas, or district heating (DH), as a single LTS at the macro level. This can be done in terms of geographic scope, by analyzing national or regional systems or by concentrating on case studies that highlight one or more systems (Summerton 1992, Magnusson 2012, Magnusson & Grundel 2023). According to LTS research, once a system gains momentum, it becomes challenging to modify it because of its embedded nature, high stakeholder involvement, and societal integration (Hughes 1986). But there has been some attention paid to reconfiguration and change, beginning with Summerton (1994), who notes that these changes happen gradually, transcend national boundaries, and merge with other systems. Additionally, linkages between various system types with diverse functions arise, and systems undergo reorganization from monopoly systems to ones that adapt to the principle of competition and financial gain – fact which has also been visible in energy systems (Sovacool, Lovell, and Ting, 2018).

Cognizant of the process of large-scale energy development needs, it is helpful to incorporate sustainability in the governance of the natural resources and materials required for energy systems incorporating renewables. As energy transition gains traction, ensuring sufficient and sustainable extraction of critical materials and minerals to support the new renewable energy mix needed for the low-carbon era is likely to be a fundamental issue (Hazrati & Heffron 2021). An emphasis on sustainability implies that energy transitions must meet complex economic, social and environmental sustainability criteria. Finding the right balance among these criteria is difficult and hindered by the absence of shared visions and interests, as well as different degrees and effectiveness of different sustainability interventions (Stirling 2007, Jordan 2008, Nweke-Eze & Kioko 2021, Nweke-Eze & Adongo 2024). Furthermore, even if society and relevant stakeholders agree on what a more sustainable future might look like, the root causes of (and hence remedies for) unsustainability or unsustainable practices are likely to be hotly debated, making consensus on even the most basic of standards and policy framework elusive (Jordan 2008). Owing to these complexities, scholars at the Resilience Alliance (https://www.resalliance.org/) advocate for management of socio-environmental systems in adaptive ways while ensuring cross-learnings, flexibility, diversity and stakeholder engagement (Berkes et al. 2003). Double loop learning, as a measure of building common ground in sustainability transition by altering preexisting beliefs, can also be facilitated through the participation of regime actors in ‘green’ experimental projects that challenge existing established status quo (Bos and Grin 2008). Environment and Social Impact Assessment (ESIA) processes allows for environmental and social impacts evaluations in energy transition endeavors, especially for large-scale projects (Klagge et al 2020). These ESIAs, facilitated by designated public authorities, provide some guidelines and standards to “prevent, mitigate and repair” the negative social and environmental impacts of infrastructure projects (Heffron & McCauley 2017:2).

Innovation system studies address some of these concerns in socio-technical transition studies. Innovation studies scholars conceptualize innovation as a dispersed multi-actor process involving “the co-evolution of technology, social networks and institutions” (Smith et al 2010:4). The insights provided by innovation studies about the relationships among corporations, academic institutions, governments, and markets/consumers are valuable for researching energy transition. Yet, in order to overcome the analytical obstacles pertaining to directionality, normativity, and social mobilization, innovation studies would have to extend its analytical purview to encompass more dynamics involving consumer behavior, social movements, and civil society (Geel 2010, Andersson et al. 2021). For a thorough analysis of socio-technical transitions to sustainability, further engagement with the fields of geography, cultural studies, political economy, economic sociology, and consumer studies is needed (Geel 2010, Smith et al. 2010). Morlacchi & Martin (2009:579) make a similar point, noting that the STI literature is more “intrinsically interdisciplinary, problem-oriented and pluralistic”, and will benefit from further strengthening to ensure that “implicit assumptions and social theories [are] made explicit”.

1.2.2 Literature gaps and the contributions of geography

The study of actors, processes and linkages in energy transition literature is characterized by a limited scope in the theories and concepts used to address the complex realities of energy transition (Newell & Philips 2016, Osunmuyiwa et al. 2018). The fact that the cost and benefits of energy development, financing, production, distribution and consumption are experienced differently and unevenly by people and places makes energy transition an uneven politico-economic, social and spatial process, and should be studies as such (Newell & Mulvaney 2013, Huber 2015, Rutherford & Coutard 2014, Calvert 2016).

Further, most ontologies in the multifaceted energy transitions framework tend to focus only on particular aspects and dimensions, like stability states and incremental changes, and to excessively rely on external shocks to explain changes in the system. This makes it difficult to fully explain energy transitions dynamics and discontinuous changes with endogenous explanations. As such, they tend to: (1) be biassed towards elite actors and in place of more participatory decision-making processes, especially when it comes to the application of transition management; (2) lay more emphasis on technology and artefacts while not paying sufficient attention to context-specific social and political relationships; (3) be geographically naive in conceptualizing space, scale, and the applicability of insights beyond a narrow range of case-study scenarios and contexts; and (4) not go far enough in addressing the role that power relations play in shaping sociotechnical system outcomes.

There are several reasons why theories in energy transition studies may not be applicable to large-scale transformations. First, these theories usually concentrate on regional practices and projects (Callon, 1980, Latour, 1996). Although it is possible to empirically follow the actors in these initiatives or projects, doing so poses practical challenges for large-scale transitions involving thousands of diverse actors. Additionally, it becomes challenging to discern more general patterns that include a range of activities due to the emphasis on local practices, fluidity, and volatility. There has also been a recent trend of theories on the subject matter focusing more on challenging preconceived concepts and assumptions, and coming up with new vocabularies, rather than on creating analytical models for better understanding and analyzing energy transitions and governance. These new vocabularies are often criticized for not being clear, being weak in explanation, and being difficult to generalize (Collins & Yearley 1992, Geels 2010).

Although the concepts of Large Technical Systems (LTS) and Multi-Level Transitions (MLT) are essential to our understanding of sociotechnical systems, their applicability to the Global

South is limited by their focus on post-war socio-technical systems in the Global North. Moreover, they tend to present a universally applicable models of sociotechnical configuration in their application, while often failing to be sensitive to peculiar political and social contexts. Because of this, it would appear that LTS and MLT have nothing to say about the hybrid infrastructure situations often seen in the Global South (Newell & Philips 2016, Osunmuyiwa et al. 2018). Yet LTS and MLT theories remain relevant in that they inspire new questions about sociotechnical systems in the Global South by addressing issues in sociotechnical systems stability and changes. These questions may lead to a broader understanding of the difficulties and opportunities associated with moving towards more equitable configurations of energy transition and its processes.

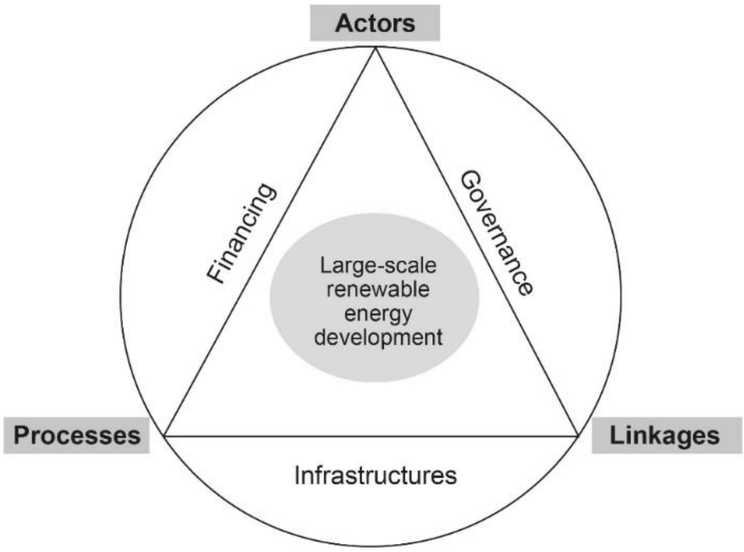
These literature gaps in energy transition studies have motivated geographers to argue for viewing energy transition as a geographical process that involves rearrangements in current patterns and scales of social and economic activity conditioned by realities in specific spaces and places (Lawhon & Murphy 2011, Bridge et al. 2013). Scholars like Sneddon et al. (2006), Hinchliffe (2007), Krueger & Gibbs (2008), Lawhon & Murphy (2011) highlight the role of geographical perspectives in enhancing the usefulness of energy transition frameworks, like STS, by explaining how and why specific unsustainable development pathways arise and persist as well as what prevents a society from moving towards cleaner technologies within given socio-economic and political structures and institutions. This understanding facilitates a holistic view of socio-technical transition in which focus is shifted from specific objects or static socio-material patterns to the dynamic interactions among various socio-economic and political factors and scales and the coevolution of technology and society. It also makes it possible to heuristically conceptualize possibilities for innovative sustainability initiatives, leading to better policy formulation. Lawhon & Murphy (2011) go on to suggest that human geographers are well positioned to tackle the limitations of socio-technical transition through establishing connections between the transition studies literature and the growing body of human geography perspectives, especially political ecology, thereby allowing for critical examination of the construction of knowledge and engagement with different subjects and contexts, as well as social processes and power relations.

In response to calls to develop more politically informed transition studies suitable in the Global South context, a growing body of literature on transitions-discourse complementarities as well as on the interconnections between niches and regimes has emerged. Bakker (2003) and Jaglin (2008) allude to the fact that the Global South transitional realities have been more of transition from artisanal to industrial, as well as give room for non-uniformity and co-existence among different technical alternatives. Analytical frameworks in energy transition studies in the Global South can therefore be enhanced by recognizing that multiple socio-technical systems can co-exist (Graham & Thrift 2007, Furlong 2014). Additional geographers have addressed the wide range of barriers to technical service expansion in the Global South by employing a political ecology approach that emphasizes the political and historical roots of resource and environmental inequality (Monstadt 2009, Lawhon & Murphy 2011). They have also taken interest in the physical components of energy supply as well as in the processes of power mobilization (Lawhon & Murphy 2011, Furlong 2014).

1.3 Analytical Framework

Following the call for more sensitivity to the role of spatial and geographical factors, and better accounting of the role of power in energy transition research, this dissertation provides ontological and analytical framing that reflects successful contributions of economic geography to energy transition research (Lawhon & Murphy 2011, Wilson 2007, Truffer 2008, Truffer & Coenen 2012). By applying geographical perspectives, this dissertation supports the move of energy transition studies from the general inclination that all things coevolve in tandem to identifying "what is coevolving with what, how intense…this process [is], and whether indeed there is a bi-direction of causality" (Malerba 2006: 18, Geel 2010). This dissertation develops a more comprehensive understanding of the complexities of energy transition while also providing new empirical insights from large-scale and Global South contexts. It sheds light on the constellation of multifaceted actors, dynamic processes and far-reaching socio-economic linkages involved in the development of large-scale renewable energies in Kenya by focusing on their key arrangements, namely financing, governance and infrastructures (see Figure 1). As a result, this dissertation provides useful insights for further energy transition theorizing, particularly in Global South contexts.

Figure 1: Diagrammatic representation of analytical framework



Source: Author's own

1.4 Research questions

The theoretical analysis, gap and proposed contribution presented above lays the groundwork for the research questions that inform the conceptual and empirical analysis of this dissertation. In focusing on the key arrangements for the development of large-scale technological systems—namely, financing, governance and infrastructures—this dissertation asks the following question: what are the economic geographies (actors, processes and linkages) of large-scale renewable energy development in Kenya? To further break this broader question down for analysis, I ask the following sub-questions.

1.4.1 Actor constellation

Q1: Which actors are involved in the development of large-scale renewable energies in Kenya? What are their roles, aspirations and strategies?

1.4.2 Processes

Q2: Which dynamic processes are involved in the delivery of large-scale renewable energies in Kenya? What drives these processes and how do they manifest?

1.4.3 Linkages

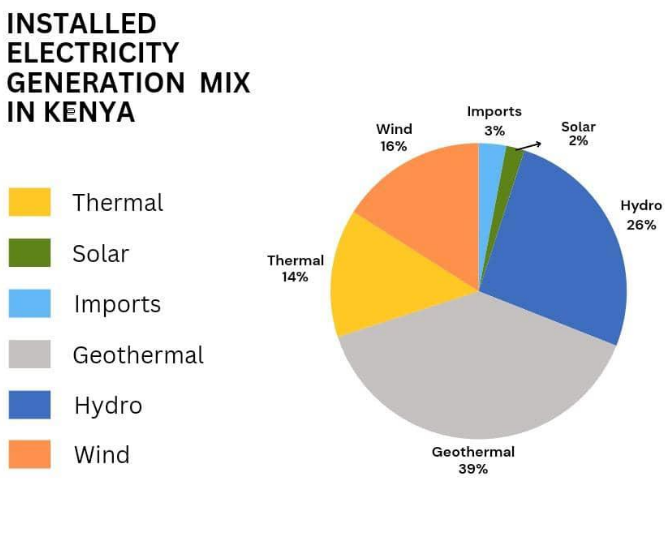
Q3: Which linkages are established in the development of large-scale renewable energies in Kenya? What do these linkages entail in relation to broader socio-economic interests and expectations?

1.5 Case Study: Kenya's energy sector and large-scale renewable energy projects

Kenya's development of large-scale renewable energy projects is used as case study in this dissertation to study the geographies of financing, governance and infrastructures associated with energy transition in the Global South. This section provides background information on the vision, status, structures and actors in Kenya's energy sector and large-scale renewable energy projects in preparation for the empirical analysis. The case of large-scale renewable energy development in Kenya has much to offer, both theoretically and empirically, as the following chapters discuss. On a more personal level, this research provided me with the opportunity to conduct research in a country whose experiences and progress in energy and infrastructure development deeply interest me.

Kenya is situated on the equator on the East African East Coast, bordered by South Sudan on the north-west, Ethiopia on the north, Somalia on the east, Uganda on the west, Tanzania on the south and the Indian Ocean on the south-east. Its total area is 582,650 sq km. With a population of ca. 54 million growing at 3% growth rate per annum (World Bank, 2022a), Kenya' GDP per capita is estimated at 366 USD, with an average of 5.6% growth rate per annum (World Bank, 2022b). Current electricity access in Kenya is ca. 70%, with a recorded jump from 15% in 2008 to 65% in 2018 (World Bank 2022c). This growth in electricity access between 2008 to 2022 is mainly attributed to rapid increase of large-scale renewable energy projects, particularly geothermal, wind, solar, and biomass energy projects, in addition to existing hydro and thermal energy capacities (Figure 2).

Figure 2: *Pie chart showing the installed electricity generation mix in Kenya (2023)*



Source: Author's own from Kenyan Energy & Petroleum Regulatory Authority (EPRA), 2023.

However, with 12 million households still lacking access to energy, especially in the rural areas, the Kenyan government admits that an extra 2700MW needs to be added to improve its energy generation capacity, mainly from its diverse renewable energy resources (GoK 2018a & b, IEA et al. 2023). Kenya's plans, targets and strategies for achieving universal energy access and industrialization are partly embodied in its Vision 2030 (GoK 2007). The Kenyan Vision 2030 recognizes national and regional energy infrastructure development as a critical enabler to achieving Kenya's socio-economic development visions. In line with this, Kenya's energy sector aims to increase power generation capacity, transmission and distribution within the country; increase access to reliable, clean and affordable energy; promote renewable energy development using new technology in power generation; and increase regional trade of electricity by interconnecting regional networks. Figure 3 shows a completed and commissioned large-scale scale geothermal plant located in Olkaria Kenya; while Figure 4 shows large-scale geothermal projects under construction in Baringo-Silali Kenya.

Figure 3: *Geothermal power plant and infrastructure in Olkaria in Kenya*

Source: Field data 2018 (Photo: Britta Klagge)

Figure 4: *Drilling site in Baringo-Silali geothermal development project in Kenya*

Source: Field data 2020 (Photo: Britta Klagge)

With these projects in place and more in construction, Kenya has become a renewable energy champion in Africa. It has made significant strides in attracting both public and private investments in the renewable energy sector. The country's progress in developing renewable energy capacity in a relatively short period of time is remarkable. In 2018, renewable energy made up 70% of Kenya's energy mix, mainly via hydropower and geothermal plants (EPRA 2023). At that time, hydropower was the dominant source of energy in the country, like in many other African countries (Onyango, 2018). However, due to limited capacity in hydropower, caused by droughts and dwindling investments, geothermal energy became more prominent as a preferred technology, as it could also generate electricity in large quantities for base load production and at relatively inexpensive rates compared with other available renewable energies in the country (Zarembka 2020). By 2023 renewable energy contribution in Kenya had risen to about 87% (EPRA 2023) due to contributions from several new and existing large-scale renewable energy projects (see Figure 2) in different regions of the country, especially in the Kenyan Rift Valley.

These significant improvements in energy supply were prompted by governmental and institutional reforms between 1996 and 2008 that furthered Kenya's electrification ambitions by emphasizing renewable energy resources. When these reforms were introduced in 1996, Kenya's electrification rate, like most of other African countries, was less than 10% (Trading Economics, 2020). These governmental and institutional reforms meant adjustments in the legislative framework, coupled with other institutional changes, in order to increase the independence of constituent entities, mitigate risks through guarantee schemes and introduce incentive policies to make the renewable energy market more conducive for both local and foreign investments. From 1996, Kenya embarked on its energy reform by unbundling power generation from transmission and distribution, liberalizing its power generation sub-sector, and introducing a more efficient tariff system. These changes were driven by the national need to liberalize and privatize the sector, which also aligned with the preconditions of the International Monetary Fund (IMF) and the World Bank for releasing large donor funds (Godinho & Eberhard, 2019). These trends and dynamics make researching the geographies of financing, governance and infrastructures of renewables development in Kenya interesting and relevant.

1.5.1 Governance structure and actors in Kenya's energy sector

The unbundling and liberalization of the Kenya's energy sector, which started in the mid-1990s, led to a new institutional framework for energy sector governance, embodied in Sessional Paper No. 4 of 2004 (GoK 2004) and the Energy Act No. 12 of 2006, which succeeded the Electric

Power Act No. 11 of 1997 (GoK 2018a). The 2018 Energy Act provided for the unbundling of Kenya's vertically integrated state utility, Kenya Power and Lighting Company (KPLC or Kenya Power), into three unbundled entities in line with the functions of generation, transmission, and distribution of power. Together with private independent power producers (IPPs), the public electricity generation company – Kenya Electricity Generation Company (KENGEN) undertakes power generation, while two separate entities – the Kenya Electricity Transmission Company (KETRACO) and Kenya Power undertake power transmission and distribution, respectively. KETRACO, a fully government-owned entity, has the responsibility for transmission and infrastructure development. KPLC, listed on the Nairobi Stock Exchange, with the government holding 50.1 per cent of shares, maintained its existing responsibility of power distribution (GoK 2018a). The unbundling of the transmission and distribution entities proved successful with KETRACO adding more than 1,000 km of transmission lines in the energy system in less than six years following its establishment (GoK 2018b). These new additional transmission lines enabled the effective transmission of power produced by new large-scale renewable energy projects like the 310MW Lake Turkana Wind Power (LTWP) Project (Osiolo et al. 2017, GoK 2018b).

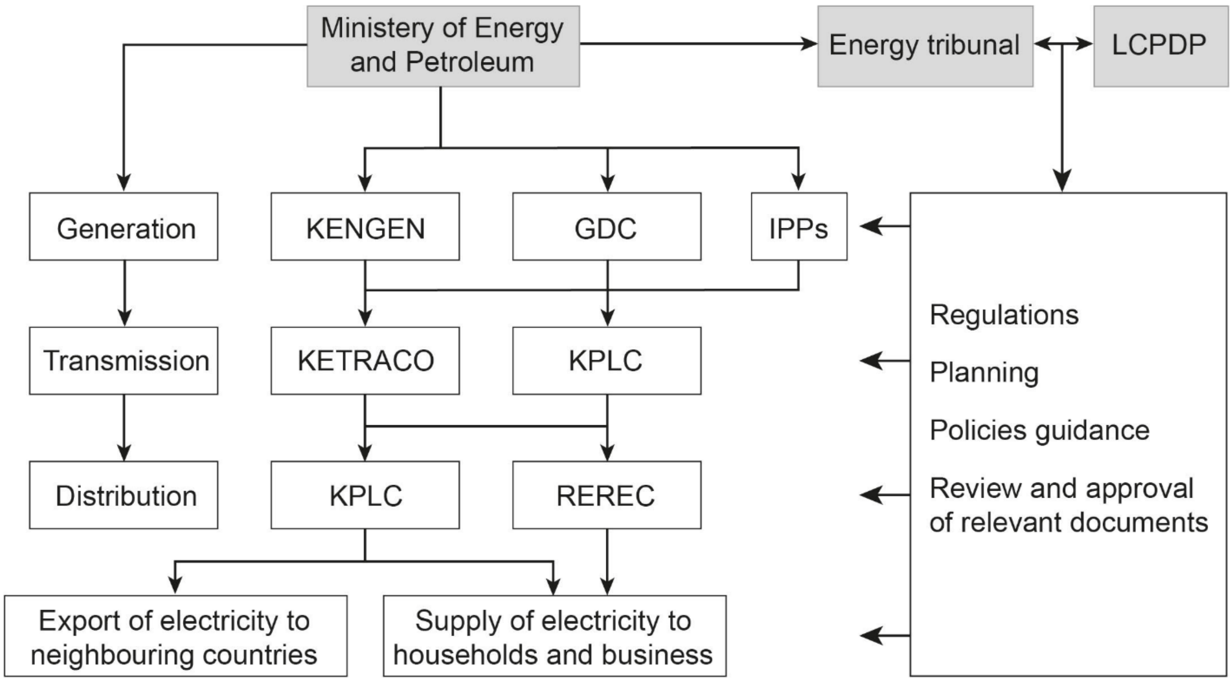
The 2006 Energy Act also established the Rural Electrification Authority (REA) which has the mandate to accelerate the subsidized Rural Electrification Programme; the Geothermal Development Corporation (GDC) which is the fully government-owned Special Purpose Vehicle (SPV) created to prepare geothermal fields from exploration up to drilling and sale of steam; the independent regulator Energy Regulatory Commission (ERC), which is in charge of setting tariffs, oversight and monitoring; and the Energy Tribunal, which is the independent legal-entity that would arbitrate disputes in the energy sector. The Ministry of Energy and Petroleum (MoEP) defines energy policy and oversees overall policy articulation and planning and sets the long-term vision for all sector players.

The 2004 and 2006 key policy documents were reviewed again in the Energy Bill of 2015 to accommodate and align with the government development strategy set out in Vision 2030 and the revision of the country's constitution following the establishment of a devolved government system (GoK 2007). The Energy Bill 2015 distributed responsibilities between national and sub-national (county) governments, accounting for opportunities and challenges in political decentralization and the discovery of fossil fuel in the country (GoK 2015a). It enabled the county governments to create their own energy plan, grant land and right of way rights for energy infrastructure, facilitate energy demand through the planning of energy-intensive activities, and enforce regulations for conservation and efficient use of energy (GoK 2015a, Volkert & Klagge 2022).

The Least Cost Power Development Plans (LCPDPs), the Feed-in Tariff (FiT) policy, and the Energy Local Content Regulations are further policies and regulations that are pertinent to the renewable energy sector in Kenya. The MoEP prepares the LCPDPs in consultation with industry and interministerial panels. The LCPDPs includes electricity demand forecast, assessment of the energy resources, and plans to increase generation and transmission capacity, among others (GoK 2018a). The LCPDPs contain recommendations on a range of investment possibilities, which are determined by calculating levelized cost of electricity (LCOE) across the life cycle of energy projects (Osiolo et al. 2017). In order to encourage private investment in renewable energy, the Kenyan government implemented feed-in tariffs (FiTs) in 2008 (later changed in 2010 and 2012), which aim to offer a stable long-term price and ensure grid access (GoK 2018b). With the approval of the purchasing power agreements (PPAs) issued by the ERC, the tariffs are applicable to grid-connected plants and are valid for 20 years from the start of the PPA (GoK 2018b). The FiT policy also covers the role of KPLC in providing power purchase guarantees for all categories of power generation (GoK 2018b). Furthermore, the 2014 Energy Local Content Regulations require that companies operating in the energy sector adhere to the local content plan by giving priority to Kenyan goods, services and employees and committing to train and reskill local employees on the job (GoK 2018a). They achieve this by setting minimum local content requirements for energy operations in the country (GoK 2018a). The current regulations require levels of 75 per cent in a project, 80 per cent in goods and services, 70–80 per cent of management and technical core staff, and 100 per cent of other staff in average and non-technical positions (Osiolo et al. 2017).

In March 2019, Kenya updated and passed a new energy act – the Energy Act (2019), which sets out the rules and laws pertaiing to the power production, transmission, distribution, and trade, describes the different functions and responsibilities of the various governmental entities and authorities, and regulates the development and use of renewable energy, petroleum and coal resources in the country (GoK 2019). The Energy Act further replaced the Rural Electrification Authority (REA) with the Rural Electrification and Renewable Energy Corporation (REREC), with the additional mandated of driving Kenya’s renewable energy pursuits in addition to spearheading the implementation of electrification projects in rural areas (GoK 2019). As such, under the Energy Act (2019) the REREC has a wider responsibility compared to those of the REA, which was formerly limited to addressing rural electrification problems. It additionally plays a significant role in formulating policy, carrying out research and development, fostering international collaboration, and advancing renewable energy across Kenya (GoK 2019). They compile and keep an inventory and resource map for renewable energy resources in counties and regions as mandated by the MoEP (GoK 2019). The 2019 Energy Act also set up the Renewable Energy Resources Advisory Committee (RERAC), which regulates the development of the renewable energy policy (GoK 2019). Figure 5 below illustrates the connections and interactions among the several entities and stakeholders in the Kenyan energy sector.

Figure 5: *Entities, stakeholders and interactions in the Kenyan energy sector*



Explanation of abbreviations: GDC = Geothermal Development, IPPs = Independent Power Producers, KENGEN = Kenya Electricity Generation Company, KETRACO = Kenya Electricity Transmission Company, KPLC = Kenya Power and Lighting Company, LCPDP = Least Cost Power Development Plans, REREC = Rural Electrification and Renewable Energy Corporation

Source: Author's own

Other important players in Kenya's energy sector include the development financial institutions (DFIs) and agencies, the private sector, and civil society. In Kenya's electricity industry, development finance organizations and agencies are important players. They bear much of the financial burden for infrastructure related to generation, transmission, and distribution, and they have the power to shape energy policy through their technical advisors and the terms of concessional financing (Klagge & Nweke-Eze 2020). DFIs and development agencies meet regularly in a coordination group chaired by the MoEP to enhance collaboration and define priorities for targeted and strategic actions (Klagge & Nweke-Eze 2020). The private sector is another important player in Kenya's power sector, accounting for about one third of the country's installed capacity in 2016 (Pueyo et al. 2017). Private sector players are mainly international firms and project developers, most of whom are investing or developing geothermal, biomass and small hydro energy projects in the country (Pueyo et al. 2017). The local private sector players in the renewable energy sector are represented by the Kenya Private Sector Alliance (KEPSA), the Kenya Association of Manufacturers (KAM), and the Kenya Renewable Energy Association (KEREA), with KEPSA and KAM mainly representing actors in large-scale renewable energy projects (Newell & Philips 2016). Finally, Kenya's civil society has proven to be important stakeholders in Kenya's energy sector, with bold voices in promoting environmental justice, sustainability, and peaceful agreements and influencing project development to maximize socio-economic benefits (Allison 2016, Klagge et al. 2020). These civil society actors often organize themselves into non-governmental organizations (NGOs) and civil society groups (CSGs) to deepen their reaches and influences (Klagge et al. 2020). Table 1 below summarizes the multifaceted and multi-leveled actors and stakeholders in Kenya's energy sector.

Table 1: *Selected energy sector stakeholders mapping in Kenya*

Stakeholders	**International**	**National**	**County**
Government	Deutsche Investitions- und Entwicklungsgesellschaft (DEG), World Bank, Africa Development Bank (AfDB), Kreditanstalt für Wiederaufbau (KfW – the German government development bank), European Investment Bank (EIB), Agence Française de Développement (AFD – the French government development bank), Trade and Development Bank (TDB), United States Agency for International Development (USAID), Tetra-Tech: Power Africa Transactions and Reforms Program (PATRP), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).East Africa Power Pool (EAPP).	Ministry of Energy and Petroleum (MoEP), Ministry of Environment and forestry (MoEF), National Treasury, Energy Regulatory Commission of Kenya (ERC), Kenya Power and Lightening Company (KPLC), Kenya Electricity Generation Company (KenGen), Kenya Electricity Generation Company (KenGen), Rural Electrification and Renewable Energy Corporation (REREC), County commissions.	County governments.
Businesses (private and state-owned)	Engineering, Procurement and Construction (EPC) firms, Independent Power Producers (IPPs, e.g. Lake Turkana Wind Power Ltd, Oserian Ltd, Orpower), Equity Investors (Eg. Aaldwych International) M-KOPA, Commercial Banks.	Kenya Electricity Generation Company (KenGen), Kenya Electricity Transmission Company (KETRACO), Geothermal Development Corporation (GDC), Kenyan	-

		Independent Power Producers (IPPs), Kenya Bankers Association (KBAs).	
Civil Society	Practical Action, GermanWatch.	Powershift Africa, Nature Kenya.	Community residents, Project Affected Persons (PAPs), Pastoral groups, Women groups, Youth groups, Agricultural cooperatives, Savings and Credit Cooperative Societies (SACCOs).

Source: Author's own

1.5.2 Large-scale renewable energy projects in Kenya

Kenya is one of the African countries with the largest share of renewables in its generation mix due to the development of several large-scale renewable energy project over the last decades. This dissertation defines large-scale energy projects as projects with capacities beyond 25MW. These projects consist of geothermal, wind, hydro, solar and biomass projects. In 2015, large-scale renewable energy projects, mainly from hydropower and geothermal plants, supplied over 70 per cent of Kenya's electricity (GoK 2018a). Hydropower potential from large hydros in Kenya is estimated at 6,000MW, while small, mini, micro and pico hydros have an estimated potential of 3,000MW (Kemp 2023). Kenya has five water towers: Mt. Kenya, Abadare Ranges, Mau Complex, Chelangani Hills and Mt Elgon (Figure 8). However, most power generation is along the Tana, Seven Folks: Kamburu, Kindaruma, Kiambere, Masinga (Figure 8). Installed hydropower generation capacity is currently at 26 per cent of total installed generation capacity in Kenya (EPRA 2023).

Similar to many other African nations, hydropower used to be the main source for Kenya; but, in an effort to increase energy security in the face of increasing droughts, the Kenyan government sort to diversify its energy supply. In this regard, geothermal energy emerged as the preferred technology as it could produce significant amounts of least-cost base load power, which could wheel electricity that is always available even to meet minimal demands. There are currently more than 14 high-temperature potential geothermal sites in the Kenyan Rift Valley, with an estimated potential of more than 10,000MWe (Omenda & Simiyu 2015, Gitonga 2018). Other potential high-temperature geothermal electricity generation areas include, Homa Hills in Nyanza, Mwananyamala at the Coast and the Nyambene ranges. Beyond electricity generation, geothermal power has potential uses in the dairy industry as well as in refrigeration and space and water heating in Kenya. Current generation from geothermal in

Kenya is still at 799 MW, mainly from Olkaria power plants (KenGen 2024). Planned expansions of Olkaria and Menengai power plants are still ongoing, while surface explorations for geothermal energy have been completed in Naivasha east, Suswa, Baringo and Silali (Figure 8).

To harness the vast geothermal resources located along the Rift Valley, Kenya implemented a long-term geothermal development plan with support from international development institutions in the form of technical assistance and concessional finance (GoK 2018a & b). These geothermal development efforts have led Kenya to emerge the largest producer of geothermal energy in Africa. Figures 6 and 7 show infrastructures and billboards describing the features of large-scale geothermal projects in Menengai and Baringo-Silali in Kenya. Wind has also played an increasing role in the total installed generation mix, with the largest wind power plant in Africa, the 310MW Lake Turkana wind farm, currently installed in Turkana and generating electricity. Bio-energy production for clean energy applications accounts for 68 per cent of the total primary energy consumption in Kenya, especially cooking and heating (GoK 2020).

Figure 6: *New power line for the Menengai geothermal project in Nakuru, Kenya*

Source: Field data 2020 (Photo: Britta Klagge)

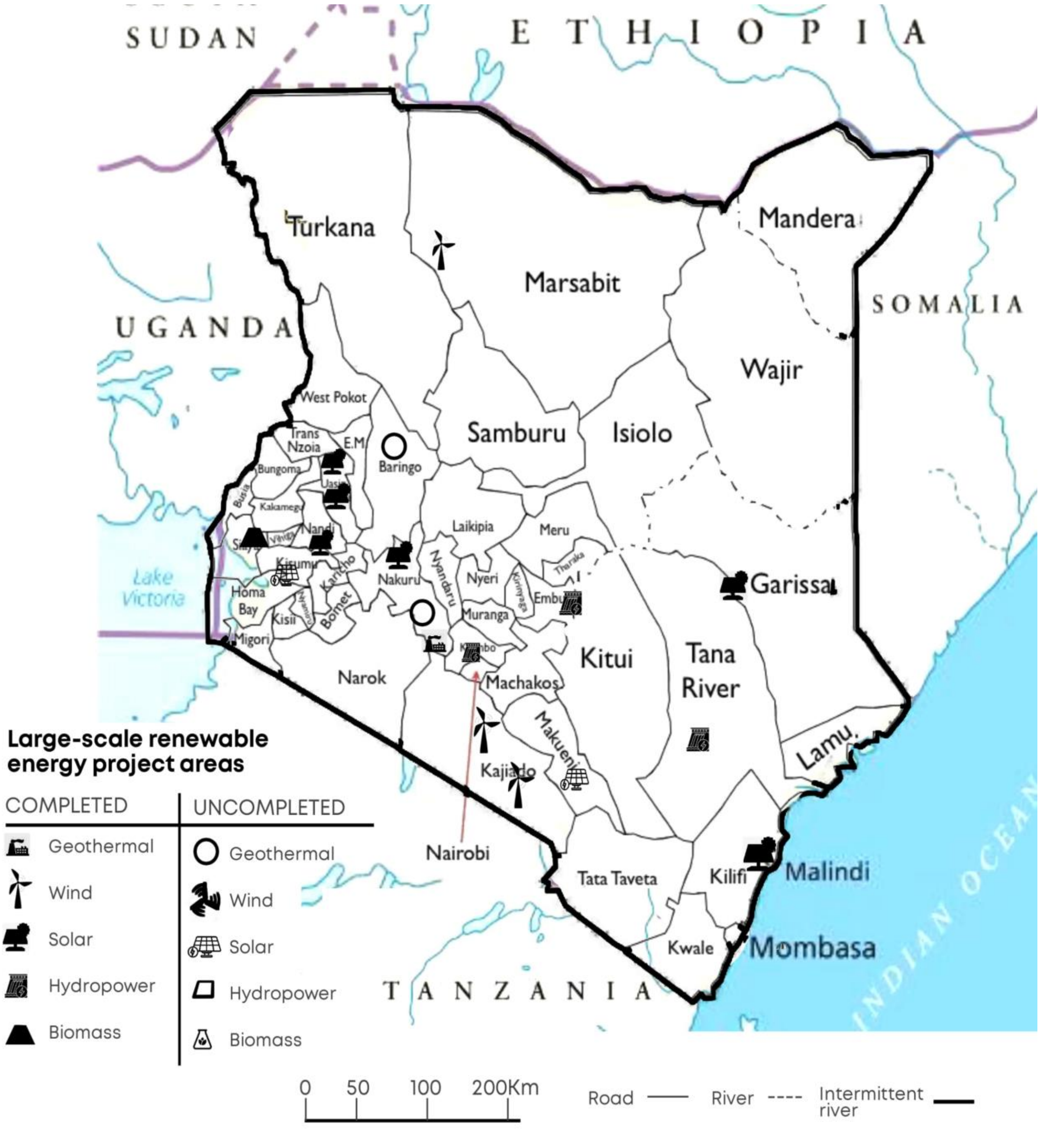
***Figure 7**: Signs announcing the Baringo-Silali geothermal development project in Kenya*

Source: Field data 2020 (Photo: Britta Klagge & Chigozie Nweke-Eze)

Kenya plans to increase electricity generation capacity from the current 3GW to 100GW by 2040, with electricity coming mainly from large-scale renewable energy projects, especially geothermal and wind (EPRA 2023, GoK, 2018a & b, Gitonga 2018). The Kenyan government's Feed-In-Tariff program, which requires KPLC to enter into PPAs of 20 years with IPPs to purchase power at a pre-determined price, encourages more production of electricity as it increases investors' confidence to invest more in the sector. These planned generation capacities are aimed at meeting both household and industrial demands. Industrial demand is expected to significantly increase with the development of the country's Lamu Port-South Sudan-Ethiopia-Transport (LAPSSET) Corridor and the Standard Gauge Railway (SGR) projects as well as connected plans to expand the mining and industrial sector through the construction of new industrial parks. The Kenyan LAPSSET and SGR projects have been identified as among Vision 2030 key and priority infrastructure projects to play essential roles in fast-tracking economic growth and industrialization in the country as well as consolidating cooperation amongst the East Africa Community member states (GoK 2015b, 2016). The LAPSSET Corridor Program is intended to connect 160 million people in the three Eastern African Countries of Kenya, Ethiopia and South Sudan by providing large-scale transport and logistics infrastructures (GoK 2016). The SGR is viewed as a critical milestone infrastructure that will boost Kenya's road and rail transport networks for bulk freight flows, coal, containers, petroleum products, fuel oil and cement, as well as include few goods produced in townships and outlying areas along the line in addition to providing local passenger transport services (GoK 2015b).

Figure 8 depicts different large-scale renewable energy projects and plants in Kenya, showing their various locations and stages of development. Table 2 further describes the stakeholders, institutions and mechanisms involved in the various large-scale renewable energy projects in Kenya.

Figure 8*: Map showing locations of large-scale renewable energy projects in Kenya.*



Source: Author's own, generated from various project official websites as at 23-June-2024, as well as from various interview information (2018-2021).

***Table 2**: Large-scale renewable energy projects in Kenya**:** stakeholders, institutions and mechanisms.*

Renewable energy types	Plants and Projects	Locations	Project status and years	Capacity in MWs	Developers & investors	Development financial institutions and agencies	Climate finance institutions & mechanisms
Geothermal	Olkaria I, II, III, IV, V, VI	Olkaria, Nakuru County	Partly completed in 2015, other constructions ongoing	185	KenGen (70% GoK-owned)	EIB, JICA, IDA, AFD & KfW	GEF, GCF, CDM.
	Menengai I	Menengai, Nakuru County	Under construction since 2011	105	GDC, QPEA GT Menengai Ltd, Sosian Menengai Geothermal Power Ltd, Orpower Twenty-Two Ltd	AfDB, AFD, EIB, USTDA; PPIAF, SREP	GEF, GCF.
	Menengai II	Menengai, Nakuru County	In exploration and drilling since 2011	60	GDC	n.a	n.a
	Baringo-Silali	Mount Silali, Baringo County	In exploration and drilling since 2018	n.a	GDC	KfW, GRMF	GEF, GCF.
Wind	Lake Turkana Wind Power (LTWP)	Loiyangalani, Marsabit County	Completed in 2018	310	LTWP Ltd	AfDB, EIB, EKF, FMO, EADB, TDB, PROPARCO, ICCF, EU-AITF	GEF
	KenGen wind Park (Ngong)	Ngong, Kajiado County	Completed in 2015	25	KenGen	n.a	GEF, CDM
	Kipeto wind	Kiserian, Kajiado County	Completed in 2021	100	Craftskills Wind Energy International, Meridiam.	OPIC, ATIDI	CDM
Solar	Garissa Solar	Balambala, Garissa County	Completed in 2018	55	REREC	Exim Bank of China	GEF, GCF
	Alten Kesses 1	Eldoret, Uasin Gishu County	Under construction since 2013	52	Alten	Standard Bank of South Africa, Stanbic and EAIF	GEF
	Malindi Solar	Langobaya, Kilifi County	Completed in 2022	52	Globeleq, (as part of Malindi Solar Group Ltd consortium)	NorFund and AEDC (as part of Malindi Solar Group Limited consortium)	n.a

	Voltalia Kopere Solar	Kopera, Nandi County	Completed in 2024	50	Votalia	n.a	n.a
	Eldosol Solar	Near Eldoret, Uasin Gishu County	Completed in 2021	40	Frontier Investment Management, Selenkei Investment Ltd, Cedate Ltd, Interpro International LLC, Paramount Universal Bank.	n.a	n.a
	Radiant Solar	Near Eldoret, Uasin Gishu County	Completed in 2021	50	Frontier Investment Management, Selenkei Investment Ltd, Cedate Ltd, Interpro International LLC, KPLC, Paramount Universal Bank		n.a
	Rumuruti Solar	Rumuruti, Laikipia County	Under construction since 2020	40	Kenergy Renewable Ltd and Scatec solar (as part of Rumuruti Solar Generation Holding).	Norfund (as part of the Rumuruti Solar Generation Holding consortium).	n.a
	Nakuru (Migitiyo) Solar	Near Mogotio, Nakuru County	Under construction since 2020	40	Astonfield Sosian Energy Ltd	n.a	n.a
	WITU Solar	n.a	n.a	40	n.a	n.a	n.a
	Kisumu Solar One	Kajulu (Kibos), Kisumu County	Under construction since 2014	40	Ergon Solair Africa Limited	n.a	n.a
	Makindu Solar (Makueni)	Makindu, Makueni County	n.a	33	n.a	n.a	n.a
Hydro	Tana	Off the Nairobi-Embu Road, Murang'a County	Completed in 2010	67.7	KenGen	--	GEF, CDM
	Kiambere	Tana River near Kiambere, on the Border of Embu and Kitui Counties	Completed in 2009	168	KenGen	World Bank	GEF, CDM.
	Turkwel	Turkwel River, on the	Completed in 1991	106	KenGen	n.a	n.a

		border of West Pokot and Turkana counties					
	Gitaru	Tana river/basin, on the border between Embu and Machakos Counties	Completed in 1978	225	KenGen	n.a	n.a
	Kamburu	Tana River, on the border of Embu and Machakos Counties	Completed in 1974	94.2	KenGen	n.a	n.a
	Kindaruma	Tan river, on the border of Embu and Machakos counties in Kenya.	Completed in 1968	72	KenGen	n.a	n.a
Biomass	Mumias Sugar	Mumias, Kakamega County	Completed in 2008	35	Mumias Sugar Co. Ltd	PROPARCO	GEF, CDM.

Explanation of abbreviations:
Developers/Investors: AEDC = Africa Energy Development Corporation. ATIDI = African Trade and Investment Development Insurance. KenGen = Kenya Electricity Generation Company. KPLC = Kenya Power and Lighting Company. LTWP = Lake Turkana Wind Power. GDC = Geothermal Development Company. GoK = Government of Kenya.
Intervening international development institutions and programs: AFD = Agence Française de Développement (the French government-owned development bank). AfDB = African Development Bank. EADB = East African Development Bank. EAIF = Emerging Africa Infrastructure Fund. EIB = European Investment Bank. EKF = Danish Export Credit Agency. EU-AITF = EU-Africa Infrastructure Trust Fund. EXIM Bank of China = Export and Import Bank of China. FMO = Dutch Entrepreneurial development bank. GRMF = Geothermal Risk Mitigation Facility. ICCF = Interact Climate Change Facility. IDA = International Development Association. JICA = Japan International Cooperation Agency. KfW = Kreditanstalt für Wiederaufbau (the German government-owned development bank). OPIC= Overseas Private Investment Corporation (US government's development financial institution). PPIAF = Public Private Infrastructure Advisory Facility. PROPARCO = subsidiary of AFD focused on private sector development. SREP = Scaling-up Renewable Energy Program. TDB = Trade and Development Bank (mainly of member countries in East and Southern Africa). USTDA = U.S. Trade and Development Agency.
UNFCCC's intervening mechanisms: GEF = Green Environment Fund. GCF = Green Climate Fund. CDM = Clean Development Mechanism.

Sources*: Author's own, generated from various project official websites as at 23-June-2024, as well as from various interview information (2018-2021).*

1.6 Research methodology and design

Before proceeding to outline the structure and contributions of my dissertation, I provide information on my research design and my methodology in this sub-section. Interwoven in this section are also details about my research processes which influenced my design and methodological choices and ultimately the findings of the study. Supporting information on my research design, procedure, and activities can be found in the Appendices. Each chapter also contains a methodological note or section which details specific methods pertaining to the specific research questions raised therein. The research and fieldwork largely benefited from support by the German Research Foundation (DFG) through funding for the project "Energy futures" as part of the collaborative research center (CRC) "Future Rural Africa" (Project-ID 328966760 – TRR 228).

1.6.1 Research methodology

This dissertation is based on a mixed-methods approach, majorly featuring empirical fieldwork which I conducted in Kenya from 2018 to 2021. My methods involved conducting expert and informal interviews, visiting key field sites across Kenya (particularly in Nakuru and Baringo), observing industry conferences and events, and analyzing relevant documentation and online archives. In addition to these 'formal' methods, my understanding of Kenya's energy resource and infrastructures in the context of energy transition was broadened through knowledge acquired in many informal conversions with multi-level energy sector stakeholders in relaxed atmospheres, in which many were also happy to express their personal views. The data informing these papers were collected through 120 semi-structured, qualitative interviews with representatives of national and sub-national government institutions, regional and international development financial institutions and agencies, and civil society/non-governmental organizations (NGOs), as well as international consultants, industry actors, and local community members (see Appendix 2 for list of interview partners).

These interviews were conducted in person during research stays and visits across Kenyan counties that play key roles in the governance and planning of large-scale renewable energy projects, and host most of the large-scale renewable projects used as case studies for this dissertation. These sites include the Kenyan capital, Nairobi, as well as Nakuru and Baringo counties. Follow-up interviews for clarifications were mainly conducted over the phone. Although certain knowledge about the country's energy development was acquired before the fieldwork, the interview process reflects a 'research-as-supplicant' approach '…predicated upon an unequivocal acceptance that the knowledge of the person being researched (at least regarding the particular questions being asked) is greater than that of the researcher' (England 1994: 241, also see McDowell 2010). To gain the most from my encounters with my interview partners, I carefully considered potential interview environments, following McDowell who writes that 'rather than being a transparent, straightforward exchange of information, the interview is a complex and contested social encounter riven with power relations' (2010: 161). With an eye toward power relations and inherent differentials, I used an open-ended but theme-structured conversational interview style, largely letting my interview partners navigate the theme, often without direct interruptions. As a result, certain questions were answered in greater detail and new perspectives revealed during the interviews. Figures 9 and 10 show pictures with doctoral colleagues and Principal Investigators (PIs) of the "Energy futures" CRC (I) research project, after an expert interview session in Nakuru, Kenya.

Figure 9: *PhD student Nweke-Eze and PI Greiner after interview with GDC representatives in Nakuru, Kenya.*

Figure 10: *PhD students Nweke-Eze, Greven and Rahier (University of Leuven), and PIs Greiner and Klagge after an interview session with Kenyan interview partner in Nakuru, Kenya.*

Sources: Field data 2020 (Photos: Britta Klagge & Chigozie Nweke-Eze)

To contextualize the narrative around the case study of the dissertation, I also visited and observed important large-scale renewable energy project sites across Nakuru and Baringo counties. I visited the Olkaria and Menengai geothermal sites in Naivasha, as well as the Baringo-Silali project sites in Baringo county, while also observing the Suswa, Arus Bogoria, and the Longonot prospects, which were located along the direction of travel. I also took the opportunity to interact with some employees and community members living around the project sites, using sign languages and the help of a local translator. Watson & Till (2010) define participant observation as a method of discovery that a scientific researcher engages in to become acquainted with unfamiliar environments. It enables the researcher to be immersed in the structural and social context of the studied case, allowing for observations and recordings of conduct under the widest range of possible settings (Watson & Till 2010). My participant observation and site visits precisely accomplished this. They allowed me to visualize, more deeply understand and contextualize the different relations, processes, and interlinkages involved in the development of large-scale energy projects. Figures 11 and 12 show pictures from field visits to the site of the Baringo-Silali and Menengai geothermal project in Baringo and Nakuru counties, respectively, together with doctoral colleague Greven and PIs Greiner and Klagge.

Figure 11: *PhD students Nweke-Eze and Greven with PIs Greiner and Klagge during Baringo-Silali geothermal project visit in Kenya*

Figure 12: *Menengai geothermal project site visit in Kenya together with PhD Students Greven and Rahier (University of Leuven), and PIs Greiner and Klagge.*

Sources: Field data 2020 (Photos: Chigozie Nweke-Eze)

I also gathered relevant insights on trends and practical discourse by observing industry and civil society conferences and events both physically and virtually. For example, while I was in Kenya, I attended the Kenya Energy Forum organized by EnergyNet (https://www.africa-energy-forum.com) and the "Energy for Whom" event organized by the Society for International Development (SID) and the Heinrich Böll Foundation in Nairobi (https://www.sidint.org/sid-publications/energy-whom-scenarios-eastern-africa), in which several multi-level actors presented their perspectives during panel discussions on energy development in Kenya. My participation in these conferences enabled me to connect with several additional interview partners. I also physically attended the 2021 Africa Energy Forum in Brussels (https://www.africa-energy-forum.com, see figure 13) as well as the 2023 Conference of Parties (COP27) in Egypt (https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop), which was dubbed the African-COP and from which I gained further insights into global debates on energy transition and climate mitigation, as well as actions at international and national levels.

***Figure 13**: PhD Student Nweke-Eze with interview partner at the Africa Energy Forum in Brussels.*

Sources: Field data 2021 (Photo: Chigozie Nweke-Eze)

Finally, to complement and supplement the methodology of my dissertation, I analyzed relevant documents, including government policy papers, corporate reports of government parastatals and DFIs, industry publications and websites, consultancy reports, conference materials and reports, academic research, and news stories. Relevant publications and news stories were collected using email notification subscriptions and Google alerts. By studying and analyzing the contents of these documents and media, I immersed myself in the trends happening around large-scale renewable energy development in Kenya. This made it possible for me to '…explore patterns in and across the statements and identifying the social consequences of different discursive representations of reality' (Jorgensen and Phillips 2002: 21). The document analysis helped me find answers to questions that could not be sufficiently addressed by my other methods of data collection. It also allowed me to place my case study (large-scale renewable energy development in Kenya) in a larger international and global perspective and context of energy transition and governance. Document and media analysis also allowed me to triangulate and validate my findings and address data gaps after my first fieldwork visit (2018), especially regarding sensitive issues on finance, land and sustainability. Finally, it informed the direction and focus of my stakeholder engagements during subsequent fieldwork visits (2019-2021).

Reflecting on my personal experiences during the fieldwork, I recognize that my position as a young, educated, African male gave me access to interview partners and project sites, most of which I may not have accessed otherwise. National government officials and development finance institution actors are often sensitive and generally reluctant to grant interviews. Having referees that were able to recommend me to certain partners and offices certainly opened doors for me on several occasions. My position and general perception as a young African scholar, with enthusiasm for economic development in Africa, contributed to some interview partners giving me deeper and further information, including several "off the mic" opinions that they would not normally share with a differently positioned academic. These overwhelmingly welcoming attitudes by local interview partners and other experts proved contrary to the initial general opinion that being a young Nigerian male might result in challenging and hostile debates during interviews or in unnecessary restrictions during my fieldworks. Dwyer & Buckle (2009) suggest that this kind of reflexivity of methodology is important and offers useful lessons for future researchers, especially when done in an open, authentic and honest manner. These reflections are also useful for shaping my future research endeavors. Figure 13 shows a picture I took with an interview partner after an interview in Baringo county, Kenya.

***Figure 14**: PhD Student Nweke-Eze with interview partner (government official) after an interview in Baringo county, Kenya.*

Sources: Field data 2020 (Photo: Chigozie Nweke-Eze)

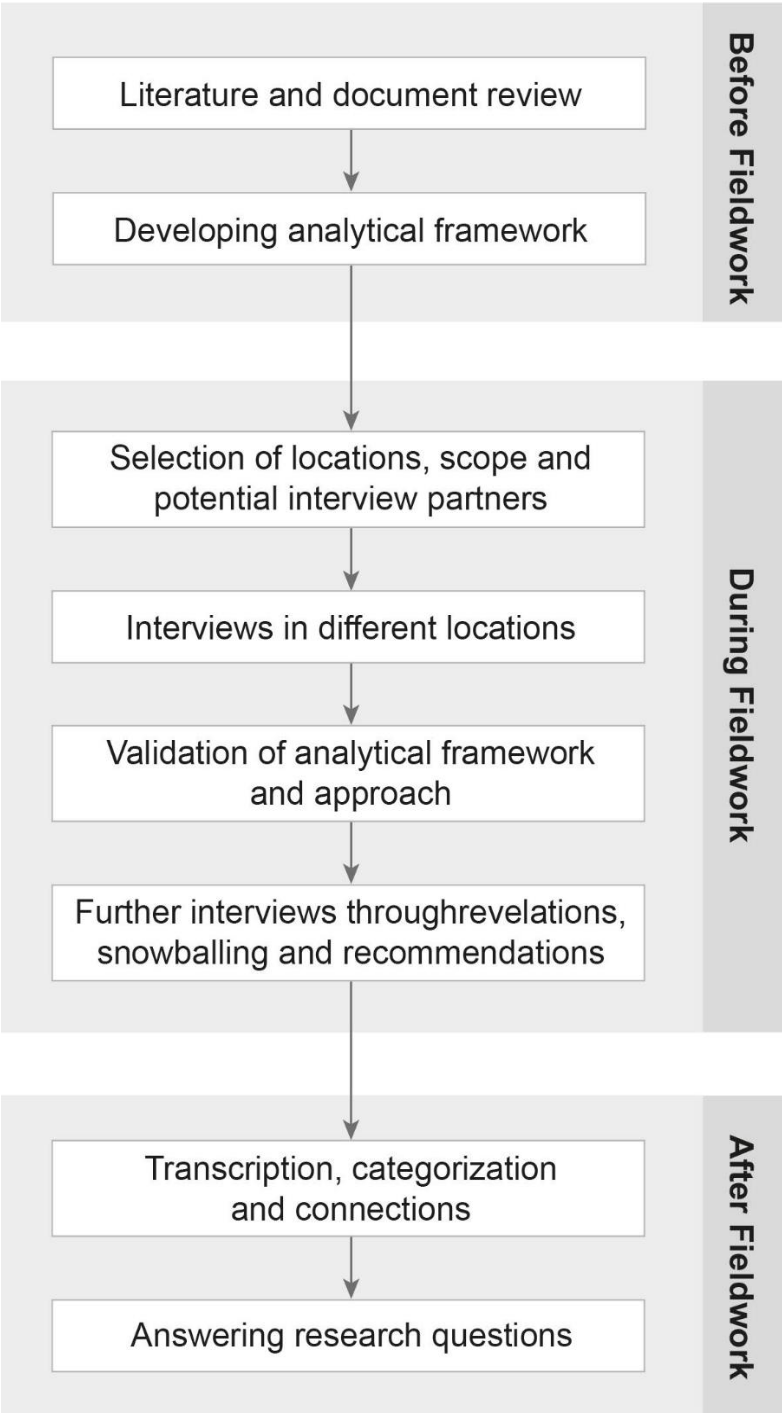
1.6.2 Research design

The first step before starting the field visit in Kenya was to conduct literature review on the subject matter in order to determine and identify key issues and stakeholders in Kenya's large-scale renewable energy sector. Four stakeholder groups were identified: national and county governments, national and international private sector, international development and financial institutions, and research and consulting institutions and agencies. Following the identification of these stakeholder groups, potential national and international interview partners were identified and contacted by email, phone calls or met physically in workshops or conferences.

The next step was to arrange appointments to interview the interview partners. Most of the interviewees were interviewed in person, while few others were interviewed via phone. The interview partners were enthusiastic, free and willing to speak on the subject matter from their different perspectives. They also referred to other players, allowing me to access more interview partners in a snow-balling process.

After the interview, the recorded files (all of which received recording and transcription permission from the interview partners) were transcribed and coded using colour highlights, making it easier to analyze, organize and categorize the data and insights to answer the research questions. I personally completed the detailed transcription of the interviews. The transcription had to be done by me because of the mostly poor quality of the recordings due to noise in the environment in some interviews, coupled with the fact that most of the local interview partners spoke with heavy accents. Taking the time to transcribe most of the interviews, though painstaking, provided me with a deeper insight into the discussed themes and their inferences, resulting in a richer empirical analysis. Figure 12 below illustrates the research design, showing their protocols and processes as discussed in this sub-section.

Figure 15: *Research design and processes*



Source: Author's own

1.7 Structure of thesis and statement of contributions

The remainder of my dissertation is comprised of six empirical research papers. The arguments and findings of the studies contribute to closing energy transition literature gaps identified in section 2 (1.2.2) of this chapter. I explain the contributions of each of the chapters in the following paragraphs.

In chapter 2, titled **"***But we cannot do it all': Investors' sustainability tensions and strategic selectivity in the development of Kenya's largest geothermal energy plants in Olkaria*", we explore sustainability adherence processes in the development of large-scale renewable-energy projects and their associated challenges and complexities in Kenya. We argue that investors' commitment to the sustainability framework in the development of such projects is characterized by sustainability tensions reflected in conflicting interests, dilemmas, and power struggles that investors face as they attempt to simultaneously apply the three principles of sustainable development in delivering their projects. To manage these tensions, the paper shows that investors engage in "strategic selectivity", whereby the extent of adherence to certain components of the sustainability principles are based on winning interests, priorities and convenience. These processes are explored by drawing on perspectives from sustainable development, Triple-Bottom-Line and corporate sustainability discourses. Expert and informal interviews, document analyses, ethnographic fieldwork and field visits are used to track and illustrate these processes, using the case of large-scale geothermal project developments in Olkaria. This chapter contributes to the energy transition literature by offering a deeper and broader understanding of the expectations, power relations and negotiations among multi-level actors in the process and practice of energy transition in the Global South context (Lawhon & Murphy 2011, Bridge et al. 2013). It also offers insights into how the difficulties and complexities in these relations are governed and managed for energy transition to proceed (Rutherford & Coutard 2014, Calvert 2016, Osunmuyiwa et al. 2018). The chapter was published in "*Leal Filho, W., Pretorius, R., Olim de Sousa, L., (eds): Sustainable Development in Africa. World Sustainability Series. Springer: Cham, 385-404*" in 2021. It was written together with Eric Kioko (Kenyatta University). I contributed 80 per cent to the conceptualization and theory, 85 per cent to the data gathering and curation, 80 per cent to the analysis, and 85 per cent to the writing.

In chapter 3, titled "*Conflicting futures of geothermal development in Naivasha: Between state visions and local community expectations*", we explore state visions, community expectations, and the interactions between these 'futures' in the development of large-scale geothermal energy infrastructures in Naivasha, Kenya. In so doing, we reveal the conflicts, which are inherently embedded in the interaction between state visions and community expectations in future-making. We call these conflicts, 'conflicting futures'. As a starting point, we adapt the concept of state-community relations in future-making to operationalize the interactions between the (mainly state-based) investors and the infrastructure-affected community in our case study. Our analysis contributes to scholarship on the social interplays and dynamics in the materialization of large-scale development infrastructures and their associated socio-ecological transformations in the wider Lake Naivasha area, as well as in similar areas and contexts in the Global South. Similarly to the previous chapter, this chapter contributes to the energy transition literature by offering a deeper understanding on expectations, power relations and negotiations among multi-level actors in the process and practice of energy transition in the Global South context (Lawhon & Murphy 2011, Bridge et al. 2013). In addition, it sheds light on the predominantly uneven socio-economic and spatial processes of energy transition and how unsustainable pathways could arise in the process of energy transition (Newell & Mulvaney 2013, Huber 2015, Sneddon et al. 2006, Hinchliffe 2007, Krueger & Gibbs 2008). The chapter is published in "*Kuiper, G., Kioko, E. & Bollig, M. (eds): Agricultural intensification, environmental conservation, conflict and co-existence at Lake Naivasha Kenya. Brill: Leiden,305-330*" in 2024. It was written together with Christine Adongo (EHESS Paris). I contributed 90 per cent to the conceptualization and theory, 50 per cent to the data gathering and curation, 50 per cent to the analysis, and 50 per cent to the writing.

In chapter 4, titled "*Financing large-scale renewable-energy projects in Kenya: investor types, international connections, and financialization*", we explore investors-types, the international connections and (possible) financialization of two large-scale renewable-energy projects in Kenya. Based on case-study analyses of geothermal and wind projects in Kenya, we argue that, due to their complex risk structure, public investment and support from both domestic sources and development finance institutions (DFIs) are key to facilitate or even enable such projects. In contrast to Baker's (2015) case study on South Africa, we neither see nor expect financialization of large-scale renewable-energy projects in Kenya and most other Sub-Saharan African countries any time soon. This chapter contributes to the understanding of multi-level financing actors and their relations in the process and practice of energy transition in the Global South (Lawhon & Murphy 2011, Bridge et al. 2013). It also contributes to the deeper understanding of financial and economic processes involved in the practice of energy transition, specifically in the Global South context (Sneddon et al. 2006, Hinchliffe 2007, Newell & Philips 2016). The chapter is published as a journal article in "*Geografiska Annaler: Series B,* *Human Geography 102 (1), 61-83*" in 2020. It was written together with Britta Klagge (University of Bonn). I contributed 25 per cent to the conceptualization and theory, 85 per cent to the data gathering and curation, 50 per cent to the analysis, and 50 per cent to the writing.

In chapter 5, titled "*Assembling climate governing and financing actions in Kenya's large-scale renewable energy market*", I explore the different forms and mechanisms of climate governing and financing actions in today's climate mitigation agenda, focusing on renewable energy markets. I argue that assembling and structuring climate actions allow for better planning and impact appraisal of climate intervening actions, contributing to closing mismanagement and inefficiency gaps in today's climate mitigation governance and finance systems, especially in the Global South context. The chapter structures a framework for assembling climate governing and financing actions in climate mitigation by classifying them based on their various roles and functions into policy, institutional, and catalysing actions. Drawing from this classification, the study goes on to assemble and analyse UNFCCC's climate governing and financing actions and to examine their roles and impacts in Kenya's large-scale renewable energy market, as well as possible manifestations of financialization processes thereof. The analysis draws on data from expert interviews with actors in the energy, environment, and financial management sectors in Kenya, as well as on document and reports analysis. This chapter contributes to the energy transition literature by showing how different technical alternatives of climate actions co-exist in the process and practice of energy transition (Bakker 2003, Jagliin 2008). It further supports the conceptualization that different innovative sustainability initiatives come together to enhance energy transition in complementary ways, leading to better policy formulation (Markard et al. 2015, Lawhon & Murphy 2011). The chapter is currently in press for publication in "*Fanea-Ivanovici, M. & Baber, H. (eds): Alternative finance: A framework for innovative and sustainable business models. Routledge International Studies in Money and Banking Series, Taylor & Francis*." I am the sole author of this chapter, with 100 per cent contributions in conceptualization and theory, data gathering and curation, analysis, and writing.

In chapter 6, titled "*Infrastructures of large-scale geothermal energy projects in Kenya: materialization, generativity and development linkages*", I explore the materialization and generativity of infrastructures in large-scale projects and their complex linkages to socio-economic development, using the case of geothermal energy projects in Kenya. The chapter shows how the delivery of 'core' infrastructure projects enables the provision of 'other' infrastructures – 'required' and 'generated' infrastructures, all of which entail different socio-economic development linkages for different interest groups at national and local community levels. In exploring these processes, I engage with multi-disciplinary scholarship on the materialization and generativity of infrastructures and their variegated and multifaceted linkages to socio-economic development. A methodological combination of expert and informal interviews, document analysis, and project-site observations form the basis of the analysis. This chapter contributes to the energy transition literature by enhancing the understanding of socio-economic and spatial processes in hybrid infrastructure situations often seen in the Global South context (Newell & Philips 2016, Osunmuyiwa et al. 2018). It also enhances the understanding of the socio-economic linkages and interests of the multi-level actors in connection to energy transition infrastructures (Newell & Mulvaney 2013, Huber 2015, Rutherford & Coutard 2014, Calvert 2016). The chapter is published as a journal article in "*Athens Journal of Sciences 11(2):125-150*" in 2024. I am the sole author of this chapter, with 100 per cent contributions in conceptualization and theory, data gathering and curation, analysis, and writing.

In chapter 7, titled "*Cross-Scale Linkages of Centralized Electricity Generation: Geothermal Development and Investor–Community Relations in Kenya",* we explore how and with whom government actors and local communities in rural and peripheral areas interact in planning and implementing large-scale power plants. Starting from a comparison of decentralized and centralized energy systems, we demonstrate that the development of these large-scale infrastructures and their associated investor-community relations are governed by various cross-scale linkages. To this end, we adapt the concept of cross-scale linkages from the literature on natural-resource governance in order to explore actors, rules and practices at local, regional, national and international levels. This chapter contributes to the energy transition literature by enhancing the understanding of the political and socio-economic relations among multi-level actors in energy transition (Lawhon & Murphy 2011, Bridge et al. 2013). It also enhances the understanding of the actors' participatory decision-making processes in energy transition in the context of the Global South (Monstadt 2009, Lawhon & Murphy 2011, Furlong 2014). The chapter is published as a journal article in "*Politics and Governance 8 (3), 211-222*." in 2020. It was written together with Britta Klagge (University of Bonn), Clemens Greiner (University of Cologne) and David Greven (University of Cologne). I contributed 10 per cent to conceptualization and theory, 30 per cent to the data gathering and curation, 10 per cent to the analysis, and 5 per cent to the writing.

Table 3 below summarizes the contents, arguments and the contributions of the thesis to closing literature gaps in energy transition.

Table 3: *Summary of thesis arguments and contributions*

Chapter nos.	Chapters	Main arguments	Contributions to energy transition studies.	Paper contribution statements
2	But we cannot do it all': Investors' sustainability tensions and strategic selectivity in the development of geothermal energy in Kenya. *"Nweke-Eze & Kioko. 2021. In: Leal Filho, W., Pretorius, R., Olim de Sousa, L., (eds): Sustainable Development in Africa. World Sustainability Series. Springer: Cham, 385-404.*"	Investors' commitment to the sustainability framework in the development of large-scale renewable energy projects in Kenya is characterized by sustainability tensions reflected in conflicting interests, dilemmas, and power struggles that investors face as they attempt to simultaneously apply the three principles of sustainable development in delivering their projects. For investors to manage these tensions, the paper shows that they engage in "strategic selectivity", whereby the extent of adherence to certain components of the sustainability principles are based on winning interests, priorities and convenience.	It offers deeper and broader understanding of the expectations, power relations and negotiations among multi-level actors in the process and practice energy transition in the Global South context. It also offers insights into how the difficulties and complexities in these relations are governed and managed for energy transition to carry on.	Written together with Eric Kioko (Kenyatta University). I contributed 80% to the conceptualization and theory, 85% to the data gathering and curation, 80% to the analysis, and 85% to the writing.
3	Conflicting futures of large-scale geothermal energy development in Naivasha: Between state visions and community expectations. *"Nweke-Eze & Adongo. 2024. In: Kuiper, G., Kioko, E. & Bollig, M., (eds): Agricultural intensification, environmental conservation, conflict and co-existence at Lake Naivasha Kenya. Brill: Leiden, 305-330."*	There are inherent conflicts embedded in the interaction between state visions and community expectations in future-making. The paper calls these conflicts, 'conflicting futures' and adapts the concept of state-community relations in future-making to operationalize the interactions between the (mainly state-based) investors and infrastructure-affected communities in large-scale renewable energy development in Kenya.	It offers a deeper understanding on expectations, power relations and negotiations among multi-level actors in the process and practice energy transition in the Global South context. In addition, it enhances understanding of the predominantly uneven socio-economic and spatial processes of energy transition and how unsustainable pathways could arise in the process of energy transition.	Written together with Christine Adongo (EHESS Paris). I contributed 90% to the conceptualization and theory, 50% to the data gathering and curation, 50% to the analysis, and 50% to the writing.
4	Financing large-scale renewable-energy projects in Kenya: investor types, international connections, and financialization. *"Klagge & Nweke-Eze. 2020. Geografiska Annaler: Series B, Human*	Due to their complex risk structure, public investment and support, both from domestic sources and development finance institutions (DFIs), are and will remain key to facilitate or even enable such projects. In contrast to Baker's (2015) case study on South Africa, we neither see nor expect financialization of large-scale renewable-energy projects in Kenya and most other Sub-	It contributes to the understanding of multi-level financing actors and their relations in the process and practice of energy transition in the Global South. It also contributes to the deeper understanding of financial and economic processes involved in the practice of energy transition, specific	Written together with Britta Klagge (University of Bonn). I contributed 25% to the conceptualization and theory, 85% to the data gathering and curation, 50% to the analysis, and 50% to the writing.

	Geography 102 (1), 61-83."	Saharan African countries any time soon.	to the Global South context.	
5	Assembling climate governing and financing actions in Kenya's large-scale renewable energy market. *"Nweke-Eze. 2024. In: Fanea-Ivanovici, M. & Baber, H. (eds): Alternative finance: A framework for innovative and sustainable business models. Routledge International Studies in Money and Banking Series, Taylor & Francis, 151-166."*	Assembling and structuring climate actions allow for better planning and impact appraisal of climate intervening actions, contributing to closing mismanagement and inefficiency gaps in today's climate mitigation governance and finance systems, especially in the Global South context. In the case of UNFCCC's climate governing and financing actions in Kenya's large-scale renewable energy market, we are yet to see the manifestation of financialization processes.	It contributes to the energy transition literature by showing how different technical alternatives of climate actions co-exist in the process and practice of energy transition. It further supports the conceptualization that different innovative sustainability initiatives come together to enhance energy transition in complementary ways, leading to better policy formulation.	I am the sole author of this chapter, with 100% contributions in conceptualization and theory, data gathering and curation, analysis, and writing.
6	Infrastructures of large-scale geothermal energy projects in Kenya: materialization, generativity, and socio-economic development linkages. *"Nweke-Eze. 2024. Athens Journal of Sciences 11(2):125-150."*	The materialization and generativity of infrastructures in large-scale projects entail unusual geographies of diffusion and linkages that defy many easy narratives, especially in the Global South context. The delivery of 'core' infrastructure projects enables the provision of 'other' infrastructures – 'required' and 'generated' infrastructures, all of which entail different socio-economic development linkages for different interest groups at national and local community levels.	It enhances the understanding of socio-economic and spatial processes in hybrid infrastructure situations often seen in the Global South context. It also enhances the understanding of the socio-economic linkages and interests of multi-level actors in connection to energy transition infrastructures.	I am the sole author of this chapter, with 100% contributions in conceptualization and theory, data gathering and curation, analysis, and writing.
7	Cross-scale Linkages of Centralized Electricity Generation: Geothermal Development and Investor-community Relations in Kenya's Semi-arid North. *"Klagge, Greiner, Greven & Nweke-Eze. 2020. Politics and Governance 8 (3), 211-222."*	The development of centralized electricity generation plants in Kenya involves interactions among government actors and local communities in rural and peripheral areas in their planning and implementation. These investor-community relations are governed by various cross-scale linkages among multi-level actors, rules and practices.	It enhances the understanding of the political and socio-economic relations among multi-level actors in energy transition. It also enhances the understanding of the actors' participatory decision-making processes in energy transition, in the context of the Global South.	Written together with Britta Klagge (University of Bonn), Clemens Greiner (University of Cologne) and David Greven (University of Cologne). I contribute 10% to the conceptualization and theory, 30% to the data gathering and curation, 10% to the analysis, and 5% to the writing.

Source: Author's own

1.8 Summary of findings

Although scholars in energy transition studies have made important contributions to the knowledge of challenges and possibilities for achieving more sustainable societies, the literature will generally benefit more from perspectives in geography and power relations (Bridge et al. 2013, Lawhon & Murphy 2011, Furlong 2014). To contribute to closing this literature gap, this dissertation evaluates the economic geographies (actor constellations, processes and linkages) of large-scale renewable energies development in Kenya. The following six chapters address the research questions of this dissertation. The findings of the study are summarized in this sub-section.

1.8.1 Actor constellation

Q1: Which actors are involved in the development of large-scale renewable energies in Kenya? What are their roles, aspirations and strategies?

The development of large-scale renewable energy projects in Kenya is governed by interactions among various stakeholders, broadly classified in this dissertation as investors and communities. The various investor and community groups have different strategic roles and represent different interests and aspirations, which are often in conflict (Nweke-Eze & Adongo 2024, Nweke-Eze & Kioko 2021, Klagge et al. 2020, Klagge & Nweke-Eze 2020). Investors in the development of these projects come from public and private sectors, at international and national levels. They consist of the Government of Kenya (GoK) at national and, since devolution, also at sub-national (county) levels. The GoK is involved in the projects through its several ministries and parastatals, foremost of which are the ministry of energy and Petroleum (MoE), and the National Treasury (NT). On behalf of the Kenyan government, the Ministry of Energy and Petroleum (MoE) oversees all aspects of the energy sector planning and execution, including the development of large-renewable energy projects, in accordance with its Vision 2030.

Investors also consist of project developers, such as Geothermal Development Corporation (GDC), which is fully government-owned, and the Kenya Generation Company (KenGen), which is partly government-owned. Government project developers play important roles in de-risking the projects at their early stages to increase the confidence of private developers. Private development firms and industrials, such as the Oserian LTD, and private consortiums consisting of different firms and formed as Special Purpose Vehicles (SPV), such the Lake Turkana Wind Power (LTWP) LTD, are also involved in project development at different levels. These private firms often get involved at the mid to final stages of the project to build out and manage further technical infrastructures, after the explorations are successful. Another set of investors are the several regional and international development financial institutions (DFIs) and agencies, such as the European Development Bank (EIB), the French Agence Française de Développement (AFD), the German Kreditanstalt für Wiederaufbau (KfW), Japan International Cooperation Agency (JICA), and the World Bank. DFIs and development agencies play an important catalytic role in the development of large-scale renewable projects by providing financing in various forms (loans, grants and mezzanine) as well as technical assistance in the engagement of project stakeholders and sustainability management.

Additionally, the project-host communities and their representatives, consisting of NGOs and community leaders and liaison officers, also play important activism roles in ensuring that community human rights are adhered to and that their expectations are met regarding the improvement of their socio-economic livelihood because of the presence of the projects in their communities, especially for project-affected persons (PAPs). Further, environmental conservationist groups, such as the state-owned environmental conservationist institution, Kenyan Wildlife Service (KWS), act as mediums for wildlife and biodiversity preservation, ensuring that wildlife habitats and forest covers are maintained during and after the development of the project.

1.8.2 Processes

Q2: Which dynamic processes are involved in the delivery of large-scale renewable energies in Kenya? What drives these processes and how do they manifest?

Large-scale renewable energy infrastructures in Kenya are mainly driven by Kenya's Vision 2030, an ambitious plan to transform Kenya into a newly industrializing, middle-income country (Nweke-Eze & Kioko 2021). The Government of Kenya views investment in large-scale renewable energy as the critical enabler for realizing its industrialization ambitions while allowing for climate change mitigation (Nweke-Eze & Kioko 2021, Nweke-Eze 2024b). To achieve these goals, the country's energy sector has gone through neoliberal reforms, including the privatization of previously public entities and private sector participation in energy development. While there are some large wind (most prominently the Lake Turkana Wind Park), solar, and biomass projects, the bulk of new energy capacity comes from geothermal development (Klagge & Nweke-Eze 2020, Nweke-Eze 2024a). The development of these large-scale renewable energy projects in Kenya is characterized by underlying processes of risk financing, cross-scalar governance, negotiations, sustainability dilemmas, strategic selectivity and infrastructure generativity (Nweke-Eze & Kioko 2021, Klagge & Nweke-Eze 2020, Klagge et al. 2021, Nweke-Eze 2024a, Nweke-Eze 2024b).

Financing for these projects includes public finance from international and national sources, as well as private equity finance from private firms and industries. The highest percentage of financing for the projects comes in the form of concessional loans, grants and mezzanine from international development financial institutions (Klagge & Nweke-Eze 2020). These financing instruments play important catalytic roles, especially at early project stages, such as exploration phases. Climate financing also plays an important catalytic role in leveraging other financing in the renewable energy market and comes in the form of market-based mechanisms, such as the Clean Development Mechanism (CDM); specialized funds such as the Green Environmental Facility (GEF) and the Green Climate Fund (GCF); and green bonds (Nweke-Eze 2024b). Grants and debt-blending instruments from climate financing help to crowd-in investment, especially from the private sector, while also playing other local institution-building roles (Nweke-Eze 2024b). Due to the complex risk and investment structure of these large-scale renewable projects and the dominance of public investments from international and national sources as opposed to private sources, financialization processes do not manifest (Klagge & Nweke-Eze 2020, Nweke-Eze 2024b).

Turning to governance, we find that contrary to the popular notion that large-scale electricity projects are governed in top-down processes, the materialization of the projects actually involves various processes of cross-scalar negotiations and interactions among diverse stakeholders (investors and communities), governed by rules, laws and regulations, such as the Environmental and Social Impact Assessment (ESIA) and the Community Land Act, as well as institutions and practices at various scalar levels (Klagge et al. 2020). The challenge in these governance process in the development of large-scale renewable energy projects is in connecting and balancing out the interest and expectations of the involved actors (Nweke-Eze & Adongo 2024, Nweke-Eze & Kioko 2021). In the case studies included in this dissertation, investors' visions are often in conflict with local community aspirations and expectations (Nweke-Eze & Adongo 2024, Nweke-Eze & Kioko 2021). This leads to contestations and protests, which when escalated can stop the progress of 'future-making', if left unmanaged (Klagge et al. 2020). In our case studies, however, we find that notwithstanding the resistances of the host-project communities, the state takes the upper hand in fostering the development of large-scale projects (Nweke-Eze & Kioko 2021). When investors' engagements with local communities and conservationists are viewed from the lens of sustainability, we find that as a result of these cross-scale linkages, public and private investors face sustainability dilemmas and tensions in simultaneously applying the sustainability triad (economic, social and environment). In the end, investors often proceed in implementing these projects using a process of strategic selectivity, notwithstanding the existence of certain unresolved issues, especially regarding land and compensation (Nweke-Eze & Kioko 2021).

Infrastructures of large-scale energy projects in Kenya materialize and diffuse in interesting ways, driven by negotiations, mediation and socio-economic development motives. The latter part of this dissertation discusses how the delivery of ‘core’ infrastructure projects, such as access roads, water tanks and renewable energy artifacts becomes generative, enabling the provision of ‘other’ infrastructures – ‘required’ and ‘generated’ infrastructures, such as network roads, pipe-borne water, schools, health dispensaries, and business kiosks –by the project’s developers as required in order to enable core project. Given that most projects are pursued and advanced notwithstanding the existence of some unresolved issues (especially regarding land and compensation), national and international agencies and investors often implement Corporate Social Responsibility (CSR) infrastructure projects and activities, such as the provision of drinking water for people and their livestock in the communities, to smooth relations with host communities (Nweke-Eze & Kioko 2021, Nweke-Eze 2024a). However, some of these endeavours fail to fully and sustainably address the socio-economic concerns of local communities (Nweke-Eze & Kioko 2021). Unfulfilled promises by investors and high expectations of the communities can easily turn into frustration (Nweke-Eze & Adongo 2024). When unmanaged, these frustrations can result in acts of resistance or even sabotage (Klagge et al., 2020), thereby having the potential to delay or even bring projects to a halt.

1.8.3 Linkages

Q3: Which linkages are established in the development of large-scale renewable energies in Kenya? What do these linkages entail in relation to broader socio-economic interests and expectations?

The development of large-scale renewable energy projects in Kenya often takes place at the intersection and linkages among the various actors, as they pursue their various interests for self-beneficiation and for broader socio-economic development (Klagge et al. 2020, Nweke-Eze 2024a, Nweke-Eze & Kioko 2021). Large-scale renewables future-making in Kenya is governed by linkages among various stakeholders ranging from international investors such as the KfW and national government actors, especially the Geothermal Development Cooperation (GDC), to county and community representatives (Nweke-Eze & Kioko 2021, Klagge et al.

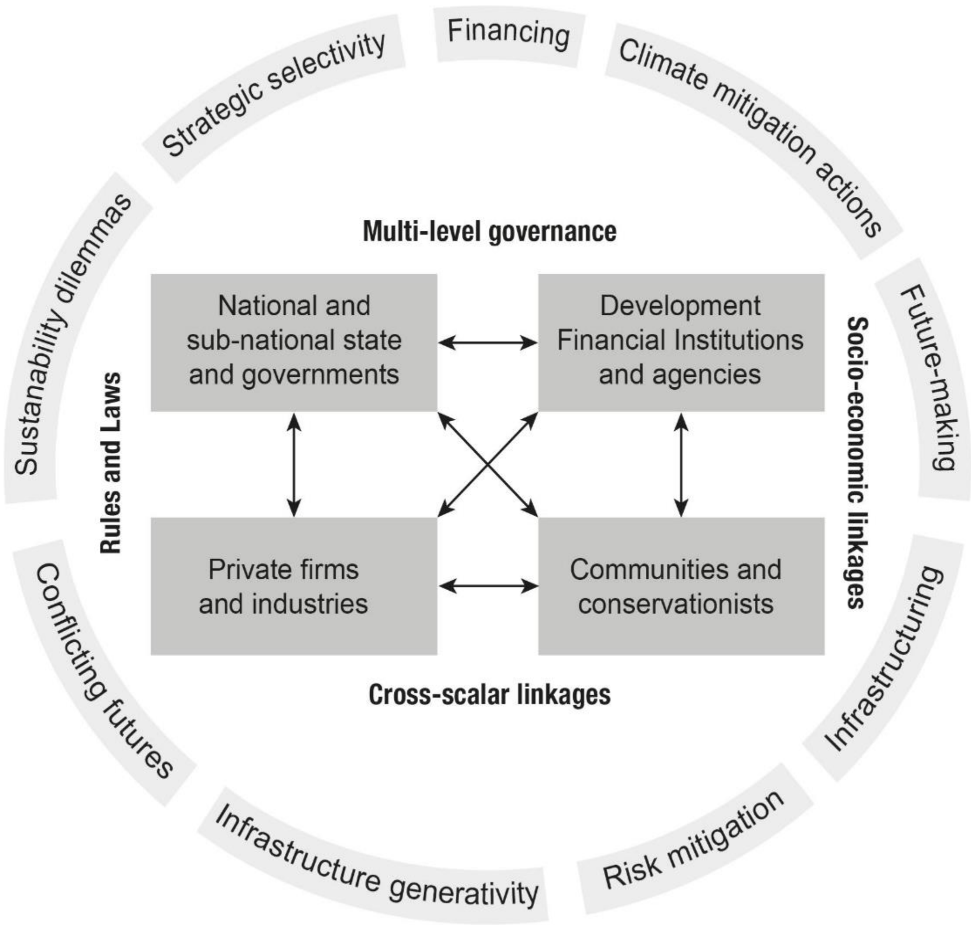
2020). Cross-scale linkages are also manifest in form of financial flows between the national public sector to communities in form of compensation, and between the Global North to the Global South in development and climate financing (Nweke-Eze 2024a, Nweke-Eze 2024b).

These cross-scalar linkages among diverse stakeholders in large-scale renewable energy projects (broadly classified as investors and communities) are enabled by rules, laws, institutions and practices at various scalar levels. These interactions among multi-level stakeholders are important as projects could be delayed or halted if they are neglected or left unmanaged (Klagge et al. 2020, Nweke-Eze & Adongo 2024). The frontier situations in investor-community relations in the context of these cross-scale linkages are characterized by conflicts regarding land acquisition and compensations, as well as the formulation of new rules and laws and the presence of state security forces in attempts to manage these conflicts (Klagge et al. 2020, Nweke-Eze & Adongo 2024). While the Government of Kenya, KenGen, GDC, and private investors have articulated long-term visions regarding sustainability, green energies and economic growth, project-affected and host communities have more concrete goals, such as jobs and access to drinking water (Nweke-Eze & Adongo 2024, Klagge et al. 2020). Investor-community and inter-ethnic conflicts are often sparked and fueled by expectations of future compensations, benefits and compliances, and can escalate if not managed well (Nweke-Eze & Adongo 2024, Nweke-Eze & Kioko 2021).

Studying the infrastructures of the large-scale renewable energy projects in Kenya reveals that such infrastructures can be differentiated and classified into two categories based on their functions, who they serve and their socio-economic linkages. “Core infrastructures” are the infrastructures of renewable energy systems, including plant machineries and drilling and piping equipment (Nweke-Eze 2024a). “Other infrastructures” are the co-existing infrastructures that are constructed due to the delivery of the core infrastructures, including roads, pipe-borne water, schools, health dispensaries, business kiosks. These infrastructures are provided by the projects developers to enable core project construction or as Corporate Social Responsibilities (CSRs) (Nweke-Eze 2024a). While the national agenda is to increase electricity generation from renewable energy and economically-viable sources, for the communities it is in fact these “other infrastructures” that have the most socio-economic significance (Nweke-Eze 2024a, Klagge et al 2020). Roads, for example, can improve mobility and provide opportunities for the construction of business kiosks, and water projects can ensure that communities no longer need to travel long distances for water for themselves and their animals (Nweke-Eze 2024a).

The findings of the dissertation are summarized in figure 16 below.

Figure 16: *Summary of findings*



Source: Author's own

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Chapter 2

‘But we cannot do it all’: Investors’ sustainability tensions and strategic selectivity in the development of geothermal energy in Kenya.

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Abstract

Several studies have questioned investors’ adequate consideration of the three pillars of sustainable development (economy, society, and environment) in the development of projects in host communities. Other studies have proposed and developed frameworks for fostering the adoption and application of the sustainable development principles in the development of such projects. However, relatively little attention has been directed to understanding the processes and dynamics involved in investors’ application of the sustainability triad in developing projects in the Global South. This paper explores these sustainability adherence processes, and the associated challenges and imponderability in the context of large-scale renewable-energy projects development in Kenya. We argue that investors’ commitment to the sustainability framework in the development of such projects is characterized by *sustainability tensions* reflected in conflicting interests, dilemmas, and power struggles that investors face as they attempt to simultaneously apply the three principles of sustainable development in delivering their projects To manage these tensions, the paper shows that investors engage in *strategic selectivity*, whereby the extent of adherence to certain components of the sustainability principles are based on winning interests, priorities and convenience. These processes are explored by drawing on perspectives from sustainable development, Triple-Bottom-Line and corporate sustainability discourses. Expert and informal interviews, document analyses, ethnographic fieldwork and field visits are used to track and illustrate these processes, using the case of large-scale geothermal project developments in Olkaria.

Keywords: sustainability, tensions, strategic selectivity, geothermal, Kenya.

1. Introduction

In “The Future We Want” (UN 2012), world nations reaffirmed the need to achieve sustainable development, in its three dimensions of economic, social and environment, in the face of new and emerging challenges. At continental level, African states also reaffirmed their commitment to a new more inclusive and sustainable path for attaining industrialization and economic development in the Agenda 2063 “The Africa We Want” (AUC, 2015). African countries, along with most other countries of the Global South, essentially grapple with challenges in all the three dimensions of sustainable development (UN 2013). The breadth and linkages of these challenges and how to simultaneously address them, present sustainability dilemmas, tensions and conflicts (Jayanti & Gowda, 2014, Brix-Asala et al. 2018, Newig et al. 2007, Shove & Walker 2007).

There is much skepticism on the possibility to simultaneously address the three dimensions of sustainability given the diverse country-specific political, institutional, and economic capacities and priorities (Romijn et al. 2010). This is particularly true for Africa where resource-intensive investments and industrial expansion remain a key priority for the achievement of rapid economic growth despite their negative socio-environmental impacts. Pressing challenges such as high poverty levels, population growth, and inadequate employment opportunities continue to undermine efforts towards sustainable development (Ahenkan & Osei-Kojo 2014). With these dynamics, reconciling economic growth with social equity and environmental protection becomes an almost elusive endeavor given the many conflicting goals, priorities, and trade-offs (OECD 2013, Ramos-Mejia et al., 2018, Leach et al., 2010).

Such choices, trade-offs and decisions are especially reflected in Kenya’s transition to green energy solutions through the massive investment in geothermal power. Geothermal energy development is expected to play a major role in the country’s transition to a green economy (GoK, 2007). In Kenya, investment in renewable energy has increased fourfold from USD 88 billion in 2005 to USD 349 billion in 2015, most of which has gone into geothermal energy development (Koissaba, 2018). Olkaria geothermal plants, located in Kenya’s Rift Valley (KRV), continues to witness massive investments for expansion and upgrading, while other sites in Menengai and Baringo-Silali are in plant construction and exploration phases. Investors in geothermal in Kenya include the national government (through the Kenyan Electricity Generation Company and Geothermal Development Company), international development financial institutions and private independent power producers (Klagge & Nweke-Eze, 2020).

Despite these massive investments by diverse investors and the expected economic potential, geothermal development in Kenya raises concerns over the extent of investors' commitment to social and environmental dimensions of sustainable development (Mariita 2002, Schade 2017). There is therefore the need to take a closer look at *what counts as sustainable? for whom?* and *by whom?* (Scoones et al., 2015). Answering these key sustainability questions requires understanding the processes, interplays and conditions in which green projects materialize. In this paper, we explore the processes in which both public and private investors seek to simultaneously adhere to the sustainability triad in delivering large-scale renewable energy projects, using Kenya' largest geothermal projects in Olkaria as case study. In so doing, we reveal the challenges, conflicts and tensions that characterize investors' application of the sustainability triad in the Global South context and how these sustainability tensions and dilemmas are managed through strategic selectivity – that is, through adhering to certain sustainability components while neglecting others, based on winning interests, priorities and convenience.

Going forward, we first set out a conceptual framework on the interface and tensions between different players and perspectives in adherence to sustainable principles, based on sustainable development, corporate sustainability and Triple-Bottom-Line (TBL) discourses. Thereafter, we present the Olkaria geothermal case study, describing the project site and plants and the socio-economic and environmental contexts of the area. In our analysis, we examine investors' relations with other stakeholders (in this case, local project-host communities and conservationist institutions/groups) in their efforts to apply the sustainability triad in the development of Olkaria geothermal. In so doing, we reveal the conflicting interests, dilemmas and power struggles that investors face and how they manage these tensions through strategic selectivity and trade-offs in the development of such projects. In the discussion and conclusion, we draw the main lessons from the paper and outline future prospects necessary for fostering sustainable development in Africa.

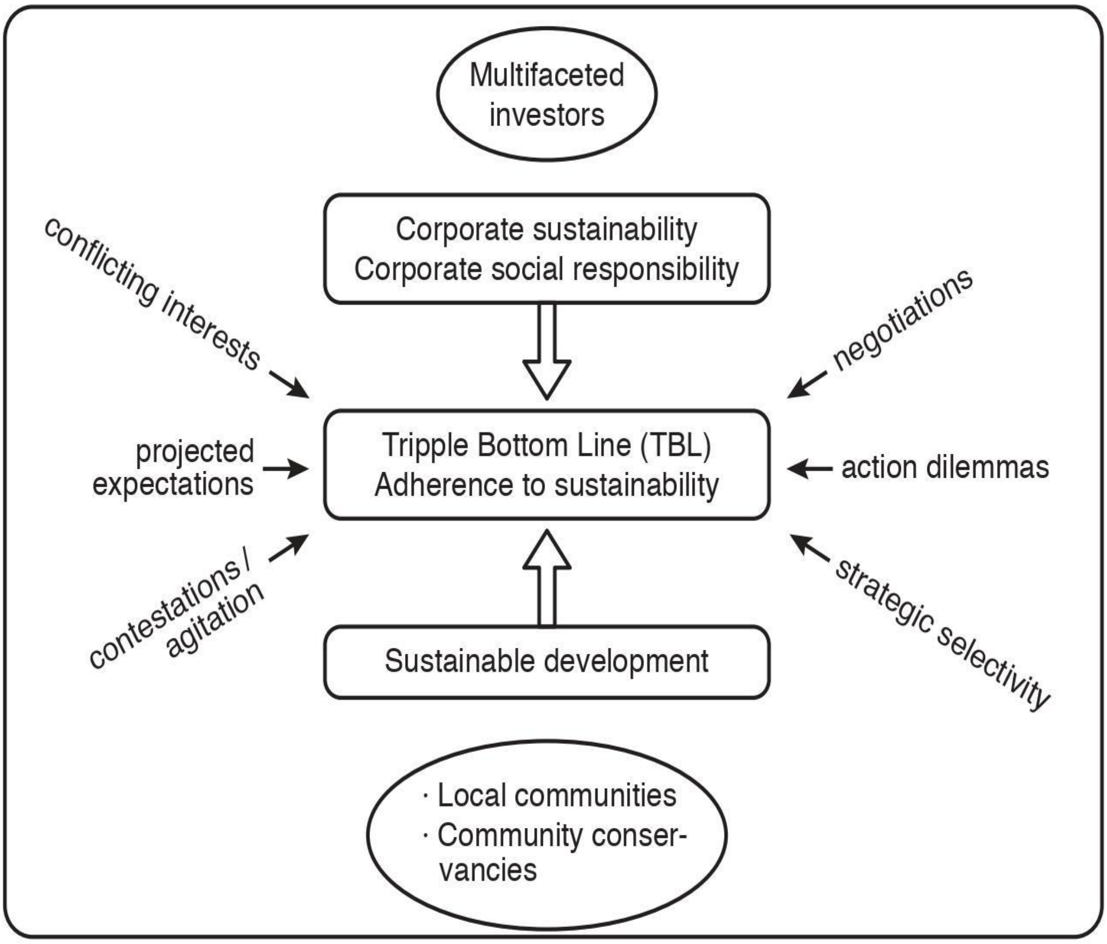
2. Sustainable development, Triple Bottom Line, and Corporate Sustainability.

Despite the popularity and importance of sustainable development, the concept is difficult to define with precision and, therefore, difficult to measure (UN, 2008). It is also characterized by tensions, disconnect, ambiguity, contradictions, and paradoxes, which define the incompatibility of the interplay of economic, social, and environmental factors of development, otherwise known as the sustainability triad (see McIntosh, 2003). In most developing countries context, there is the tendency to prioritize the economic dimension of sustainable development over the social and environmental dimensions (Enns & Bersaglio, 2020; Romijn et al. 2010). This is especially the case for most investors in the developing world where the desire for profits often outweigh sustainability concerns, epitomizing what Alexander (2015) and Lange & Washburn (2012) call Corporate Social Irresponsibility. Given this tendency, the corporate sustainability idea and the Triple Bottom Line (TBL) approach have been forefront in guiding investors in assessing the sustainability of their businesses and the scope of their corporate social responsibilities.

Corporate sustainability present economic, environmental and social concerns as systematically interconnected and interdependent at different levels and enjoins firms to address them simultaneously (Hahn et al 2015). Ideas of corporate sustainability are traceable to Carroll's work of the late 1990s, which largely draw from the report of the Brundtland commission. The justification for corporate responsibility, according to Carroll (1999), stems from an understanding that actions of corporations touch community members at many points and, as a result, corporates or businesses should be responsible for the consequences of their actions to communities and the environments in which they operate. The TBL concept (introduced by Elkington (2004)), on the other hand, is a traditional accounting framework adopted by corporations in examining the extent of their broader company value (Lee, 2007). Under the TBL framework, corporate sustainability is anchored on environment, economics and equity dimensions, and with the position that corporations should ideally commit to social and environmental concerns in their operations as they do on profits (Gray & Milne, 2004).

However, as Hahn et al. (2015) show, the expectation of companies and businesses to simultaneously address the three pillars of sustainability faces tensions at different levels and scales (also see Brix-Asala et al., 2018 and Ramos-Mejia et al. 2018). In adherence to sustainability in the development of renewable energy projects in the Global South, we identify that these tensions manifest in the form of conflicting interests, projected expectations, leading to agitations, contestations and dilemmas, which are managed through negotiations and strategic selectivity (see figure 1). The sustainability outcomes are based on interest hierarchies and power pulls among public and private sector investors at international and national levels, and the local communities as well as wildlife and bio-diversity conservationist institutions and groups, at the TBL- sustainability adherence interface (see figure 1). The local host-communities and conservationists act as face-off actors, facing-off with the investors, in the development of renewable energy projects.

Figure 1: *Adherence to sustainability principles: players, perspectives, and external factors*



Source*: Authors' own.*

In the following sections, we will empirically explore stakeholder characteristics and their conflicting interests as well as the extent to which tensions in adherence to sustainable development influence decision-making and investors' choices in Olkaria geothermal development in Kenya. Moreover, we explore the extent to which these choices are based on the balanced needs of all stakeholders including investors/shareholders, and government, communities and environmental conservationists (Jamali 2008).

3. Study Area and Methodology

3.1 Study Area

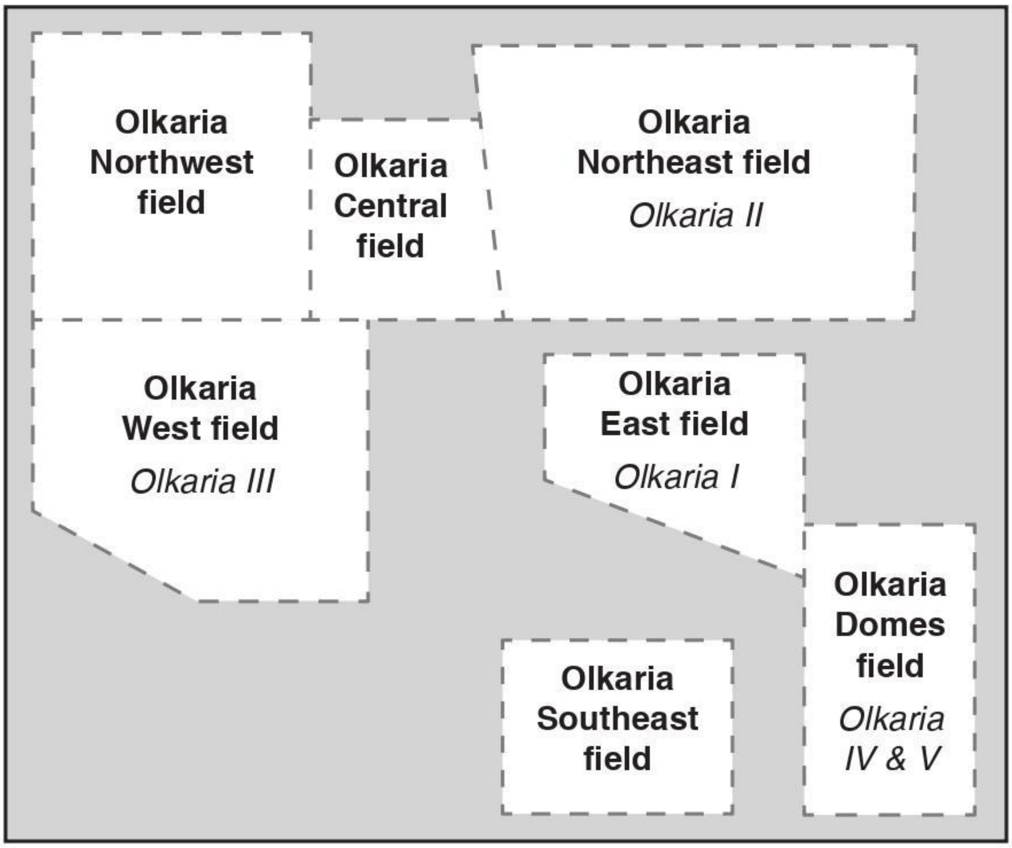
The Olkaria geothermal field is located in the central part of the Kenya Rift Valley, south of Lake Naivasha and about 120 KM northwest of Nairobi. The field is divided into seven blocks, which include Olkaria East field serving Olkaria I power plant, Olkaria Northeast field serving Olkaria II, Olkaria West field serving Olkaria III, and Olkaria Domes field serving IV & V (see figure 2). Except for Olkaria III[1], All Olkaria power plants (Olkaria I, II, IV) are operated by a partly government-owned parastatal, Kenya Electricity Generating Company (KenGen). For this study, we will focus on these KenGen geothermal projects. KenGen's Olkaria I, Olkaria II, Olkaria IV currently generate a total of 185MW[2], 105 MW and 140MW of electricity, respectively. Olkaria V is under construction within the Olkaria Dome field, with estimated generation of 165.4MW; and Olkaria VI of 140 MW is planned for 2021, under a Public Private Partnership (PPP) project development model.

Olkaria I and Olkaria II are located within the Hell's Gate National Park (HGNP) – a fact that has elicited some environmental management concerns. Hell's Gate National Park lies on the south of Lake Naivasha and about 120km north-west of Nairobi. The state gazetted the park in 1984, three years after the commissioning of Olkaria I Power Station. The park features rare flora, fauna, and exquisite scenery. Olkaria IV power plant is located on Kedong Ranch, a property acquired by KenGen, and is about 15km from the Olkaria I power station. Furthermore, KenGen utilizes water from the nearby Lake Naivasha, which is a wetland of international importance according to the Ramsar Convention on Wetlands.

The cumulative impacts of the existing Olkaria I & II, the proposed Olkaria IV and Olkaria I Units 4 & 5 power stations on air quality and noise pollution prompted KenGen to earmark the following nearby villages for resettlement: Cultural Centre, Olo Nongot, Olo Sinyat, Olo Mayiana. Interviews with KenGen officials revealed that a Resettlement Action Plan (RAP) to relocate the Project-affected Persons (PAPs) was developed as a mitigation measure against the impacts of prolonged exposure to air and noise pollution promising to provide PAP with social amenities like land, water, modern residential houses, a school, churches, and a health facility.

[1] Olkaria III is 48MW power plant, owned and operated by the privately owned U.S. company OrPower 4, a subsidiary of Ormat Technologies Inc., under an IPP arrangement.
[2] With the plans to rehabilitate Olkaria I, units 1-3 and to build a new plant (Olkaria I unit 6, which is estimated to be 83MW), total capacity of Olkaria I is estimated to reach 237.7MW from its current 185MW by 2021 (Field data, 2019).

Figure 2: Structural map of Olkaria geothermal fields and plants in Kenya



***Source**: Field data, 2018 & 2019, Omenda et al., 2014.*

3.2 Methodology

The Olkaria geothermal projects were chosen as case study because of its provision of a high representative material, involving diverse stakeholders and capturing the stakeholder interplays and dynamics in investors' adherence to sustainability in the development of the largest geothermal projects in Africa. The analyses of the study are based on several expert and informal interviews (2018-2019), document analyses (reports, work papers and proceedings), ethnographic fieldwork and field visits (2018-2020). The expert interviewees work at government agencies and parastatals at different levels (Ministry of Energy (MoE), Ministry of Environment and Natural Resources (MoEN), Kenya Wildlife Service (KWS), National Land Commission (NLC), the National Treasury, County Commissions (CCs), County Governments (CGs)). They also consist of project developers (KenGen) and staff members in development finance institutions (European Investment Bank (EIB), German Development Bank (KfW), Agence Française de Développement (AFD). For anonymity reasons, we refrain from providing the identities of our informants. Ethnographic fieldwork and field visits (2018-2020) featured observations, informal interviews and group discussions with community members at the fringes of the geothermal sites (namely, Cultural Centre, Olo Nongot, Olo Sinyat, Olo Mayiana), who had to be displaced to allow for further geothermal development in Olkaria. All the expert interviews were recorded using an electronic audio device, while observations, informal interviews and group discussions were recorded through notetaking. The interviews were transcribed, and thematic analysis was carried out. This included coding of data prior to the identification, review and analysis of key themes. Each theme was explored to develop an understanding of the perception, interests and motivations of the participants. The interviews provided rich data on the investor-community-conservancy relations, which is vital for our analysis of investors' adherence to the sustainability triad. Ethnographic fieldwork provided evidence on behaviors, expectations, social structures and shared beliefs of the case study communities. Furthermore, to augment, validate and triangulate the findings of the study, several project reports, working papers and proceedings were reviewed and analyzed.

4. Results

This section discusses the results and the findings of the study in two main clusters. In the first cluster (4.1), it discusses the constitution of stakeholders, their characteristics and interests in the development of the Olkaria geothermal project. The second cluster (4.2) draws from the first to discuss the conflicting nature of stakeholder interests, sustainability tensions and investors management of these tensions through strategic selectivity.

4.1. Stakeholders, their characteristics and interests in the development of Olkaria projects

Stakeholders in the geothermal sector in Kenya can be more generally grouped into two: namely, the investors and the local communities and conservationists. Investors, here, covers both public and private sector project developers, managers, financiers and consultants. The stakeholders, their relationships and interests in development of the Olkaria geothermal projects are discussed along the lines of these groups, in the sub-sections below.

4.1.1 Investors

Investors in the development of the analyzed Olkaria geothermal projects come from public and private sectors, at international and national levels. They consist of the Government of Kenya (GoK), the project developer (KenGen) and development financial institutions (DFIs). The roles, characteristics and interests of the Olkaria geothermal investors in Kenya are discussed as follows.

Government of Kenya (GoK), line ministries and parastatals

The Government of Kenya (GoK) is involved in the projects through its various ministries and parastatals, the foremost of which are the ministry of energy (MoE), and the National Treasury (NT). On behalf of the Kenyan government, the Ministry of Energy (MoE) oversees all aspects of the energy sector including the development of Olkaria geothermal projects.

Geothermal resource development ranks high in GoK's national development strategy, as contained in its Vision 2030 (GoK, 2007). The transition from hydropower to geothermal and other energy sources strengthens Kenya's energy resilience to unpredictable precipitation shocks of which hydropower was often prone to, as well as imported oil-price fluctuation shocks[3] (GoK, 2013). Despite the focus on expansion of renewable energy sources to achieve energy sufficiency and security, GoK is also keen on expanding the non-renewable energy sector through exploration of oil fields in northern Kenya and investment in nuclear energy power plants (Field data, 2019 & 2020).

The Kenya Electricity Generation Company (KenGen) and their consultants

KenGen is a 70 percent government and 30 percent private sector-owned company, mandated with the responsibility of developing, managing and operating power plants for electricity generation in the country. KenGen is the largest electricity generator in Kenya with 62 percent of national installed capacity amounting to approximately 1796 MW, with geothermal leading in the installed capacity mix (Maino, 2019). Key to KenGen’s plan for further expansion of its installed capacity is the development of geothermal energy (Omenda et al. 2014).

KenGen is the sole project developer of the studied Olkaria geothermal projects. It did so in cooperation with actors in the public sector, namely GoK and Development Financial Institutions (DFIs), as well as actors in the private sector - IPPs and consultants (such as GIBB Africa[4]). KenGen has a Geothermal Development Office (GDO) responsible for all administrative aspects of all geothermal projects. Its regulatory Affairs office plays an interfacing and coordinating role in the RAP implementation process, constantly engaging with the MoE, and KenGen’s executive committee (which is the highest decision-making organ) and the lenders (all of which are DFIs). The Environment and CDM office regularly supervised the implementation of the social and environmental sustainability frameworks and requirements of

[3] The GoK had relied on Hydropower for energy generation in the past (Field data, 2019).
[4] GIBB Africa is a consultancy firm hired by KenGen to conduct the census to determine compensation and to draft the Resettlement Action Plan (RAP).

the project and regularly reported to the DFIs on progresses in RAP implementation. It achieves this in cooperation with the Social Safeguards Office[5] managed by the community liaison officer, who is responsible for day-to-day implementation of social safeguards and coordination of the Project Affected Persons (PAPs), the Resettlement Action Plan Implementation Committee (RAPIC), and the local administration. The Environment and CDM office also work with the Property and legal manager's office in issues relating to land transfers and settlements; and with the Project Execution Office for the technical and infrastructural aspects of the RAP implementation[6].

Development financial institutions (DFIs).

The development financial institutions (DFIs) involved in the development of Olkaria fields include the European Development Bank (EIB), the French Agence Française de Développement (AFD), the German Kreditanstalt für Wiederaufbau (KfW), Japan International Cooperation Agency (JICA), and the World Bank. The DFIs play an important catalytic role in the development of Olkaria projects by providing financing, in their various forms (loans, grants and mezzanine) as well as technical assistances. Table 1 summarizes the DFIs and their specific roles in the development of one or more of the Olkaria projects.

Table 1: *DFIs and roles in the development of Olkaria projects.*

DFIs	**Roles**
EIB	Loans, technical assistance in due diligence
AFD	Loans, project procurement, technical assistance in the resettlement of project affected persons (PAPs) and in the implementation of environmental and social safeguards
KfW	Loans
JICA	Loans, technical assistance in field exploration
World Bank	Loans, technical assistance in the resettlement of PAPs

Sources: *Field data (2019), Schade (2017).*

[5] The Social Safeguards Office compiled monthly progress reports to share with KenGen, the Independent Evaluation Panel (IEP) – an independent professional body in charge of monitoring and ensuring sustainability adherence; and the county administration (Field data, 2019). It also assumed the role of secretary in the Resettlement Action Plan Implementation Committee (RAPIC). The RAPIC was a deliberation platform, which involved all important stakeholders involved or affected by the RAP, including the investors and the Project Affected Persons (PAPs) (Field data, 2019).
[6] including site layout and tendering, and supervision of contractors doing construction (Field data, 2019).

In order to organize, coordinate and better focus their actions, some of the DFIs often form groups, which meets periodically (three to four times in a year) for discussions on a broadened and deepened cooperation and coordination. A peculiar example of such groups in the studied context is the Energy Sector Development Partners Group (ESGPG), which includes all DFIs working in the Kenyan energy sector, in which group convening roles are rotated from time to time among the DFI group members (Field data, 2018 & 2019). In the energy group, DFIs share experiences of project development as well as indicate interests for cooperation in energy projects development. In addition, the Mutual Reliance Initiative (MRI) was initiated in 2009, among the European DFIs[7] with a view to establishing an efficient division of labor in order to fulfill the development obligations set out in the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action, of which development of renewable energy is among the key priority areas. The operational guideline of the MRI dictates approaches and delegates functions for involvement among member DFIs in a project (OECD, 2011). In the case of the development of Olkaria IV, for instance, the AFD was the assigned lead financier and project materials procurer for Olkaria IV as well as lead for the implementation of environmental and social safeguards. EIB was placed in charge of technical due diligence, while AFD administered resettlements, together with the World Bank (Field data, 2019 & Schade, 2017). Other than the European DFIs, the Japanese JICA and the World Bank have played signification financing and technical assistance roles in the development of Olkaria projects. The RAP was administered based on the World Bank's OP 4.12 on involuntary resettlement. As a result, the World Bank wielded a relative high influence in the resettlement processes. The DFIs got quarterly updates on RAP implementation from KenGen.

4.1.2 Local communities and conservationist institution

In the development of large-scale renewable energy projects, investors have to deal with other stakeholders who are equally interested or affected by the development of projects. For Olkaria, these are the project-host and neighboring communities (including the Project Affected Persons (PAPs)) and state conservationist institution – the Kenyan Wildlife Service (KWS). The local communities are interested in ensuring that their human rights are adhered to and have the expectation that their socio-economic livelihood will be improved as a result of the presence of the projects. The KWS, on the other hand, act as mediums for the wildlife and biodiversity, ensuring that the habitats of the wildlife and forest covers are maintained during and after the

[7] including EIB, AFD and KfW (Field data, 2019)

development of the project. The characteristics and interests of these stakeholders are discussed in detail below.

Local communities and Project Affected Persons (PAPs)

During the development of Olkaria IV and Olkaria I unit 1 & 2, it was determined that the total impact of the overall existing and planned geothermal facilities in the area will adversely affect certain neighboring communities. As a result, four communities (Cultural Centre, OloNongot, OloSinyat, and OloMayiana) were resettled. The four local communities were initially convinced and viewed the resettlement as an opportunity to improve their socio-economic livelihoods (Field data, 2018).

The Cultural Centre is a permanent village and a business center, which until resettlement mainly subsisted on tourism. The other three communities are predominantly pastoralists who lived and still live on a livestock-based economy. Other than these main sources of socio-economic livelihood, members of the four communities (mainly men) also gained employment opportunities offered by KenGen and their contractors, as well as by flower farms. The communities could sell pumice stones and women could engage in other small-scale trading. In addition, the communities also engaged in charcoal burning, which was illegal, as they had no license to do so (GIBB Africa, 2012, p. 5-6). Until the resettlement, the Cultural Centre, founded about 30 years ago as a place of a cultural and spiritual significance to the Maasai, consisted of one *manyatta*[8]. Most members of the Cultural Centre lived in the *manyatta*. The *manyatta* conjoined with each other in a circle, creating a space in the middle, where the village performed traditional dances and spiritual rites. There were also few members of the Cultural Centre who lived close to the Olkaria Primary School, away from the *manyatta*. The OloNongot households lived in *manyattas* in relatively close proximity to each other, while the OloSyniat households lived further from each other. In OloMayana Ndogo, the most of the *manyattas* were arranged in a linear form, with some also in clusters.

According to the 2009 GIBB Africa survey (GIBB Africa 2009a & b), the level of socio-economic wellbeing in the four communities was generally considered poor. In 61.8 percent of the PAP households, water was collected from a distance, mainly by women and girls. Only the Cultural Center had a public water pump, which was installed with the help of a French Non-Government Organization (NGO). Furthermore, 45 percent of the PAPs were believed to have no access to sanitation services and none of the households had electricity (GIBB Africa 2012).

[8] traditional Maasai housing units or clusters

Prior to resettlement, the standard of formal education among the PAPs was also generally poor. According to data compiled for the Environmental and Social Impact Assessment (ESIA) of Olkaria IV (GIBB Africa 2009a & b), 51 percent of household heads and wives had no education, 22 percent had some amount of primary education, 12 percent had some secondary education, 8 percent had some technical training, and just 3 percent had attended university (EIB-CM, 2015, p. 29). Most of the older members of the community spoke the local Maa language, while some younger literate members spoke Kiswahili and English (Field data 2018, 2019). Some community activists, however, contend with this survey finding stating that it was skewed to paint a picture of bringing hope of better welfare among the local communities through the resettlements

According to the 2009 GIBB Africa Census (GIBB Africa 2009a & b), 1,209 community members were qualified for compensation, of which 948, made up of landowners with properties and homes, were qualified for resettlement. A total of 284 persons from OloNongot, 139 persons from OloSinyat, 299 persons from the Cultural Center and 226 persons from OloMayana were deemed suitable for housing on the RAP site (GIBB Africa 2009a & b). The Maasai had some polygamous households, which implied that each spouse of a one-male household head and their respective children had their own house unit. The husband of these wives rotated among them and was liable for providing for them and their dependent children (Field data 2018, 2019, Schade, 2017). On this basis, the overall number of housing units to be constructed was estimated to be 164 (GIBB Africa, 2012), as opposed to the planned 150 housing units based on the first RAP estimates.

The resettlement land of 1700 acres is located within the Olkaria geothermal block. Upon relocation, the PAPs were, for the first time, eligible to get their title deeds, making them formal landowners – a move, which served as a major incentive for the communities to accept the relocation (Field data, 2019). At the RAP-land, KenGen provided the communities with a primary and early childhood school for 320 pupils and a health facility[9] (Field data, 2018 & 2019). All public facilities, the schools, and the dispensary were connected to the newly installed electricity grid, with cost covered by the communities (Field data, 2019).

[9] The communities previously relied on local herbal medicines for curing ill health (Field data, 2019).

The Kenya Wildlife Service (KWS)

The Kenya Wildlife Service (KWS) is a GoK parastatal created in 1990, under the Ministry of Tourism and Wildlife. Its mandate, according to a senior KWS official, is “to take care of wildlife, for the prosperity and for the people of Kenya, the citizens of Kenya and for the next generation” (Field data, 2019). Before its creation as a parastatal, the wildlife department within the Ministry of Tourism and Wildlife (MoTW) of the GoK initially undertook the activities of the current KWS. It was created at a time when the GoK was committed to strengthen conservation through law and policies for the protected areas (Field data, 2019).

KWS manages most of the National Parks and Reserves in Kenya. Its activities are run from its own generated revenues from tourist fees, complemented with supplementary funds from the GoK, public and private donors and other partners. In order to better achieve its mandate, KWS often works together with the Ministry of Environment, Water and Natural Resources, as well as the Kenyan Police and the National Intelligence Service to combat environmental crimes. For ease of reach, effectiveness, and resource allocation, KWS functions are devolved into eight regions consisting of the northern region, the mountain region, the central rift region, the southern region, the Tsavo's, the coast region, the western region and the eastern region. The Hell's Gate National Park, where most of the studied Olkaria geothermal projects are located, is within the Rift Valley region.

4.2. Conflicting interests, sustainability tensions and strategic selectivity.

As shown in the previous sub-section (4.1), the stakeholders in Olkaria geothermal plants are multiple, diverse and with different interests. The interests of the investors are aligned, to some extent, because of their perceived goal of ensuring the development of geothermal energy as an engine to socio-economic growth and development in Kenya. DFIs, in line with their sustainability agenda, required that KenGen adhere to their social and environmental sustainability principles, which are enshrined in their Environmental and Social Impact Assessment (ESIA) frameworks, as a condition for accessing financing for project development. However, as we will see in the sub-sections below, this mechanism alone is inadequate to fully enforce and investigate the extent to which KenGen and other investors adhere to the sustainability principles. ESIAs do not guarantee whether concerns for possible negative environmental impacts will be addressed or whether the need to invest sustainably will be adhered to at the post-finance unlocking phase (that is, during the project implementation phase).

KenGen also has to abide by the GoK laws and regulations during and after the projects' development. These laws and regulations are meant to protect the human rights of PAPs as well as help in the conservation of biodiversity and promotion of tourism (a sector that the government also earns revenues from). The extent to which KenGen adheres to these sustainability frameworks, laws and regulations is, however, questionable. There are allegations that ministry representatives collude with KenGen to push agendas that mainly favour cost-effective and fast-paced development of the projects to the detriment of thorough consideration of social and environment concerns (Field data, 2019).

For the GoK, such projects are often political projects that are meant to inspire public confidence that the government "is doing something" (with reference to development). They inspire high expectations of change and are therefore popularized as success stories in a bid to limit any possible counter narratives. For DFIs, the financial support is interpreted as being "part of a big thing" (with reference to transition to a green and clean alternatives). These DFIs are the channel through which climate mitigation financing reach the projects at the local levels. Local communities (individuals and groups) have their immediate concern on expected socio-economic benefits, whether perceived or real. Their hopes are that the existence of such projects directly improves their socio-economic wellbeing. On its part, KWS prioritizes environmental conservation and preservation of biodiversity. However, KWS is state-owned and therefore does not have the capacity and legitimacy to change state decision regarding the implementation of a project.

These conflicting interests and expectations between investors and their face-offs (local community and the KWS) generate tensions at the interface of sustainable project implementation as will be discussed in detail below. These tensions and dilemmas created by conflicting sustainability interests among stakeholders are managed through sustainability trade-offs; that is the choice to implement a certain sustainability principle over others – a practice we refer to as strategic selectivity.

4.2.1 Investors and the local communities

As stated earlier, the construction of Olkaria projects necessitated the evacuation and relocation of a number of Project Affected Persons (PAPs). The Resettlement Action Plan Implementation Committee (RAPIC) was the key forum for the PAPs to engage in decision-making on the relocation process. It was the place where recommendations and negotiations on the execution of the RAP were taken in consultation with selected representative members of the PAP (Field data, 2018 & 2019).

The PAP had 24 participants included in the RAPIC, consisting of five gender-balanced representatives from each of the communities (three men, two women) (GIBB Africa 2012, p. 10). The youths, the vulnerable and disadvantaged members of the communities, the Council of Elders and the Administrative managers of the Cultural Center, each had one selected representative member in the RAPIC (GIBB Africa, 2012, p. 10). Other RAPIC representatives included the Naivasha Deputy County Commissioner[10] who chaired the RAPIC, the county-level heads of line ministries, county-level heads of line ministries, one provincial-level administrative delegate[11], and the KenGen implementation team. Since the World Bank's guideline on social safeguard was adopted, the framework and functions of RAPIC was therefore greatly informed by the guidance of the Bank's local social security experts. In addition to the RAPIC, there was also the institution of the Community Advisory Council (CAC). The CAC consisted of two elders from each village who had been chosen from among their peer and age groups. It was the first stage of the operational-level dispute mediation process, where complaints and grievances relating to resettlements and resettlement process were laid (Field data, 2018 & 2019). It was meant to provide recommendations and feedback to the developers and investors on how best to deal with problems such as land registry issues and how to navigate or compensate for activities that require meddling with certain culturally or spiritually sensitive sites (Field data, 2018 & 2019).

For the resettlement of the PAPs, KenGen built only 150 houses, although a later census suggested that it should be 164 houses. To explain this discrepancy, the Tacitus report explained that the "forgotten cases" claimed by some of the communities, particularly the Cultural Centre, did not change the number of PAP under the category of "Landowners with Assets", and thus did not affect the number of houses to be constructed (Tacitus, 2012). Tenants who built their own houses were liable for monetary compensation at cost of construction but not to a house on the resettlement land (Tacitus, 2012, p. 57). The same compensation mechanism applied to landowners who owned extra houses that they rented out (Tacitus, 2012, p. 58). Business community members of the Cultural Centre that did not live in the village were considered not to be liable for compensation. This is because the Cultural Centre continued to exist in its original location as a business and commercial centre (Tacitus, 2012, p. 33). The non-resident

[10] The Naivasha District Commissioner had this position prior to the devolution of government (Field data, 2019).

[11] This position no longer existed after the devolution of government (Field data, 2019)

opportunists, who falsely claimed abode among the PAPs, were also not considered (Field data, 2018 & 2019).

The PAPs claimed that the settlement was not culturally appropriate. The geography of the land, which had steep-sided valleys, restricted the accessibility and movement of polygamous men from one housewife to another, a situation which was further exacerbated during the rainy seasons when the valleys and gullies are flooded. Since some of the households were at Narasha (- a village not available for resettlement), some polygamous families were divided. Furthermore, members of the Cultural Center, who were accustomed to living together in a clustered and circular environment in proximity, considered it psychologically unacceptable to live in isolated family groups at comparatively wide distances from each other (also see Schade, 2017).

Concerning the allocation of houses, the PAPs claimed that there was insufficient consideration given to the needs of vulnerable persons (elderly, orphans, some female-headed households, and disabled). The Tacitus report stressed that GIBB Africa did not identify this category of PAPs and encouraged KenGen to quickly identify them and their needs in order to determine the type and level of support to be offered to them (Tacitus, 2012, p. 59). Until the time of this study, such grievances persisted. In the same manner, several of the rights of indigenous people were not sufficiently addressed. The PAPs seemed not to be aware of these rights and therefore did not raise this, although conditions for addressing these needs were contained in the World Bank OP 4.10 on indigenous people (also see Schade, 2017).

Furthermore, the Muslims among the PAPs complained about not been offered a mosque in the resettlement land, nor a travel cost compensation alternative for visiting the mosque located in Naivasha (Field data, 2018 & 2019). When confronted with this complaint, KenGen claimed that they were uninformed about this situation, stating that the census recorded the existence of only one Muslim family in the area and that they had limited funding to delve into religious requirements outside of the RAP compensation guidelines (Schade, 2017).

Since relocation, the accessibility of the PAPs to each other decreased considerably due to expanded distances and limited access to existing transport facilities, with the Cultural Centre being the most affected (Field data, 2018 & 2019). On a regular basis, those PAPs who had previously stayed at the Business Center now had to cover 14 km in either direction (Schade, 2017). The Tacitus study, had however, foreseen and listed this issue in their report (Tacitus, 2012, p. 49), but it was not addressed (Field data, 2018-2020).

Regarding the question of the land's adequacy to maintain livestock and the absence of alternatives to address the issue, the Tacitus report makes the following statement:

> *"According to the GIBB report, the PAPs requested that even after the relocation, they should be allowed to continue grazing their livestock in the areas of their current settlements. KenGen, however, informed the PAPs that it could not commit itself to ensure the PAPs continue grazing in their current settlement areas since the land on which they are currently settled either belong to Kedong Ranch [a property associated with the current GoK president] or to KWS, and KenGen cannot make commitments on their behalf. KenGen hopes though, that because the resettlement site is in close proximity to the current PAPs settlements and grazing command areas, the status quo would be maintained. In this respect, if there was to be any interference by the legal landowners, it would not have been occasioned by the fact of the resettlement".*
>
> (Tacitus 2012, p. 16)

Another issue raised by the PAPs and the financiers was that it was necessary to make provision for a second piece of land for the Cultural Centre, in response to the land request made by the Centre, for the establishment of the Business Centre in a location elsewhere, where it is possible to stay overnight (Schade, 2017). KenGen agreed to the request and searched for suitable land north of the existing Cultural Centre (Schade, 2017). However, KenGen later rejected the identified parcel of land because of a pending court case and because certain development activities were already planned on the land (Field data, 2018 & 2019).

4.2.2 Investors and the Kenya Wildlife Service (KWS)

Before Hell's Gate was gazetted as a national park, KenGen had already acquired the land for geothermal development in the early 1960. Bearing this fact in mind, in addition to being a parastatal under the GoK, KWS was willing to negotiate and compromise where necessary to see to the development of the projects (Field data, 2019). KWS's key interests and concerns, however, bordered on water quality system for wildlife, air pollution, loss of food and forages for the animals as well as noise and vibrations (Field data, 2019).

In order to ensure that the interests of KWS were not completely compromised, KWS formed the Hell's Gate Park Action Committee (PAC), which held monthly update-meetings. This provided a platform for the mediation of most sustainability concerns (Field data, 2019). The committee included all the concerned stakeholders, including KenGen, community representatives, GoK representatives, as well as Tourism hoteliers that are located around the Hell's Gate Park (Field data, 2019). KWS then held regular separate meetings with the DFIs and their consultants to report their sustainability concerns. This meeting between KWS and DFIs was of particular concern to KenGen as it got financing and technical support from DFIs on the condition that it address and adheres to environmental and social concerns stipulated by KWS (Field data, 2019). For KenGen, expression of dissatisfaction had the potential to slow the release of expected financial assistance from the DFIs.

Within these mediating frameworks, KenGen agreed to wear KWS recommended clothing colours, adhere to speed limits, move away from strategic animal habitats and other potential areas that may endanger the animals, while carrying out operations in the Hell's Gate Park (Field data, 2019). When asked on the efficiency of the Hell's Gate Park Action Committee (PAC), a KWS senior warden in charge of the negotiations noted:

> *"The committee really assisted. Because if you are dealing as one person against them, it is very difficult to achieve any results. There were local people [community representatives and Tourism Hoteliers] who asked very difficult questions that government officers would not ask another government officers, they asked the hardest questions and that really helped to balance out some of the sustainability concerns".*
>
> (Field data, 2019).

When asked to rate the extent to which KenGen adhered to their stipulated sustainability concerns, the KWS senior warden replied:

> *"We did not achieve everything, but they were a very responsible organization…I would place them at 80%".*
>
> (Field data, 2019).

5. Discussion and Conclusion

There is no doubt that African countries appreciate the sustainable development approach as critical for the realization of complex development problems. This is visible in both regional and country-specific development blueprints and in the attempts towards transitioning to green economies. However, reconciling the three dimensions of sustainability – society, economy and environment – is rather difficult given the diverse continental and state-specific priorities. As OECD (2013:27) observes, developing countries have the greatest need and demand for economic growth and welfare improvement in the short term, which makes the balance between more long-term welfare gains from socio-environmental improvements, challenging. Our case study analysis reflects this observation. In the development of Olkaria geothermal projects, diverse investors face challenges in balancing the delivery of a cost-effective and an economically viable project with the socio-economic expectations of local communities and the environmental conservation concerns of conservationist institutions/groups. As such, the interests and priorities of the investors' often clash with those of the local host communities and conservationists. Investors are not able to meet all the expectations of their face-offs, thus the phrase "*But we cannot do it all*" from a senior staff in the project developing company, KenGen.

We also see that investors manage these sustainability tensions through strategic selectivity. They tend to focus on implementing certain components of the sustainability triad (mainly the economic components) while neglecting the others (mainly social and environmental components). In this manner, the investors' interests and priorities, take the upper hand, and geothermal projects are pursued and advanced notwithstanding the existence of some unresolved sustainability issues, especially regarding land and compensation. When the sustainability principles are juxtaposed, we find that the economic dimensions (economic viability and cost effectiveness) of the sustainability triad are mildly compromised as against the largely pending and unaddressed socio-economic welfare, livelihood, biodiversity and environmental issues and concerns, contained in the social and environment dimensions. These findings resonate more generally with current experiences of large-scale investments throughout Africa (Lind et al., 2020).

The study, however, shows that strategic selectivity is not acted out in a 'blunt', direct and purposeful manner. Investors do make efforts to balance-off these sustainability tensions. Such efforts include the establishment of rules, laws and frameworks (such as the ESIAs and the Community Land Acts), the implementation of Corporate Social Responsibility (CSR) projects and activities, and the formation of stakeholder groups (also see Klagge et al., 2020). These endeavors have, however, proven to be insufficient as the socio-economic concerns of local communities are not fully and sustainably addressed. For progress in improving sustainability outcomes, there is need to prioritize in-person monitoring of the implementation of the projects to ensure that they go on according to stipulated standards as contained in the ESIAs, Laws and Acts (also see Muthuri & Gilbert, 2011). Furthermore, mechanisms and spaces for interactions between the investors and the local communities and conservationists, should be increased, and made more inclusive, diverse and representative of affected communities and conservationists.

This will foster proper deliberation and consideration of sustainability options among all stakeholders during the planning and implementation stages of the projects.

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Chapter 3

Conflicting futures of geothermal energy development in Naivasha: Between state visions and community expectations.

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Abstract

In this contribution, we explore state visions, community expectations, and the interactions between these ‘futures’ in the development of large-scale geothermal energy infrastructures in Naivasha, Kenya. In so doing, we reveal the conflicts, which are inherently embedded in the interaction between state visions and community expectations in future-making. We call these conflicts ‘conflicting futures’. As a starting point, we adapt the concept of state-community relations in future-making to operationalize the interactions between the (mainly state-based) investors and the infrastructure-affected community in our case study. Our analysis contributes to scholarship on the social interplays and dynamics in the materialization of large-scale development infrastructures and their associated socio-ecological transformations in the wider Lake Naivasha area, as well as in similar areas and contexts in the Global South.

Keywords: conflicting futures, future-making, state-community relations, geothermal energy, Naivasha.

1. Introduction

In "Kenya Vision 2030" – the national development blueprint of Kenya – the state expresses its commitment to the development of geothermal energy resources in the country as a way of increasing electricity generation capacity from sustainable, "green" and resilient sources (GoK 2007). To this end, the Kenyan state, together with other public and private investors, embarked on several geothermal development activities along the Kenyan Rift Valley (KRV). The largest centre of geothermal explorations and electricity production from geothermal sources is in Olkaria, Naivasha Sub-County of Kenya. These infrastructures fit with the state's sustainability narrative (Nweke-Eze and Kioko 2021) and, partly as a result, have attracted huge infrastructure and climate-change-related financing from public and private investors at national, international, and global levels (Klagge and Nweke-Eze 2020). The Kenyan state's vision for the development of geothermal infrastructures goes beyond the provision of electricity for national benefits. The energy infrastructures are developed with the vision of attracting both local and foreign investments into the state-proposed Naivasha Industrial Park, which is to be located near the Olkaria geothermal plant, benefiting from the cheaper power supply than the market price while expanding and creating jobs for the locals in the region (Ngugi 2020). In the development of these infrastructures, the state often acts through dedicated institutions, including the ministries, parastatals, and Special Purpose Vehicles (SPVs), often with financial and technical support from international development financial institutions (Klagge et al. 2020; Klagge and Nweke-Eze 2020).

The development of these geothermal energy infrastructures, however, often defies infrastructure-affected communities' expectations, raising concern over their exacerbation of land grabbing and resource-use conflicts, their destabilising of community bonds and identities by dispossession, as well as their adverse effects on the socio-economic livelihoods and biodiversity in the infrastructure-affected communities (Adongo 2015; Hughes and Rogei 2020; Nweke-Eze and Kioko 2021). The infrastructure-affected community members are predominantly *Maasai* – a pastoral community that has lived in the area for decades, subsisting mainly on low-impact pastoralism and living in coexistence with the wildlife in the area (Adongo 2015; Mariita 2002; see also Waller, this volume).

These narratives on conflicting interests and futures are common with such large-scale development infrastructures (Lind, Okenwa, and Scoones 2020). The development of infrastructures in accordance with state visions and for national benefits, however sustainable they may be framed as being, often require substantial socio-economic and environmental sacrifices and relegation of expectations at local levels (Nweke-Eze and Kioko 2021; Hughes and Rogei 2020). In contribution to this scholarship, this chapter explores the processes and dynamics of these conflicting futures through the lens of the interplay between the (mainly state-) investors and infrastructure-affected community, in the development of Olkaria geothermal energy infrastructures in Naivasha. The development of these infrastructures in Naivasha is a classic case for the study, as the construction of the infrastructures involved substantial negotiations and promises, which culminated in the relocation and resettlement of four villages in the infrastructure-affected Maasai community.

We begin with a conceptual framework on state-community relations in future-making, after which, we describe the methodology of the study. In the section that then follows, we describe and explain the case and contexts of the study (Olkaria geothermal plants, state roles, and the infrastructure-affected community). Thereafter, we empirically explore and discuss the Kenyan state visions and how they come into conflict with expectations and realities at the infrastructure-affected community level. In conclusion, we discuss the implications of our findings for state-community relations in future-making in Kenya and elsewhere in the Global South.

2. State-community relations in future-making

In the era of capitalism in a globalised world, the notions of state and community are increasingly heterogeneous, both as concepts and as objects of study (Trouillot 2002; Scott 1998). The state can either be seen as existing only as a centralised entity at the national level or as a combination of multiple entities with governance presence at both national and local levels – that is, being closer to the community, for more efficient influence, in a process called decentralisation or devolution of powers (Bardhan 2002; Brown, Cloke, and Harrison 2015). Similarly, the notion of the communities is formed by what they are (identities) and how they exist (practices) (Adler 2015), all of which are constantly made and maintained in creative processes – "communities-in-the-making" (Schiemer 2018). However, when the interests of the state and the communities are considered in the context of future-making – that is, the practice of materialising futures – the state and community appear more as two clear-cut and homogeneous entities, defined by common interests. It is this constellation of the state as one entity and community as another that gives both sides force in "making their cases" in future-making.

Following this understanding, we therefore contend that future-making is made up of and shaped by competition between visions of the state and the expectations of the community (also see Appadurai 2013; Granjou, Walker, and Salazar 2017; Müller-Mahn, Moure, and Gebreyes 2020; Bollig 2021). These futures play a central role in social life and are acted upon in the present (Berkhout 2006; Ruivenkamp and Rip 2011; Mathews and Barnes 2016; Urry 2016). Future-making is anticipated (Groves 2017), prepared for (Anderson 2010), and is often contested and saturated with different interests (Brown, Rappert, and Webster 2000; Beckert 2016). The state envisions certain practices and delivers them to foster "development" (Scott 1998; Jasanoff and Kim 2015). Likewise, the community has expectations from the state and aspires to improved socio-economic conditions (Meadowcroft 2010; Appadurai 2013).

The interaction of these futures is premised on the state's complex, dynamic and interdependent relationship with the community in the course of future-making (Nilsson et al. 2011; Klagge et al. 2020). The state's nature and role in the community and the extent to which it 'makes the future', also depends on its relationship with non-state actors in the community, who also have certain degrees of power and influence, such as tribal leaders, religious authorities, and civil-society organizations (Meadowcroft 2010; Hufen and Koppenjan 2015). This process of state formation and interaction with the community is often non-linear, involving tensions, conflicts and compromises (Brown, Rappert, and Webster 2000, Sovacool and Cooper 2013; Nweke-Eze and Kioko 2021).

With each range of non-state actors wielding a certain amount of power and influence, and contesting with the state for their futures, negotiations become important in managing the inter-actor relations in the course of future-making (Marginson, Keune, and Bohle 2014; Klagge et al. 2020). These also bring about innovative ways of negotiating, with non-state actors gaining more momentum fuelled by globalisation trends. Such trends, including major strides in the flow of information, communication, and transportation, have also created avenues for international actors and organizations of various forms, to exert influence on state functions and future development (Alexandre et al. 2012; Mawdsley 2012). This is, in part, evident in the emergence of several international political and economic organizations, such as the World Bank, the International Monetary Fund (IMF), and the African Union.

Notwithstanding the powerful influences of non-state actors in the community, the state often still gains the upper hand in charting the course of the future through its far-reaching powers, functions, and tools. Several studies (Fairhead, Leach, and Scoones 2012; Benjaminsen and Bryceson 2012; Hughes and Rogei 2020; Nweke-Eze and Kioko 2021) focusing on resource appropriation and the correlated community-level consequences often allude to the disjuncture and unbalanced interplay between state visions and community expectations. The state pushes its agenda toward implementation through its function of resource distribution and its power to draw up, repeal and enforce rules, laws, and regulations (Enns 2016). In addition, the state also uses certain community-influencing tools – for example, the media – to persuade, mobilise and enforce its agenda (Migdal 2009 and Beckert 2016).

3. Methodology

This study is based on robust data collected through extensive fieldwork conducted by the two authors. The first author (C.N.-E) carried out several key-informant interviews in Nairobi, Nakuru, and Naivasha (2018–2021) as well as made several fieldwork visits to the geothermal infrastructure project sites and surrounding infrastructure-affected communities in Olkaria (2018–2021). The second author (C.A.) carried out successive periods of ethnographic fieldwork (2014–2020), which comprised two household surveys (2014 and 2015) in the infrastructure-host community. The findings were augmented with documents, communication correspondence, and archival data analyses gathered by the two authors.

The key informants work at government agencies and parastatals at different levels (Ministry of Energy (MoE), Ministry of Environment and Natural Resources, Kenya Wildlife Service (KWS), National Land Commission (NLC), the National Treasury (NT), Rural Electrification and Renewable Energy Corporation (REREC), county commissions and county governments). They also include the infrastructure developers such as KenGen and the Geothermal Development Company, and staff members in development finance institutions (EIB, KfW, AFD, World Bank), involved in the development of the Olkaria geothermal infrastructures. In addition, independent and energy-related consulting firms and consultants (Geohydro limited, EED Advisory) as well as a geothermal research institution, Geothermal Training and Research Institute (GETRI), were interviewed.

The ethnographic methodology featured a series of successive fieldwork periods in Olkaria that began in 2014. Data were collected through key-informant interviews, informal and focus-group discussions with the Project-affected Persons (PAPs), and participant observation in mediation sessions between the investors and representatives of the infrastructure-affected community. The first phase of the study was conducted in four villages, namely Olonongot, Olosinyat, Olomayana Ndogo, and Emanyatta,[12] while the second phase was conducted in RAP-land[13] – the resettlement site that lies between Suswa Oloiruwa plains and Olkaria V

[12] The village of Emanyatta is also called cultural centre, because it had been established as a cultural centre for facilitating international cultural exchange (Field data, 2014).

[13] RAP stands for Resettlement Action Plan.

stations, 14 km from the aforementioned villages. Two household surveys (N=350) were also conducted: one in early (February) 2014 before the resettlement and the other, a year later (February 2015) post resettlement, with the same households. Personal correspondence and informal conversations have also been useful in providing additional information to the subject of study.

The study also analyzed secondary data largely comprising minutes from meetings between the developers and the community, Environmental and Social Impact Assessments (ESIAs), and other reports such as those from funders (EIB, JICA, World Bank) such as the RAP, mediation documents, and responses to claims by the PAPs. Through community records, the second author also kept track of correspondences (emails, letters, texts) between the community and the developers and funders.

4. Olkaria geothermal infrastructures, state roles, and affected community.

The Olkaria geothermal infrastructures are located about 120km north of Kenya's capital Nairobi, in the Hell's Gate Ward of Olkaria, Naivasha Sub-County. Most of the infrastructures are situated within the Hell's Gate National Park (HGNP), a gazetted protected area that covers about 68 km^2 (see figure 1). The geothermal field within the Greater Olkaria Geothermal Area (GOGA) is subdivided into five blocks, namely: Olkaria East (Olkaria I), Olkaria Northeast (Olkaria II), Olkaria West (Olakria III), Olkaria Domes (Olkaria IV, V and VI) (see table 1 for further elaboration).

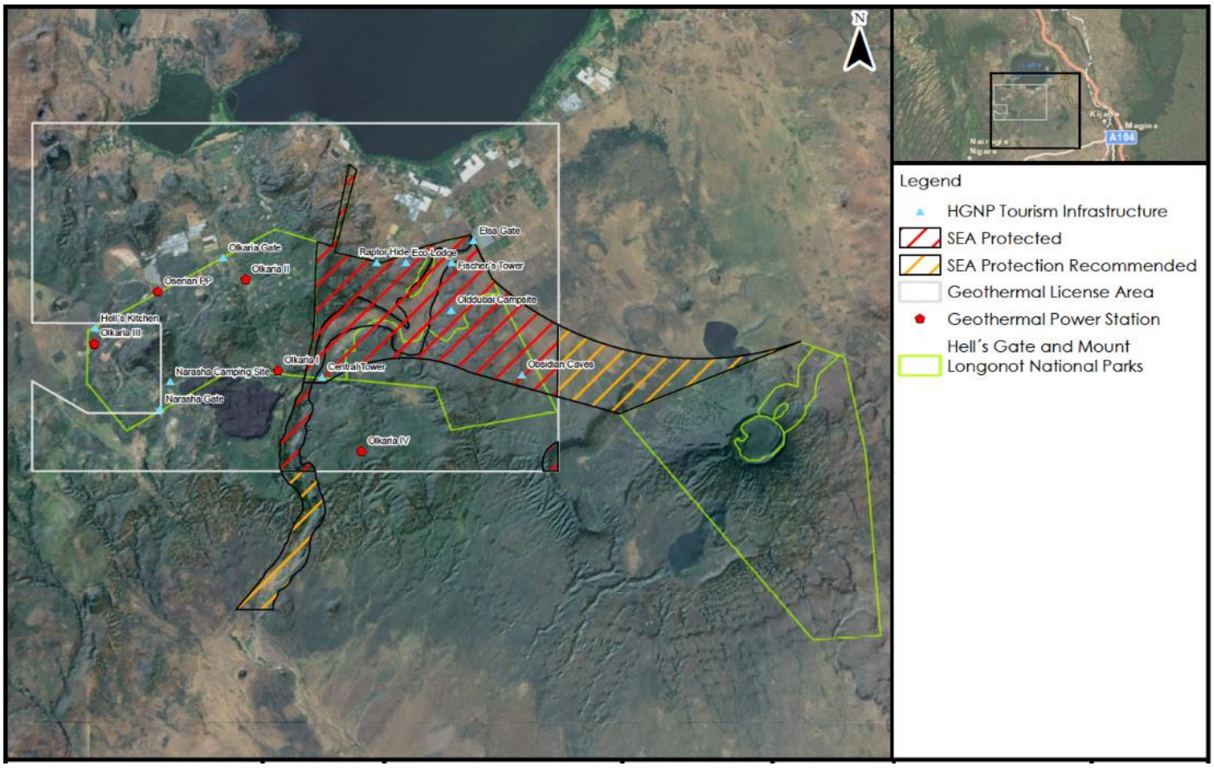
Table 1: *Olkaria geothermal energy infrastructures in Naivasha*

Power stations	**Capacity (MWs)**	**Ownership**	**Status/Year of commissioning of finished projects**
Olkaria I (Units 1, 2 and 3)	45	KenGen	Finished in 1981, 1982 and 1985 respectively
Olkaria II	105	KenGen	Finished in 2003
Olkaria I (Unit 4 and 5)	140	KenGen	Finished in 2015
Olkaria I (Unit 6)	83.3	Public-Private Partnership (PPP) between KenGen and four private companies	Ongoing

Olkaria III	139	Independent Power Producer (IPP) - Ormat Technologies Inc (OrPower 4)	Finished in 2000
Olkaria IV	140	KenGen	Finished in 2014
Olkaria V	165.4	KenGen	Finished in 2019
Eburru Wellhead	25	Eburru (private company) and KenGen	Various times
Olkaria Wellhead	81	KenGen	Various times
Olkaria VI	140	Public-Private Partnership (PPP) between KenGen and five private companies	Ongoing

Source: *Field data (2018-2020) and various geothermal infrastructure developers' websites, 2019/2020.*

Figure 1: *Olkaria geothermal infrastructure area*



Source: *Field data, 2019 (sourced from Akiira ESIA report, 2016)*

__Figure 2__: Aerial view of Olkaria II geothermal infrastructures

Source: *Field data 2019 (sourced from KenGen archives, 2019).*

4.1 State roles

Most of the Olkaria geothermal infrastructures are owned by the Kenya Electricity Generation Company (KenGen) – a 70% state-owned entity (Table 1). In total portfolio, KenGen currently owns seven larger geothermal power stations – Olkaria I, Olkaria II, Olkaria IV, Olkaria V, and Olkaria I units 4 and 5, in addition to the well-head generation plants in Eburu and Olkaria,[14] bringing the entire KenGen geothermal capacity portfolio to 818 MW.[15] Ormat Technologies Inc. owns Olkaria III, with 150 MW installed capacity. In 2008, the 100% state-owned Geothermal Development Company (GDC) was formed as a SPV charged with accelerating the development of geothermal fields by taking up the riskiest aspects of the development (exploration and drilling). From 2009 to 2010, the state-owned SPV undertook drilling of 59 wells in Olkaria I and IV, with a total yield of 412MW.[16] In 2014, the company launched its blueprint development strategy, envisioning to install 12 more rigs and to drill at least 1,200 wells in total by 2030.[17] GDC is currently prospecting for more geothermal development in other areas of Olkaria, in Menengai, Baringo-Silali, Suswa, and Bogoria.[18]

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[14] Geothermal wellhead technologies allow for early generation of electricity from single wells before the construction of large power plants.
[15] KenGen and MoE interviews, 2019.
[16] GDC interviews, 2019.
[17] GDC interview, 2019.
[18] GDC and KenGen interviews 2018/2019

The development of the Olkaria geothermal infrastructures is not only driven by national state commitments and favourable policies; the Kenyan state also received substantial financial and technical assistance from international development financial institutions (DFIs) and technical assistance agencies in Europe, the US, and North Asia. These international institutions include the European EIB, the French AFD, the German KfW, the Japanese JICA, and the World Bank. These institutions played an important catalytic role in the development of the Olkaria energy infrastructure by providing financing, in their various forms (loans, grants, and mezzanine) as well as technical assistance. The DFIs often blended their financing with climate-related financing (mainly grants) from specialised funds such as the Green Environmental Facility (GEF). With technical assistance from DFIs, KenGen also leveraged carbon credits from traded carbon, under the Clean Development Mechanism (CDM) to augment geothermal financing. Table 2 below summarises the DFIs and their specific roles in the development of one or more of the Olkaria infrastructures.

Table 2: *DFIs and roles in the development of Olkaria infrastructures.*

DFIs	**Roles and activities**
EIB	Loans, technical assistance in due diligence
AFD	Loans, project procurement, technical assistance in the resettlement of project affected persons (PAPs) and in the implementation of environmental and social safeguards
KfW	Loans
JICA	Loans, technical assistance in field exploration
World Bank	Loans, technical assistance in the resettlement of PAPs

Sources*: Field data (2018-2020), Schade (2017).*

4.2 The infrastructure-affected community

Although the wider Naivasha area is largely cosmopolitan with a diversity of livelihood options such as horticulture, fishing, and irrigation agriculture, the pastoralist Maasai largely inhabit the Olkaria ward, with a population of about 64,507 (KNBS 2020). From oral history, the Maasai in the area claim to have migrated from Kinangop, specifically during the forced migration to the southern reserves established by the British colonial rule, after the Maasai treaties with the British in 1904 and 1911 (Rutten 1992; Waller, this volume). While some Maasai continued southwards, others chose to settle nearer to Lake Naivasha. After Kenya's independence, around 1964, these Maasai who settled closer to the lake would again be pushed further, as a result of land grabbing by the first independent state government, which had made

Nakuru the headquarters of the Rift Valley province. Other forced migrations would again occur due to the establishment of the Hell's Gate National Park as well as Olkaria geothermal explorations in the area.[19] The two enterprises attracted immigrant workers, who ended up establishing their own village (Olomayana Ndogo), in Olkaria, with the consent of the local Maasai. With time, these immigrant workers had somewhat become an extension of the Maasai through intermarriages. Thus, while the Maasai remain the majority inhabitants, the Turkana, Rendille, Pokot, Borana, and Luo represent the minority inhabitants. This diversity, as we show in the following section, has created tensions in the resettlement and compensation process. While the Maasai largely depend on livestock, practising seasonal transhumance, part of the population, especially the immigrant workers, depend on casual labour from the Hell's Gate NP and the geothermal industry. Some Maasai also supplement pastoral activities with tourism-based livelihood such as community tour guiding and beaded jewellery trade (see figures 3 and 4).

Figures 3 and 4: *Maasai socio-economic livelihood in Naivasha*

Sources: *Field data 2016/2017 (right photo credit: Dr. Benoit Hazard)*

5. State visions, community expectations, and conflicting futures in geothermal infrastructure development in Naivasha

5.1 Geothermal infrastructures in Naivasha as state development vision

The Olkaria geothermal energy infrastructure development was envisioned by the Kenyan state as a means of achieving sustainable socio-economic growth and development through the provision of electricity to stimulate industrial investments, create jobs, and increase tourism and

[19] According to informants recounting their history in the Olkaria area (Field data, 2014)

government revenue potentials, all with minimal negative environmental and socio-economic impacts.[20] Olkaria geothermal electricity has sufficient base-load to securely provide for household and industrial electricity needs in the country, as its reliance on hydropower continues to diminish due to drought.[21] Some of this generated electricity is envisioned to be sold to large-scale industries and flower farms for the planned Naivasha Industrial Park – a Special Economic Zone (SEZ) near the geothermal operations at Olkaria.[22] Investors in the industrial park are to be offered a lower power tariff of KSh 5/ kWh to set up their businesses as approved by the country's regulatory agency, the Energy and Petroleum Regulatory Authority (EPRA).[23] This electricity tariff deal is roughly half of the market price for other commercial consumers, who are currently paying KSh 10–12/kWh at peak hours.[24] KenGen (the partly state-owned company, owning most of the geothermal plants in the area) has already been able to sell not only electricity to flower firms in the area but also its steam.[25] Oserian Development Company, for instance, has been using geothermal heat from KenGen for its rose-growing business over 50 hectares since 2003.[26] Furthermore, the initially planned East African railway network, a rail connection between the Kenyan harbour city of Mombasa with the nation's capital, Nairobi, is now planned to be extended to connect to the market town of Naivasha in proximity to the Olkaria geothermal field.[27] This was deliberately planned to further enable manufacturing facilities in the region to benefit not only from easier access to cheap geothermal power, but also from easier access to markets by rail transport to the port of Mombasa in the western part of the country.[28]

The state also envisioned that the development of the Olkaria Geothermal Project would create direct and indirect jobs for skilled, semi-skilled, and non-skilled workers in the project host community and beyond.[29] The construction of the projects was expected to create job opportunities for highly skilled workers, including geologists, geochemists, geophysicists, engineers (electrical, civil, drilling, and mechanical among others), environmentalists, community liaisons, and human resource personnel.[30] The infrastructure host community and

[20] MoE, KenGen and county governments interviews, 2019.
[21] MoE interview, 2019.
[22] KenGen interviews, 2019.
[23] EPRA interview, 2019.
[24] EPRA and MoE interviews, 2019. At January 1, 2019, KSh 1 was equivalent to $0,00976 (source for the exchange rate: https://www.oanda.com/currency-converter/en/).
[25] KenGen interviews, project site visits, 2019.
[26] KenGen interviews, 2019.
[27] KenGen and MoE interviews, 2019.
[28] KenGen and MoE interviews, 2019.
[29] KenGen, NT, and MoE Interviews, 2019–2020.
[30] KenGen and independent consultants' interviews, 2019.

their neighbours were also to benefit from the need for unskilled and semi-skilled labour during the construction of the geothermal projects. Such job opportunities include construction of access roads, clearing of projects sites, driving, masonry, carpentry, loading/off-loading of project equipment, provision of security for the project area, among others.[31] Other indirect employment opportunities, more in the form of self-employment, were also expected to emerge due to the construction of the projects. They include petty trading, restaurant trade, housing construction, and provision of accommodation, for the benefit of the workers as well as other members of the community.[32]

Furthermore, due to the strategic location of Olkaria geothermal plants within the Hell's Gate NP, it was envisioned that it will contribute to boosting the park's tourism potentials.[33] Other than animals within the park, the state expected that most of the tourists would be eager to see the geothermal plants and to visit the Geothermal Spa and Recreational Centre – a direct-use feature of geothermal energy, as part of sightseeing activities during touristic tours.[34] Other than enhancing the touristic value of the NP,[35] Olkaria geothermal energy infrastructure itself was also expected to earn the state some additional revenue through taxes and fees.[36] The energy infrastructures were also expected to generate operating license fees, Value Added Tax for most of the procured project construction equipment, as well as corporation tax at 30% of net income.[37] After the completion of the projects, the state and KenGen also look forward to earning additional revenue through the sale of carbon credits, officially called Carbon Emission Reductions (CERs), as well as to meet the state's climate-change mitigation commitments contained in the Paris Agreement.[38]

5.2. Conflicting interface of state visions with community expectations, and realities of living with geothermal infrastructures

In this section, we discuss the expectations of the community, its conflicts with the state-level visions, and the ensuing and persistent local consequences and realities of the Olkaria

[31] KenGen, county commissions and county governments interviews, 2018–2020.
[32] KenGen, independent consultants, county commissions and county governments interviews, 2018–2019.
[33] Tourism is one of the Kenyan state's major sources of national revenue and foreign exchange (NT interviews, 2019).
[34] KWS and KenGen interviews, 2019.
[35] This takeover by geothermal energy production as the focal point of tourism in Hell's Gate NP has generated mixed feedbacks among tourists. Some see it as having added sightseeing value, while others miss the earlier completely natural environment, complaining that geothermal development has eroded the natural beauty of the park (field data, 2019).
[36] NT and KenGen interviews, 2019.
[37] NT and KenGen interviews, 2019.
[38] NT and KenGen interviews, 2019.

geothermal infrastructure development.[39] Although the Olkaria geothermal project has also had ecological impacts, especially in the Hell's Gate National Park, we focus on the experiences and perceptions of the human inhabitants – the Maasai.[40] As we will find, and as opposed to their own initial expectations, the Maasai continue to struggle to coexist with the state's development of Olkaria geothermal infrastructures, against the backdrop of historical continuities of land grabbing, dispossession, resource alienation, and human rights violation from the colonial to the post-independence era (Rutten 1992; Fratkin and Sher-Mei-Wu 1997; Hughes 2008; Sena 2015).

The expectations of the predominantly Maasai community from the development of Olkaria evolved over time.[41] In the early stage of project-infrastructure development, there was no resistance from the communities on the planned development and expansion of geothermal infrastructures in Olkaria.[42] One reason for this is that the land for the energy infrastructure had long been gazetted as a national park under the management of the Kenyan Wildlife Service (KWS).[43] KenGen acquired the land from KWS, for a repurposed usage for geothermal development, governed by a Memorandum of Understanding.[44] Although the communities did not resist the development of the energy infrastructure at this stage, they implicitly expected that their construction would enable the provision of better amenities such as water and health dispensaries as well as better socio-economic opportunities, including market access, within their communities.[45] These expectations were premised on the assumption that the presence of geothermal energy in their community would not disrupt their existing livelihood and cultural heritage.[46] In the initial stages, these concerns were expressed informally to visiting project developers, but not formally established, as the community were still ignorant of their benefit-sharing rights from local resources as contained in the Kenyan law.[47]

However, as Olkaria projects development advanced to cover more areas in the Hell's Gate National Park (NP), with risks of air pollution and land acquisition increasingly becoming apparent, expectations of benefits from the infrastructure development grew among members

39 The data and views presented here span 7 years (2014 to 2020). A recent survey by Hughes and Rogei (2020) reaffirms the persistence of these sentiments and the overall situation of the Maasai at RAP-land.
40 Although there are other ethnic minorities in the area, we use Maasai, who are the majority, to refer to the inhabitants unless specified otherwise.
41 Field data, 2014–2020.
42 Field data, 2014.
43 Field data, 2014; KWS interviews, 2019.
44 KenGen interviews, 2019.
45 Field data, 2014.
46 Field data, 2014.
47 Field data, 2014.

of the community. These expectations grew partly through sensitisation by civil-society organizations as well as due to the insistence from international DFIs that the developers adhere to sustainability principles.[48] Soon after, more serious and formal talks about compensations for pollution, land acquisition, and other socio-economic benefits arose among the state, DFIs, and the community. This led to the creation of RAP committees and the signing of a Memorandum of Understanding for the resettlement of the PAPs and socio-economic benefits for the infrastructure host and affected community.[49] These relocation and resettlement plans were against the initial expectations of the communities, though. However, the state, together with its partner DFIs, promised to resettle the PAPs in areas with better living conditions, to provide opportunities for the restoration of their socio-economic livelihoods and to provide infrastructures and scholarships to the PAPs and surrounding communities.[50] In the following paragraphs, we discuss how most of these promises and agreements were not met, at least according to the rising expectations of the affected Maasai community, and how the socio-economic conditions of the community worsened due to the geothermal infrastructure development in the area (Kimani 2020).

After several attempts to relocate the predominantly Maasai inhabitants from the Olkaria geothermal complex,[51] KenGen successfully achieved this aim, displacing the inhabitants of the first four villages in August 2014. At the time, KenGen, in accordance with its Environmental and Social Impact Assessments (ESIAs), cited health hazards (JICA 2015) as the motive for such displacement. Coincidentally, at the same time, the Akiira Geothermal Limited (owners and developers of the 140 MW geothermal power project) was in the process of establishing its first plant (70 MW) adjacent to the resettlement location, causing the Maasai to question the validity of KenGen's justification for the displacement.[52] "What is different about Akiira plant? Is it not the same steam, the same effluents, the same noise? Why take us there then?" they pondered.[53]

Despite expressing their concerns, the displaced PAPs found themselves in "RAP-land", lost and aggrieved.[54] To them, the land that KenGen had evicted them from had always belonged to

48 Independent consultants & DFI Interviews, 2019.
49 KenGen & DFIs interviews, 2019.
50 Field data 2014–2015, and KenGen interviews, 2019.
51 FGD with Maasai of Emanyatta (cultural centre) February 2014: they narrate two incidents when their village was set ablaze in an attempt to evict them. The latest prior to resettlement occurred on July 26, 2013.
52 Akiira is a private geothermal developer at Olkaria owned by a consortium of American investors. Power Africa – a major funder of Akiira.
53 Interviews and FGD between February and June 2014.
54 3 weeks fieldwork at RAP-land and 1 day after displacement.

them, regardless of who had the legal title deed.[55] Following the relocation, the communities were also dissatisfied with the value of compensation and the relocation processes contained in the proposed resettlement plan of KenGen and their financiers.[56] They had not been prepared to move into the "*wilderness"*.[57] To compound matters, the violence with which they had been evicted provoked distress for many families, especially those with young children[58] (see also Kimani 2020).

Further, the positioning of the RAP-land between geothermal concessions and the NP in GOGA has not favoured the Maasai,[59] and this is set to worsen with tentative plans for land acquisition for further geothermal development.[60] Consequently, the Maasai is subject to restrictions in terms of grazing and access to water sources. The RAP-land prevents them from advancing their pastoral activities.[61] Six years after the resettlement, the Maasai still lack water and certain social amenities, still feel poorer, and struggle to adapt to their "new" homes and lifestyle.[62]

Despite having been increasingly sedentarised over the past decades (Fratkin and Mearns 2003; Adano and Witsenburg 2005), the Maasai in general, including those in the Olkaria area, continue to depend upon expansive land to support their pastoral livelihoods. They graze strategically, moving between areas of pasture and water depending on the seasons. The Maasai of Olkaria, for example, used the Orbatata not only as a dry-season grazing area and watering ground for their livestock,[63] but also to access pasture in the Suswa lowlands during wet seasons.[64] Loss of land coupled with restricted access to pasture in the NP and around geothermal plants has thus curtailed their transhumance and livelihoods as pastoralists.[65] Even though at RAP-land these pastoralists have access to 1,700ha, they claim that the vegetation

55 The Maasai have been living on this land without a legal title deed since independence due to historical continuities of land injustice and corruption that dispossessed the Maasai from their lands, see Lotte Hughes (2006) and Marcel Rutten (1992).

56 A house and moving allowance of KSh 35,000 (approximately $350) (Field data, 2014). Many community members also stated that they did not receive the allowance (Field data, 2014).

57 Interviews in RAP-land 2014, just after resettlement. The community members claimed that many hyenas that threatened their livestock inhabit the RAP-land and that they did not feel safe (Field data, 2014).

58 Interview with a mother of three children (Field data, 2014): the morning following night evictions – I found her preparing tea for her three children under a tree next to her demolished house. "They gave me KSh 1,000 ($10) and told me to leave", she stated.

59 We use Maasai because of their predominance in Olkaria. There are however other (minority) ethnic groups present, represented by Samburu, Borana, Turkana, and Rendille. From interviews with them, we found they had settled in Olkaria in search of job opportunities, marriage, or had come to visit their relatives at a young age but ended up not returning home.

60 Threats of degazettement (interview with Nature Kenya, 5th February 2015, personal communication with a board member of the LNRA.

61 Field data, 2014-2019.

62 Field survey results (2014-2015).

63 Orbatata is the Maa reference to the Orjorowa gorge that connects Olkaria to the Suswa plains.

64 We followed the herders from February to July 2014, to determine livestock routes and grazing areas.

65 FGD s with PAP s 2014, RAP document, shows that the Maasai lost 4,200 hectares.

there is unpalatable to livestock.[66] Besides, the deep gulleys, loose soil, and severe soil erosion in RAP-land render grazing impossible.[67] Several of the pastoralists attested to have lost their livestock in the gulleys, which forced some of them to keep their livestock with relatives living outside of the Olkaria area.[68] The Maasai in RAP-land recount painfully how they have lost the gorge (Orbatata), a culturally and historically significant area. They feel that by being denied access to their cultural sites, they have lost a part of their culture. For instance, one elder told of how they used to conduct child-naming ceremonies under a special rock in the gorge, something they have been unable to do since being resettled at RAP-land.[69] Besides this, the entire *Orbatata* not only constitutes caves and hideouts that the Maasai say had been used for their meat-eating ceremonies (*Olpul*) and as hideouts during the Mau Mau uprising, but also contains springs and grass-banks crucial for their livelihood as pastoralists as well as red and white ochre sites that the Maasai use during ceremonies. Presently, the effluents from geothermal wells heavily pollute some of the springs, rendering it unhealthy for community members and livestock.[70]

During fieldwork at RAP-land following the resettlement,[71] we observed families in congested houses sleeping on the cold cement floors and sitting on stones.[72] Unlike in their previous settlements where the bed and seating areas were inbuilt and made from readily available natural resources (sticks and earth), in these new RAP houses, there was the need to purchase furniture – which many of the settlers could not afford. Many attest to being poorer because not only have they had to sell their livestock in order to finance a new lifestyle, but they have also lost jobs.[73] Even without the casual employment from the geothermal industry, in their previous villages the Maasai had their livestock, grazing areas, beaded-ornaments businesses, and tour-guiding activities at the edge of the Orjorowa gorge "*Orbatata".* Having been displaced more than 25 km away, the trek to the Gorge and back to RAP-land became expensive and

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66 Our observation of RAP-land ecology suggests that the predominant vegetation is mostly *Taconanthus conpharatus* (leleshwa in Maa language).

67 Interviews 2014, RAP-land.

68 Interview with five livestock owners, 10th September 2014.

69 FGD, elders (11th February 2014).

70 One of the interviewees described how their cows started dying after drinking from the springs (interview with a PAP in Emanyatta 15th February 2014).

71 Fieldwork started on the day of resettlement.

72 For example, a disabled single mother of 4, living with her mother and brother, who had been in prison at the time when censuses were conducted to determine who gets resettled; her brother did not get a house as a result (Field data, 2014).

73 They were poor in comparison to the rest – they largely depended on tourism (FGD, Maasai market, 13 September 2014, with women depending on Maasai market and tour guiding (especially those from cultural centre).

impossible,[74] especially for the women[75] and the old.[76]

Traditionally, the husband gets his own "*Enkaji*"[77] while the wives share their *Enkaji* with their children and spend the night with the man in his space, depending on their arrangement in case several wives are involved.[78] Circumcised boys prefer to have their own independent *Enkaji* away from their parents. This presents the dilemma facing several families in the RAP houses[79] meant for a nuclear family with one or two children, in an urban set-up. For our 72-year-old polygamous informant with his ten children, among them adolescent sons and daughters, for example, this was a nightmare.[80] The physical fence around each housing unit fitted with gates, further enforced seclusion. During an interview with a 43-year-old father of one,[81] he narrated how he had been alone with his wife during the emergency: "I shouted but no one came because they could not hear me – the houses are far apart. If it were back in the village [referring to their previous settlement], people could have heard me and come to my aid. … By the time I got back from seeking help, I found the child dead". The Maasai also claim that RAP-land has also promoted individualism, contrary to the Maasai culture. For instance, during a focus-group discussion (FGD) with the women of RAP-land, on 6 February 2017, they claimed: "The fencing deters people from visiting freely; it is like our minds have developed fencing also... In the village [referring to their previous settlement] it was not a problem to borrow sugar or salt just next door".

The binary categorisation of the PAPs as deserving or non-deserving further deepened the wedge between the Maasai and non-Maasai, with the latter accusing the Maasai of unjustly locking them out of the entire process.[82] These non-Maasai persons had been classified as tenants. One of our informants – a Turkana, who came to Olkaria at the age of fourteen – has had three children whose fathers are Maasai; and having given birth to all her children in Olkaria, she felt that she deserved to partake in the resettlement process.[83] In response to such

74 They spent at least KSh 600 on transport – their daily average income is KSh 200 (FGD with tour guides, 1 October 2014).

75 FGD with women at Maasai market gorge, September 13, 2014. Also see a short fieldwork documentary on the RAP-land by EHESS (2019).

76 Field observation, 2014-2019.

77 Maasai traditional hut.

78 FGD with the PAP s 10 October 2014, at the RAP-land.

79 Comprising a living room, two bedrooms, and a kitchen.

80 He and others finally resorted to building his *manyatta* in the compound.

81 Whose second child had died shortly after being born at his home.

82 Interviews with individual non-Maasai 12 October 2014, RAP-land and FGD with the "non-deserving PAP s"; Emanyatta (June 6, 2014).

83 Interview with Narumbe; she was given KSh 300,000 ($3,000) as compensation, used the money and came back to Olkaria market to sell beads.

claims, one chairperson told us:

> *Yes, they are pastoralists like us; in fact, they are Maasai in a way, so they are part of us. We have lived together for many years, but they have land where they came from because their ancestors owned land in those places.*

The elders on the other hand are confused about whether to call themselves Maasai elders or members of the Community Advisory Council (CAC). In RAP-land, their functions have been usurped by the chairpersons,[84] who have become more powerful as a result of their roles as brokers. Specifically, discussions and negotiations have shifted from how to apportion and manage grazing and water, or whose calves access the grass banks at the *Orbatata*, to who gets the next casual employment and tenders from the geothermal industry. Reasons for conflicts also shifted from whose animals have trespassed in the communal grazing areas reserved for dry season grazing to whose sons have got employment in the geothermal industry.

6. Discussion and conclusion

According to Appadurai (2013), the major contestation for future-making is not between dreams and realities, but between dreams and other dreams – so that future-making is essentially the product of contestations between dreamscapes. This contribution engaged with this understanding of future-making in the context of the interface between state and community dreamscapes in the materialisation of large-scale geothermal energy infrastructures in Naivasha. Our study shows how state-level futures diverge from those of the communities, alluding to similar observations by Lind Okenwa, and Scoones (2020), Mukeu and Langat (2016), Fairhead, Leach, and Scoones (2012), Benjaminsen and Bryceson (2012), and other studies focusing on resource appropriation and infrastructure development in the Global South. Our findings also highlight the unbalanced interaction between state-level and community-level dreams, leading to exclusion, alienation, and in some cases conflicts at the community level. As we show, these dreams are divergent because of equally divergent futures and views of nature and resources, their appropriation and management (see also Tilly and Cameron-Daum 2017). Whilst the state views its exploitation of geothermal resources as development projects in accordance with its development visions of bringing about positive change in the nation, as a whole, these visions conflict with the infrastructure-affected community's alternative use of these resources in accordance with their views and expectations regarding socio-economic and

[84] The rest of the PAP s accuse these chairpersons of being brokers, getting richer from tenders and bribes from KenGen (field data, 2014).

cultural wellbeing.

We also show how, notwithstanding these conflicting futures, the state, using its dominant power, enables resource availability for its visions, while attempting to compensate for the loss of dreams at community levels (see also Koissaba 2018). These compensation and reparation attempts, as we show, are non-optimal, as they do not fully compensate for the socio-economic and cultural losses, especially for the relocated PAP s. The community complains that even though electricity is generated within what they consider "their" land, 90% remain without electricity, as the electricity cost for them is unaffordable.[85] The questions, therefore, remain: whose socio-economic development aspirations is prioritised, and why? Should the socio-economic livelihoods of the infrastructure-host communities be traded off for national and/or global good?

The practice of "near-forceful" dispossession of land for development projects, without sufficient regard for the socio-economic wellbeing of its occupants, as shown in our study, reflects the Kenyan state's negative perceptions of pastoral communities and pastoralism since colonial times (Cavanagh, Weldemichel, and Benjaminsen 2020; Hughes and Rogei 2020; Hazard and Adongo 2015). In Kenya, pastoralism has always been seen at the state level as a degrading practice, an unrewarding activity, and a waste of space (Hazard and Adongo, 2015). With such views, pastoral areas thus remained marginalised, susceptible to land grabbing for "development" projects (in conservation and more recently in renewable-energy infrastructures) for "general national interests". In the case of the development of Olkaria geothermal energy infrastructure in Naivasha, the Kenyan state maintains that the development of the infrastructures will put lands, which are often the subject of conflict,[86] to "better" and more profitable use.[87] They also see it as a way of "opening up" the culture of the traditional communities.

> *With the anticipation of coming of new people from varied cultures into the project area, it is projected that there will be cultural exchange which will lead to the adoption of new ways of life and shedding off of traditional ways of living that have stagnated development in the area.*[88]

85 FGD with PAP s (9th May 2018).
86 There have been several confronting and conflictual attempts by the "original owners" of these lands to evict the Maasai.
87 KenGen and GDC interviews, 2019.
88 GDC interviews, 2019.

The above stated prejudicial comment clearly perpetuates the image of Maasai, their culture, and livelihoods as backward and insinuates that they "need" to be encapsulated. In reaction to these reproaches, the infrastructure-affected community, with help of civil-society organizations, often filed complaints to the county government and other non-national local authorities. These attempts have, however, been unfruitful,[89] as the vision of the national state traverses and influences other non-national state authorities in the country. When the communities contest the development of the infrastructures, the assumption of the state is often that the locals are against the project, and thus it asserts more of its powers as the central authority and mobilises tools to quell such contestation. In contrast to this assumption, however, our findings show that the infrastructure-affected communities do not attest to being against the project – all the community members interviewed or engaged in discussion expressed pride in the fact that resources from their lands would serve the entire nation.[90] They do however contest the modalities and processes of dispossession that the development of the infrastructures have caused and their adverse effects on their livelihoods.[91]

The Environmental and Social Impact Assessment (ESIA s) reports are important instruments through which the state and its supporting international development and financial institutions attempt to ensure the application of a balanced sustainability triad in the development of such large-scale "green" infrastructures in Kenya (Nweke-Eze and Kioko 2021; Klagge et al. 2020). In the case of Olkaria geothermal infrastructure development, its ESIA reports (JICA 2015) assert that the development of the infrastructures will provide affected and host communities with immense benefits through Corporate Social Responsibility (CSR) practices, including employment opportunities, electricity and social-amenities provision, and international tourism. Our study and others,[92] however, find that these CSR practices have given rise to new forms of exclusion often within the local community itself. For instance, the provision of casual jobs has given rise to a clamour for tenders, and disputes arising from allegations of corruption in jobs allocation among community members.[93] In addition, these infrastructures are not provided with the long-term socio-economic benefits of the communities in mind. They are chiefly a necessary means for the infrastructure developers (predominantly constituting the state) to access and extract the resources. This explains why broken-down infrastructures are often not

89 Interview with 39-year-old PAP four days after resettlement, August 2014: "*The DC came and told me I could not win against the government and that if I loved my life, I should move out*".
90 Field data, 2014-2019.
91 Field data, 2014-2019.
92 For example, Hughes and Rogei, 2020.
93 Field data, 2019.

repaired, at least not promptly.[94] Furthermore, the geothermal industry requires highly skilled professionals[95] – which the local communities do not have.[96] As a result, the employment opportunities left for the local communities are intermittent, poorly remunerated and casual.[97] A culmination of these factors gives rise to the infrastructure-affected community's view of these CSR practices as an enticement to persuade them into accepting the development of the infrastructures in their community.

Overall, our analyses highlight the growing imbalance between dreamscape contestations in future-making. Our study shows that the state often superimposes its visions, while neglecting the expectations of infrastructure-affected communities in the course of future-making. Community involvement and participation in the planning of large-scale infrastructure projects is still insufficient, despite several attempts made to close this gap through the production of Environment and Social Impact Assessments (ESIAs) and the institution of laws such as the Environment Management and Coordination Act of 1999 (GoK, 2015), which require community consultations prior to and during project development. We hope that the findings of our study will improve inter-stakeholder relations understanding and inform procedures and standards for successful community engagements in the development of renewable energy projects in the peripheries.

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[94] Field data, 2014-2019.

[95] KenGen Interviews, 2019.

[96] Less than 1% employed are local Maasai (Hughes and Rogei, 2020).

[97] These are not necessarily from Olkaria – but most of them involve working as security guards. (Field data, 2018, also see Hughes and Rogei, 2020).

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Chapter 4

Financing large-scale renewable-energy projects in Kenya: Investor types, international connections, and financialization.

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Abstract

As energy transitions are progressing and economies of scale are kicking in, renewable-electricity generation begins to include, and be dominated by, large-scale operations. This shift is accompanied by far-reaching changes in the ownership and financing structures of renewable-energy projects, involving connections and (inter)dependencies between international and domestic investors and policies. With growing sizes and maturity, renewable-energy projects are also increasingly taken to capital markets and have become subject to financialization. Until recently these processes have only been observed in the Global North but not in the Global South. So far there has been little research on renewable energy financialization in the Global South, especially in Sub-Saharan Africa. In our paper we address this gap by exploring the international connections and (possible) financialization of two large-scale renewable-energy projects in Kenya. Based on case-study analyses of geothermal and wind projects in Kenya, we argue that due to their complex risk structure, public investment and support, from both domestic sources and development finance institutions (DFIs), are key to facilitate or even enable such projects. In contrast to Baker's (2015) case study on South Africa, we neither see nor expect financialization of large-scale renewable-energy projects in Kenya and most other Sub-Saharan African countries any time soon.

Keywords: Renewable energy; large-scale projects; infrastructure finance; development finance institutions (DFIs); financialization; Kenya

1. Introduction

Renewable energies, in contrast to fossil and nuclear energy, have for a long time been characterized by their decentralized organization and geography. As a result, they were mainly analyzed from a local perspective, in addition to research on their role in energy transition policies at the national level (e.g. Becker, Kunze and Vancea 2017; Ohlhorst 2015). However, with the progression of energy transitions as well as economies of scale, renewable-energy generation, particularly from wind and geothermal sources, is becoming increasingly dominated by large-scale operations (IRENA 2018). While national energy and international climate policies are important drivers for large-scale renewable-energy projects, liberalization of energy markets and new infrastructure financing models have led to an increasing role of private and international investments in renewable energies (Jamasb, Nepal and Tilisina 2015; Pollitt 2012). This is reflected in the heterogeneous ownership and financing structures of large-scale renewable-energy projects, which involves multifarious connections between domestic and international as well as between public and private investments (OECD 2015). Projects in the Global South are especially interesting, because of the significant role of international investment and specifically of development finance in such projects (Eberhard et al. 2016). The activities of international development finance institutions have been interpreted by some researchers as supporting, or acting as a catalyst for, financialization (Mawdsley 2018).

It is against this background that we explore the roles of public and private investments as well as domestic and international investments in large-scale renewable-energy projects in Kenya. We show that despite energy-market liberalization and the growing focus on private investment, public actors, policies and resources, at both the national and international level, continue to play a decisive role for the realization of these projects. Based on our analyses, we argue that investment in large-scale renewable-energy projects in Kenya is and will remain dependent on domestic government and politics as well as on international development finance. Furthermore, we argue that most private and especially institutional-investor participation in the projects is and will be deterred as a result of these dependencies, combined with the various associated risks, thereby standing in the way of imminent emergence of financialization.

As case studies, we look at two of the largest renewable-energy projects in Africa, one of them initiated by private actors (Lake Turkana wind park) and the other by the Kenyan national government (geothermal energy exploitation). Both technologies are contingent on specific geographical and geological conditions, such as extremely high wind speeds – in the case of Lake Turkana wind park (Aldwych International 2014) – and rich geothermal resources in

Kenya's Rift Valley, whose exploitation has only started (Ngugi 2012; Mangi 2017; Ogola, Davidsdottir and Fridleifsson 2012). The projects have recently been or are being newly developed, by different groups and types of investors, for electricity generation and transmission to the Kenyan national grid. They are, however, different in their ownership structure as well as in the nature of private-sector involvement. These characteristics make them a good starting point for understanding and untangling complexities in financing large-scale renewable-energy development in the Global South. It will also enable a thorough insight into possible existence of financialization processes in Kenya's renewable-energy development.

In the following sections, we first conceptually situate our case studies in research on financialization and infrastructure finance (section 2); and then after refining our empirical research questions, explain our methodology (section 3). After introducing the reader to the Kenyan context, its energy system and the case studies (section 4), we analyze their ownership and financing structures with a focus on different types of investors (section 5). We then conclude and reflect on the implications of our results for how large-scale renewable-energy projects in Kenya are shaped by international connections and local contexts (section 6).

2. Financialization and investment in infrastructure: the case of renewable energies

2.1. Financialization: fuzzy concept with national bias

Financialization refers to "the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies" (Epstein 2005, 3). It is one of the so-called "fuzzy concepts" (Markusen 2003) which have sparked lively academic debates. At the macro level, financialization refers to growing prominence of the financial sector in national economies, especially in the US and the UK. In her seminal work, Krippner defines financialization as "a pattern of accumulation in which profit-making occurs increasingly through financial channels rather than trade and commodity production" (2005, 181). At the meso and micro level, financialization refers to "the growing influence of capital markets (their products, actors, and processes) on firm and household behaviours" (Erturk et al. 2007, 556).

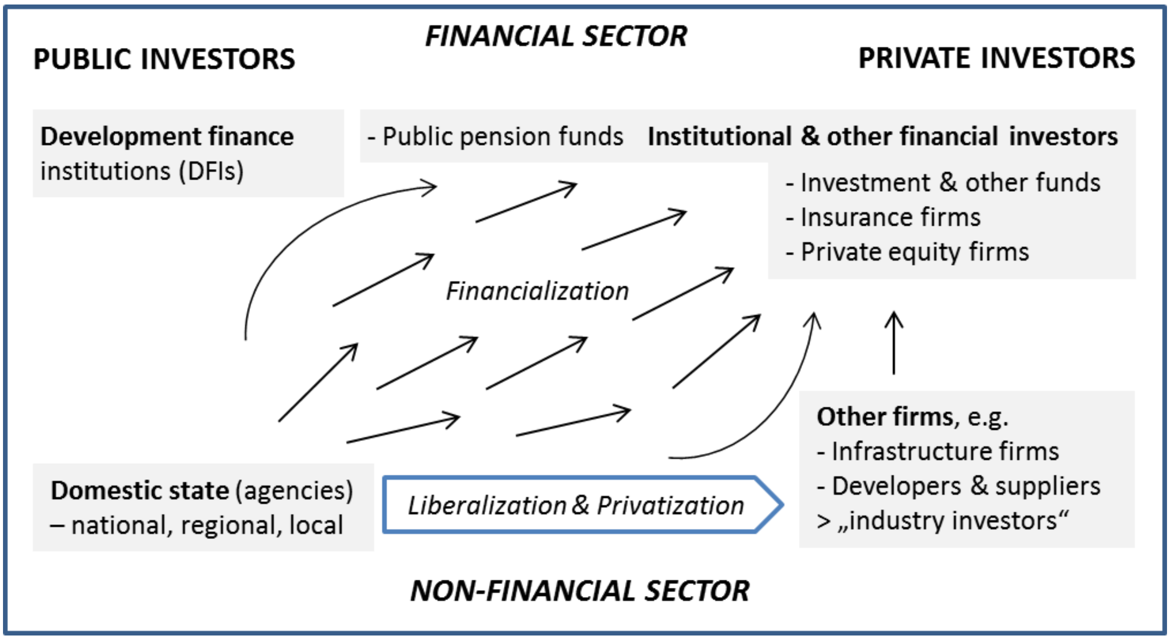
Since financialization was introduced into the academic literature, there have been debates on its merits and pitfalls as well as some empirical research which aims at corroborating financialization and its (mainly negative) effects in various contexts including infrastructures (Assa 2012; O'Brien, O'Neill and Pike 2019; O'Neill 2013). These effects include what is called "short-termism", which has become an important feature of capital market logics (Jackson and Petraki 2011; Lazonick and O'Sullivan 2000). "Short-termism" implies a focus on immediate profits and yields, often at the cost of neglecting the long-term viability of a firm or enterprise as well as its short- and long-term social and environmental implications.

A major criticism of the work on financialization includes the national bias in much of the research and discussion, i.e. the neglect of international connections (Christophers 2012 & 2015; French, Leyshon and Wainwright 2011). Furthermore, most, including critical, work on financialization deals with the structures and developments in the Global North, and only recently have developments in the Global South got some attention. Mawdsley (2018) is one of the first to discuss financialization as a research area in development geography. She sees a "deepening nexus between financial logics, instruments and actors, and intentional 'development'", which goes "beyond the more commonly referenced private-sector led development" (Mawdsley 2018, 265 & 264). Her argument is that "[f]oreign aid is being used to de-risk investment, 'escort' capital to frontier markets, and carry out the mundane work of transforming objects into assets available to speculative capital flows", thus facilitating capital market growth and thereby serving speculative financial investors' interests (Mawdsley 2018, 264). This provides an interesting take on the role of donors and development finance for infrastructure investment in the Global South.

2.2. Financialization of infrastructures

Infrastructures have been an important object in the financialization debate and developed into what is called a new or "alternative asset class" (O'Brien, O'Neill and Pike 2019; O'Neill 2013; OECD 2014; 2018). While in the past, infrastructures were mainly financed with public funds and provided through the local, regional and/or national state (including publicly-owned utilities), liberalization has opened up infrastructure for private investors and public-private partnerships (PPP) (Gurara et al. 2018; Pollitt 2012; OECD 2015). This shift, which is depicted in the bottom of Figure 1 ("liberalization and privatization"), has further been driven by fiscal crises and budget constraints at all levels of government as well as by neoliberal policy agendas and, in the Global South, structural adjustments programs. As a result, the ownership and financing structures of infrastructures have become heterogeneous, combining private investment with public funding and risk mitigation (Banerji, Bayar and Chemmanur 2018; O'Brien, O'Neill and Pike 2019).

***Figure 1**: Important types of investors and their relationship with processes of liberalization, privatization and financialization*



Source: Authors' own.

Financialization can mean different developments in this context, from making infrastructures a tradeable asset by selling shares to institutional investors or by using other capital-market instruments to ownership and/or management by large international, and often listed, infrastructure firms, which (mainly) aim at generating high profits and/or yields. Involving institutional investors or capital market instruments into infrastructure finance is seen, by its proponents, as a viable potential for providing additional funding for capital-intensive infrastructure projects, and for increasing the efficiency of infrastructure management and service (Kaminker et al. 2013; Kaminker and Stewart 2012; Sharma 2013). Critics, in contrast, point out that financialization can lead to under-investment in infrastructures and/or over-pricing of its services, due to relentless pursuit of profits, resulting in limited access to the infrastructure, exclusion and inequality (Bear 2017; Beizley 2015; Harvey 2006).

Figure 1 gives an overview of the most important public (including publicly-funded) and private types of infrastructure investors and whether they belong to the financial or non-financial sector. In this investor perspective, financialization is interpreted as the (increasing) involvement of institutional and other financial investors as capital providers. This is by no means a "linear, all-consuming, homogenizing, and unstoppable process", but rather a stepwise development leading to "complex, hybrid and messy … arrangements" (O'Brien, O'Neill and Pike 2019, 1294; also see OECD 2015). In Figure 1, this is depicted through several smaller arrows pointing towards the top right corner, that is, to "Institutional & other financial investors". Typically, liberalization and privatization are precursors of financialization, when institutional or other financial investors buy into, or provide capital for, (privatized) infrastructures. However, as has been pointed out by development researchers, development finance institutions can also support financialization by "escort[ing private financial] capital to frontier markets" (Mawdsley 2018, 264). This is especially relevant for the Global South, where development international finance institutions (DFIs) as well as other publicly-funded international investment and finance facilities (e.g. climate and other green finance) play an important role.

2.3. Role of the state and non-state investors: the challenge of risk mitigation

Despite liberalization, privatization and financialization, (domestic) state actors remain important for infrastructure development (O'Brien, O'Neill and Pike 2019). They can maintain shares or become owners of new infrastructure facilities and are often responsible for arranging international development and other supporting finance (e.g. climate finance, export credit insurance). And, last but not least, the state provides the regulatory framework through which private investors gain access to infrastructure markets and that (is supposed to) guarantee a certain scale and scope of service provision. This includes stipulations about how non-state investors are remunerated for their engagement (e.g. through guaranteed tariffs) and instruments to mitigate the risk inherent in infrastructure projects in order to make them attractive to private and international investors.

One of the most profound challenges associated with attracting and incorporating non-state capital into large-scale infrastructure provision is its complex risk structure (Baker 2015; OECD 2014; 2015). This is partly due to the long-term nature of infrastructure investment and projects, where high upfront capital expenditures are usually facing very long payback period of 20 or more years. Associated risks include legal and regulatory risks,[98] that is, when (domestic) state actors change regulation and remuneration agreements (in a worst-case scenario this can mean expropriation), as well as macro-economic risks – fluctuation of interest-rate, exchange-rate and inflation. While these risks are present throughout the project's lifetime, there are also specific risks in the construction phase (pre-completion: exploration, planning, construction and technological risks) and in the operational phase (post-completion: supply and market risk). In designing the ownership and financing structure of an infrastructure project, the different types

[98] Also referred to as political risks.

of risks need to be considered and addressed by contractual risk allocation mechanisms (for details see Banerji, Bayar and Chemmanur 2018; OECD 2014).

Project finance is the most common form of financing large-scale infrastructure projects with private participation (Banerji, Bayar and Chemmanur 2018; OECD 2014). It refers to a non-recourse or limited-recourse financial structure where repayment to capital investors is limited to profits of the projects, thus limiting the risk for equity shareholders. Generally, equity takes most of the risk, senior debt the lowest and mezzanine finance (incl. subordinate loans) is somewhere in the middle. Generally, equity makes up at least 20% in an infrastructure project and is typically provided by corporate sponsors and developers, i.e. industry investors. Accordingly, debt and mezzanine finance account for up to 80% of the total investment sum, with (syndicated) loans playing "the prominent role" (OECD 2014, 6). The contractual structure of an infrastructure project is usually through a project company – a special-purpose vehicle (SPV) – with public and/or private shareholders, banks and other financial institutions providing debt capital, insurance companies dealing with some of the (insurable) risks, contractor(s) and engineers for the construction, an operator for operation and maintenance (O&M) as well as suppliers and off-takers. The state or, more generally, public agencies can be part of the contractual agreement as shareholder, provider of debt capital, off-taker or guarantor for off-take and/or supplier (e.g. of land). In addition, the state provides licenses and concessions and possibly also investment incentives (Banerji, Bayar and Chemmanur 2018; OECD 2014).

2.4. Financialization of renewable energies?

Since the liberalization and unbundling of energy markets in the 1990s, renewable-energy infrastructures have also become subject to financialization processes (Klagge and Anz 2014). Renewable-energy projects are interesting for institutional and other financial investors because they generate steady revenue streams and (if large enough for generating economies of scale) have relatively low transaction costs. However, most financial investors are not ready to bear the huge (pre-completion) risk associated with initial (greenfield) investment in large-scale renewable projects – which is why they prefer to invest in a completed, already revenue-generating project (OECD 2018). This fits well with the preferences of developers and technology suppliers, who are often major shareholders in the construction phase and tend to sell their shares once the project is operational, in order to free-up capital for investment in new projects (Baker 2015, 154). Overall, attracting financial and other private capital to large-scale renewable-energy projects is dependent on the conditions of the risk-sharing agreements and the mix of investors in the project consortium, as well as the relevant legal and institutional conditions.

Renewable-energy projects have specifically benefitted from various legal, institutional and political changes in the context of the financial crisis and climate policies. The financial crisis in 2008 has led to a growing liquidity through central-bank interventions and decreasing yields in various traditional asset classes; this is why financial, especially institutional investors have searched for new types of assets (Inderst 2010; OECD 2014). Furthermore, the rapid development of renewable energies and supporting policies and institutions have also triggered an increasing interest of financial investors in renewable-energy projects. This is reflected in various investments by institutional investors, for example in offshore wind farms and large renewable-energy companies, but also in the development of renewable-energy indices at various stock exchanges (Klagge and Anz 2013; OECD 2015). Most of these developments have been observed in the Global North, whereas financialization of renewable energies in the Global South, and especially Africa, has not (yet) received much attention.

2.5. Renewable-energy finance in Sub-Saharan Africa

Renewable energy has a large potential in Sub-Saharan Africa (SSA) and can play an important role in achieving various social and economic development goals (Schwerhoff and Sy 2016). However, the investment environment in the SSA region is perceived by investors to be riskier than in other regions, especially with regards to legal, regulatory and market risk, but also the functioning of technology and capital markets (Eberhard et al. 2016; Klagge and Zademach 2018). These risks make the financing of renewable energies relatively more challenging in SSA (Oberholzer et al. 2018), which is reflected in the general trend of low institutional investment in infrastructure in the region (OECD 2018). Furthermore, "financing requirements of the power sector far exceed most countries' already stretched public finances", making independent power producers (IPPs) and private investment "critical to scale up generation capacity and thereby expand and improve electricity supply" (Eberhard et al. 2016, xvii). From 1990 to 2013 governments and utilities still provided more than 50% of total investment in completed power generation plants in SSA excluding South Africa,[99] but IPPs already had a share of 22%.[100] Interestingly, almost half of the IPP investment in SSA outside South Africa

[99] South Africa features more IPP projects with a higher investment sum than all other SSA countries combined (Eberhard et al. 2016, xxv). The figures include both renewable and non-renewable power generation.
[100] The remaining investment coming from China (16%) and ODA, DFI, and Arab funds (11%) (Eberhard et al. 2016, xxv).

was provided by DFIs, which emphasizes the great importance of development finance for renewable energy in Africa (Eberhard et al. 2016, xxvii).

While the majority of IPP investments in SSA used to be in thermal plants or large hydro projects, IPP investments in other grid-connected renewable energies are "gaining traction" (Eberhard et al. 2016, xxxv). In this regard, South Africa became a regional pioneer with the inception of the country's Renewable Energy Independent Power Project Procurement Programme (REIPPPP). An interesting background to our study on Kenya is Lucy Baker's exploration of the "role that different modes of finance have played in shaping South Africa's emerging renewable energy sector", in which she explicitly discusses "finance and financialization as growing features within [the South African mineral-energy complex]" (2015, 146 & 147). She finds that the ownership structures in REIPPPP projects are mostly dominated by international and domestic industry investors, whereas debt finance is much less international and mainly provided by South Africa-based institutions, as "[t]here has been minimal appetite for international banks to get involved in debt financing given the currency risk involved" (Baker 2015, 151). The role of international DFIs in South Africa is much smaller than for renewable-energy finance in other SSA countries, with some multilateral DFIs providing debt capital as co-funders "in a small number of projects, usually restricted to financing 'unproven' technology i.e. CSP" (Baker 2015, 151).[101]

Baker's findings show the heterogeneity of the ownership and financing structure of renewable-energy projects in South Africa. Even though they do not directly involve capital markets or institutional investors, Baker anticipates that international financial investors will buy into the projects after the 3-years restriction on the sale of equity is over, and that equity shareholdings "may [then] very quickly become assets that are restructured, bought, sold and repackaged in the financial markets" (2015, 154). Interestingly, Baker does not discuss donors and DFIs as drivers of renewable-energy financialization in South Africa. This contrasts with Mawdsley who, in her work on the finance-development nexus, argues that donors "are currently seeking to accelerate and deepen financialization in the name of 'development'" (2018, 264).

3. Research questions and methodology

The conceptual considerations and literature review showed that there are many open questions regarding the financing of large-scale renewable-energy projects in Sub-Saharan Africa (SSA).

[101] Baker (2015, 151) explicitly mentions the International Finance Corporation (IFC), the International Bank for Reconstruction and Development (IBRD), both part of the World Bank Group, and the European Investment Bank (EIB).

On the one hand, private and international capital is needed to expand renewable-energy generation facilities and thereby help to achieve various social and economic development goals. On the other hand, there is concern that the engagement by financial investors other than banks, including DFIs, might lead to financialization with various negative implications. It has also become clear that the national state plays an important role, not only by providing and shaping the institutional context, but also as provider and arranger of risk mitigation and as a co-investor.

Tackling these issues requires detailed analyses, for which the necessary data is not readily available. To broaden knowledge on the international connections and financialization of renewable energy in SSA, we provide in the following in-depth analyses of the ownership and financing structures of two landmark developments in the Kenyan renewable energy sector: the Lake Turkana Wind Power project (LTWP) and recent geothermal developments. The empirical research questions are as follows:

- Who are the owners and investors in these projects, and how do they finance the projects (equity, debt)? What are the roles of different types of investors?
- What is the balance between domestic and international, public and private, and financial and non-financial investors?
- What are the challenges of risk mitigation, and what types of risk mitigation approaches and instruments are built into the ownership and financing structure?

To answer these questions, we have, in addition to a thorough literature and newspaper-articles reviews, conducted interviews with key experts involved in geothermal and wind energy development in Kenya. The interviewees work at different levels of government[102] (MoE[103], County Commissioners, County Government representatives), in energy-related and other state agencies (ERC, GDC, KenGen, NLC)[104], in development finance institutions (AFD, AfDB, EIB, KfW, TDB, USAID)[105], in private firms (Tetra-Tech, GeoHydro Energy Consultants Limited) and in an energy research institute (GETRI)[106]. In addition, we have analyzed relevant investment and policy documents and conducted site visits in both Menengai and Baringo-Silali geothermal fields. As some of the interviews were granted on the condition of anonymity, we

[102] National, local and, since 2013, county levels, following the devolution of government functions in Kenya (Hope 2014).
[103] Ministry of Energy.
[104] Energy Regulatory Commission, Geothermal Development Company, Kenya Electricity Generating Company, National Land Commission.
[105] Agence Française de Développement, African Development Bank, European Investment Bank, Kreditanstalt für Wiederaufbau, Trade and Development Bank, United States Agency for International Development
[106] Geothermal Energy Research and Training Institute.

do not provide further details on the interviewees. Based on cross-checking and triangulating the statements from different interviews and sources, we only present findings which are plausible and coherent or, otherwise, indicate that there is contradictory evidence.

4. The Kenyan context and the case studies

Kenya has a population of approximately 50 million and is among the largest economies in Sub-Saharan Africa with a continuously growing GDP, both in absolute terms and per capita (WBG 2019). The Kenyan government aspires to become a middle-income country by 2030 – a goal envisioned and elaborated in its Kenyan Vision 2030 document. As part of this vision, the Kenyan government plans, and in some cases has already started, massive investments in its infrastructures (roads, railways, seaport, airports, pipe-borne water, information and communication technology) as the driver of ambitious economic development plans (GoK 2007, 8 & 4). This includes the transnational Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET) which aims to develop the previously marginalized areas in Northern Kenya (Fig. 2; Browne 2015; Greiner 2016). To finance these and other infrastructures, the government of Kenya started launching infrastructure bonds in 2009 with terms of maturity of 12 to 25 years. These bonds are tax-free with relatively high coupon rates (mostly above 10%) and thus attractive to both international buyers and domestic (incl. small) investors. From financial year 2008/09 to 2017/18, the Kenyan government has issued 13 infrastructure bonds with a total worth of Ksh 413 billion, and with a total outstanding stock of Ksh 303 billion by mid-2018 – as some of the bonds were amortized (GoK 2018). These government-issued infrastructure bonds have added to the country's growing public debt,[107] which has risen from around 40% in 2008 to more than 55% of GDP in mid-2018, thereby reaching "dangerous levels" according to some observers (CBK 2018; Kodongo 2018; Ngugi 2018).[108]

Given the importance of electricity for achieving the stipulated economic development goals by 2030, the Government of Kenya has targeted to reach universal access to electricity by 2020 (GoK 2007). The percentage of electrified households already increased from 18% to 65% between 2010 and 2016 as a result of newly-developed power plants and grid extensions (IEA 2017, 114). While Kenya's total installed grid-connected capacity stood at 2300 MW in 2015, it would take an additional 2700 MW in order to stand a chance in fulfilling its planned universal electricity access by 2020 (Eberhard et al. 2016, 101; USAID 2015) To achieve this goal, the

[107] Albeit, not substantially – as total outstanding infrastructure bond debt accounts for only 6% of total outstanding debt by mid-2018 (calculated from GoK 2018).
[108] Higher than IMF recommended 40% ratio of public debt to GDP.

government plans to continue regulatory and utility reforms in order to usher in private investors and increase private-sector participation (GoK 2007, 8). To better understand the development of large-scale renewable-energy projects in Kenya, the following sections provide some background on Kenya's electricity sector (4.1) as well as on the physical and institutional conditions of geothermal energy projects (4.2) and the LTWP (4.3).

4.1. Kenya's electricity sector and support for the development of renewable energies

The electricity mix in Kenya has always been dominated by renewable energies, contributing more than 75% of electricity generation to the national grid (Kiplagat, Wang and Li 2011). However, while in the past hydropower projects made up the bulk of such projects and were the most important baseload provider, in 2014 geothermal has surpassed hydropower in terms of power production, accounting for 51% (geothermal) and 38% (hydropower) respectively (Eberhard et al. 2016, 107).

While there are relatively few opportunities for new hydropower projects and existing plants increasingly suffer from droughts, the government has identified geothermal power as the "least cost source of energy", which can "become a preferred contributor of baseload power" (Kiplagat, Wang and Li 2011, 2969 & 2971). Furthermore, the government plans to develop a coal-fired power plant in Lamu County (AfDB 2016; Amu Power 2016; Browne 2015) as well as nuclear plants – although plans for the first are currently being reviewed, while plans for the latter have been deferred to 2036 as a result of government's current priority on renewable-energy projects (Alushula 2018; ERC, MoE interviews 2019). As an additional renewable-energy source, wind has also attracted some attention, and there are several wind projects operational or in development, most famously the Lake Turkana Wind Park (which we cover here). The development of geothermal and especially wind energies are still relatively new in the Sub-Saharan African context, and Kenya is one of the few countries in the region where both energy sources are exploited on a large scale (IEA 2014, Suberu et al. 2013).

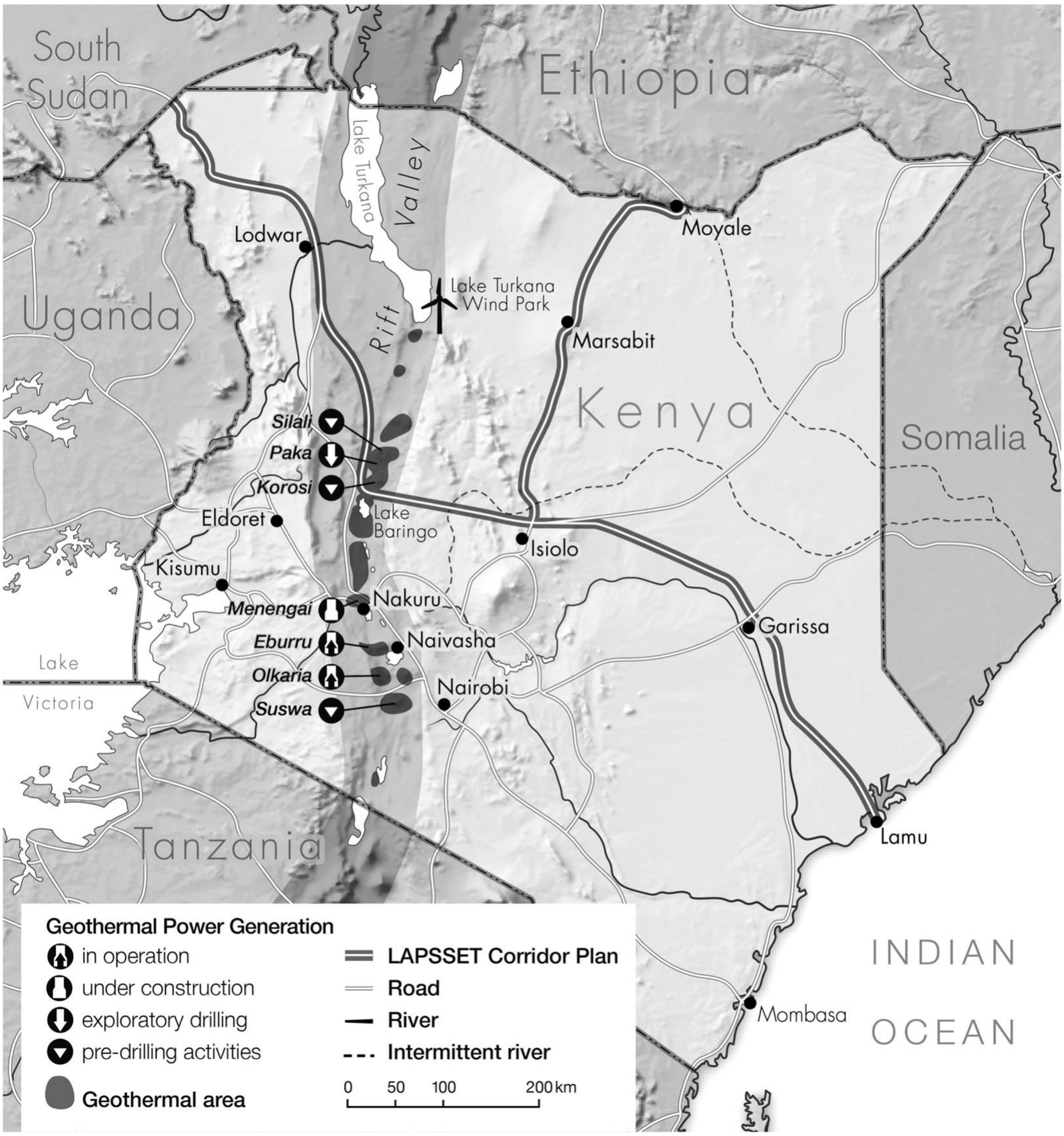
The high upfront financing requirements of large-scale renewable-energy projects far exceed Kenya's public finances, which is why donor and private-sector participation, both from international and domestic sources, are actively solicited through the implementation of supporting policies and frameworks (Eberhard et al. 2016). The necessary institutional conditions have been established since the mid-1990s when Kenya's government started, under the influence of the World Bank, to restructure and liberalize its energy sector (Eberhard et al. 2016). This "neoliberal energy transition" (Newell and Phillips 2016, 39) resulted in the current hybrid market structure of the Kenyan energy system. Whereas the Kenyan electricity system is still dominated by publicly-owned or -dominated companies such as KenGen (electricity generation) and KPLC (transmission & distribution), private investment and investors are playing an increasingly large role (Eberhard et al. 2016; Kiplagat, Wang and Li 2011; KenGen interview 2019), mainly as independent power producers (IPPs).

The main incentive for private-sector investment in renewable energy in Kenya are feed-in-tariffs (FITs), i.e. the guarantee to off-take the generated electricity at a fixed price per kWh for 20 years (GoK 2012). Furthermore, to fast-track the exploitation of geothermal energy, in 2004 the government of Kenya incorporated the Geothermal Development Corporation (GDC) as a SPV, with the aim of realizing a capacity of 5,000 MW by the year 2030. The establishment of this parastatal is due to the fact that geothermal energy entails high exploration risk which is specific to this technology; it includes the risks of high and hard-to-calculate drilling costs and of not hitting steam or less capacity than anticipated (GDC, MoE interviews 2019). Supported by foreign donors and development partners, GDC covers the very high upfront costs for drilling and assessment of geothermal resources and, together with other state agencies and international development partners, for establishing the necessary ancillary infrastructures (roads, water provision etc.). Furthermore, GDC deals with legal issues concerning land (access) rights and Environmental and Social Impact Assessment (ESIA) Licenses, and establishes community-engagement frameworks, all of which has the potential of causing conflict and thus pose risks to the realization of geothermal projects (Mariita 2002; GDC, NLC interviews 2019). Eventually, in case of sufficient resource potential, GDC sells the generated steam or the established plants to KenGen or to (private) IPPs, which are then responsible for building power plants for electricity generation and/or direct (e.g. industrial) usage of steam (Kiplagat, Wang and Li 2011).

4.2. Geothermal electricity generation in Kenya

Exploration of geothermal energy in Kenya started in the 1950s with the first grid-electricity generation commissioned in 1981 by KenGen (Mangi 2017; KenGen interview 2019). So far, Olkaria and Eburru are the only geothermal fields that generate electricity for the grid (Mangi 2017; Omenda and Simiyu 2015). While the small wellhead generator at Eburru is owned by KenGen, the power plants in Olkaria are owned by KenGen and Orpower4 (an IPP) as well as Oserian, an IPP which developed the power plants for its private use in flower farms (Mangi 2017; Omenda and Simiyu 2015, KenGen interview 2019). As of 2017, total geothermal energy-generation capacity in Kenya stands at 657MW, of which 78% are owned by KenGen and 22% are privately owned (calculated from Mangi 2017).

Figure 2. *Map of Kenya showing the Lake Turkana Wind Power project (LTWP), geothermal power generation areas and the planned LAPSSET corridor*



Source: Authors' illustration based on Browne 2015; Mangi 2017; Interview information 2019.

In addition to the already operational geothermal sites, the Rift Valley provides vast further potential for the exploitation of geothermal energy, estimated at 7,000 MW in total (Mangi 2017; Ngugi 2012; Omenda 2014). In most of these sites only surface exploration has taken place, whereas Menengai and the Baringo-Silali Block – the sites with the highest estimated resource potentials (GDC 2011; Mangi 2017) – are more advanced with exploratory drilling. Other recent geothermal developments include the expansion of existing power units in Olkaria and surface studies in Suswa as well as some private initiatives (GDC 2011; Mangi 2017; Nchoe 2018). As the financing of these developments is not documented in detail, the following analyses concentrates on Menengai and Baringo-Silali, the latter containing the three sites Korosi, Paka, and Silali.

4.3. Lake Turkana Wind Power development (LTWP)

In addition to its geothermal resources, Kenya also has large wind resources, especially in the marginal and the arid Northern parts of the country. This is where Lake Turkana Wind Park was developed by an international consortium of private and public firms and institutions, called the Lake Turkana Wind Power (LTWP) Limited, starting in 2006. After a development phase of 8 years the project reached financial close in December 2014. The construction of the wind farm started in January 2015 and was completed in mid-2017 (Schilling, Locham and Scheffran 2018, 1); however, because of delays in the construction of the transmission line the park only started feeding electricity in to the national grid in late 2018 (Kamau 2018). Turbines were provided by Danish manufacturer Vestas, and Vestas was also tasked with the supply and maintenance for the initial 10 years after the project was commissioned (Jørgensen 2016; PT 2019; KP&P Africa website as of April 27, 2019). With 365 turbines and a generation capacity of 310 MW, LTWP is the largest single wind park in Africa – and the largest private investment in Kenya’s history at that time (LTWP 2014).

The Kenyan government was neither part of the consortium nor among the lenders; however, besides the pre-negotiated power-purchase agreement (PPA), it constructed the more-than-400 km transmission line which connects the project to the national grid (AfDB 2013; AfDB, ERC, MoE interviews 2019). The World Bank was also involved but withdrew its risk guarantee commitment in 2012 because of its concerns over over-generation of electricity in relation to short-term demand and consumption, and was rather in favour of a phased development of the project (Dodd 2012). Additionally, there were criticisms regarding negative social and environmental impacts, land (use) conflicts and the consideration of local-communities’ interest (Danwatch 2016; Enns 2016; Schilling, Locham and Scheffran 2018). These, however, did not stop the project, but rather triggered an intensification of Corporate Social Responsibility (CSR) activities (County Commissioners and County Government representatives interviews 2019). It is against this background, that the project presents itself as a Vision 2030 flagship project and “transformative … in terms of the development impact to the Northern arid areas of Kenya, the electricity sector, and to Kenya as a whole” (LTWP 2014).

Overall, Lake Turkana Wind Power Project (LTWP) is an example of a predominantly foreign-driven and privately financed large-scale renewable-energy project – in contrast to geothermal exploration and development led by state-owned GDC. However, both large-scale renewable-energy projects are part of the development plan for Northern Kenya and have made Kenya a pioneer in developing large-scale renewable energies in Sub-Saharan Africa, which has attracted worldwide attention. To what extent the projects have attracted capital from private, international and financial investors is examined in greater detail in the next section.

5. Case-study analyses

This section presents, analyses and discusses the ownership and financing structures of the LTWP project and recent geothermal energy projects in Menengai and Baringo-Silali. They both have large planned (or actualized, in the case of LTWP) plant capacities – 310 MW for LTWP and 465[109] MW for Menengai, whereas Baringo-Silali is still in the explorative drilling stage. All are being newly developed, by different groups and types of investors, for electricity generation and transmission to the Kenyan national grid. The projects are, however, different in their ownership structure as well as in the nature of private-sector involvement. In the following we first give overviews of the ownership and financing structures of Menengai and Baringo-Silali (5.1) and LTWP (5.2) and then analyze the different types of major investors and their respective roles (5.3-5.5) and finally the challenges of risk mitigation in Kenya's large-scale renewable-energy projects (5.6).

5.1. Menengai and Baringo-Silali ownership and financing structures

Menengai, located in the north of Nakuru, is the most advanced new geothermal development and has an estimated potential of 1600 MW (Mwangi 2017). Exploratory drilling began in 2010, leading to steam discovering in 2011 (GDC 2011). Assessment, exploration and drilling for Phase 1 was financed by GDC together with loans from several development finance institutions as well as a combined loan and grant from the Scale-up Renewable Energy Program (SREP) (Table 1).

[109] This figure includes the envisaged five phases, of which only Phase I (with three power plants of 35MW capacity each) has started so far and is covered here.

Table 1: Capital investment and grants in the Menengai geothermal project Phase 1: name and type of capital/grant providers, country of origin, sum and type of invested capital (only assessment, exploration and drilling, that is excluding IPP investment).

TOTAL (equity, debt, grant)			**$ 518.1m**	**Remarks**
EQUITY			**$ 284m**	**55%**
GDC	Govern.	KE	$ 284m	
DEBT			**$ 216.6m**	**42%**
African Development Bank (AfDB)	Dev. Fin.	Afr.	$ 120m	Plus loan and grant for SREP (see below)
Agence Française de Développent (AFD)	Dev. Fin.	FR	$ 70m	For buying drilling equipment (incl. 2 rigs)
European Investment Bank (EIB)	Dev. Fin.	EU	$ 13.5m	
World Bank	Dev. Fin.	Int.	$ 2m	
U.S. Agency for International Development (USAID)	Dev. Fin.	US	$ 3m	For exploring direct use applications
U.S. Trade and Development Agency (USTDA)	Dev. Fin.	US	$ 0.6m	
Public-Private Infrastructure Advisory Facility (PPIAF)[110]	Dev. Fin.	Int.	$ 0.044m	Assessment of GDC for Enhanced Access to Finance
Scale-up Renewable Energy Program (SREP) Loan through AfDB	Green Fin.	Int.	$ 7.5m	
GRANT			**$ 17.5m**	**3%**
SREP Grant through AfDB	Green Fin.	Int.	$ 17.5m	

Explanations: Afr. = African; Dev. Fin. = Development Finance Institution (DFI); EU = European (Union); FR = French; Govern. = Government of Kenya; Green Fin. = Climate or Renewable-energy finance instrument; Int. = International (multilateral); KE = Kenyan; US = US-American

Sources: *AfDB (2011, 2018); Information provided in interviews with AfDB, AFD, GDC, GETRI and USAID experts (all 2019).*

Following discovery of steam, three independent power producers were selected through competitive bidding and charged to build, own and operate three power plants with a total capacity of 105MW (AfDB 2018; Richter 2018a). The steam will be provided by GDC within the so-called Project Implementation and Steam Supply Agreement (PISSA) framework of

[110] PPIAF is a multi-donor technical assistance facility, supported by the World Bank (PPIAF website as of April 29, 2019: https://ppiaf.org/activity/kenya-assessment-geothermal-development-company-gdc-enhanced-access-finance

2014. The three IPPs are: Quantum Power East Africa GT Menengai Ltd, Orpower22 (a consortium of Ormat, Civicon and Symbion), both mainly originating in the US, and the Kenyan Sosian Menengai Geothermal Power Limited (SMGPL) (AfDB 2018; Richter 2018a). All the three IPPs have started seeking for debt financing (AfDB, TDB, EIB interviews 2019).

Farther north, the Baringo-Silali Block has a combined estimated potential of 3000 MW (Richter 2018b; Mwangi 2017). Whereas the Menengai project is located close to a larger city (Nakuru), the Baringo-Silali Block lies in a remote area inhabited mainly by pastoralists and agro-pastoralists (Greiner 2017; Ogola, Davidsdottir and Fridleifsson 2012). To allow geothermal exploration and drilling, various ancillary infrastructures had to be constructed first, including roads, water pipelines and treatment plants. Drilling started after establishing a road network of more than 100 km and the water infrastructure for drilling and for providing drinking water to people and their cattle. In December 2018, the first rig was transported to Paka from the Menengai project and exploratory drilling in the Baringo-Silali Block started (GDC 2019). Financing for all these activities and infrastructures (except for the roads)[111] was provided by GDC, co-financed with a large loan from the German development finance institution KfW and additionally supported by the African Union Commission (AUC) through the Geothermal Risk Mitigation Facility (GRMF) (see Table 2).

Table 2: *Capital investment and grants in the Baringo-Silali geothermal project (assessment, exploration and drilling; ongoing operation): name and type of capital/grant providers, country of origin, sum and type of invested capital, as of April 2019 (financing not completed).*

Equity	GDC	Govern.	KE	€ 17.4m
Debt (concessional loan)	German Development Agency (KfW)	Dev. Fin.	DE	€ 80m
Grant	African Union Commission (AUC) through the Geothermal Risk Mitigation Facility (GRMF)	Green Fin.	Afr.	$ 17.3m

Explanations: see Table 1

Sources*: Abdallah (2018); Kangethe (2019); Mangi (2017); Information provided in interview with KfW expert (2019).*

5.2. LTWP ownership and financing structure

Lake Turkana Wind Park was initiated in 2006 as an unsolicited bid by Kemperman Paardekooper & Partners Africa (KP&P Africa) – a consortium of Dutch and Kenyan businessmen (KP&P Africa website as of April 28, 2019). In 2010, Aldwych Turkana Limited

[111] The roads were built and financed by the Kenyan government (GDC, KfW interviews 2019).

– a subsidiary of Aldwych International, an experienced African power development company registered in England and Wales – joined KP&P Africa as co-developer with the mandate of overseeing the construction and operations of the power plant on behalf of LTWP (KP&P Africa website and Aldwych International website as of April 28, 2019). In the following year, 2011, the consortium negotiated a power-purchase agreement (PPA) with KPLC (Eberhard et al. 2016, 113). In the same year world-leading Danish turbine producer Vestas,[112] the Danish Investment Fund for Developing Countries (IFU) and the Norwegian Investment Fund for Developing Countries (Norfund), both government-established DFIs, became equity shareholders in the project. In 2013, another Scandinavian DFI, the Finnish Fund for Industrial Cooperation Ltd (Finnfund), and Sandpiper Ltd, a Geothermal Information System (GIS) company incorporated in Kenya, joined the consortium. The total equity finance was estimated at €125 million (Table 3).

Table 3: *Capital investment in the Lake Turkana Wind Power (LTWP) project (completed): name and type of investors, country of origin, sum and type of invested capital*

TOTAL (Equity, debt)			**€ 623m**	**Remarks**
EQUITY			**€ 125m**	**20%**
KP&P Africa B.V.	Proj. Dev.	NL	€ 31m	
Aldwych Turkana Limited	Proj. Dev.	UK	€ 38m	
Vestas Eastern Africa Ltd.	Turb. Prod.	DK	€16m	acquired by Google in 2017
IFU-Danish Development Bank	Dev. Fin.	DK	€ 7.5m	
Norfund	Dev. Fin.	NO	€ 16m	
Finnfund	Dev. Fin.	FI	€ 16m	
Sandpiper	GIS firm	KE	€ 0.5m	
DEBT incl. mezzanine finance: *subordinate debt and **equity financial instrument, all other senior debt			**€ 498m**	**80%**
African Development Bank (AfDB)	Dev. Fin.	Afr	€ 115m *€ 2m	plus € 20m for EKF (see below);
European Investment Bank (EIB)	Dev. Fin.	EU	€ 100m	plus € 100m for EKF (see below)
Eksport Kredit Fonden of Denmark (EKF)	Exp. Cred. Bank	DK	€ 120m	€ 100m via EIB, € 20m via AfDB
Netherlands Development Finance Company (FMO)	Dev. Fin.	NL	€ 35m	
EU Africa Infrastructure Trust Fund (EU-AITF)	Dev. Fin.	EU	**€ 25m	investor's website calls this a grant [a]
PROPARCO	Dev. Fin.	FR	€ 20m	investor's website announced € 50m[b]
The Trade and Development Bank (TDB), formerly the PTA Bank	Dev. Fin.	Afr.	€ 10m *€ 10m	

[112] through its subsidiary Vestas Eastern Africa Ltd.

DEG	Dev. Fin.	DE	*€ 20m	
East African Development Bank (EADB)	Dev. Fin.	Afr.	*€ 5m	
Interact Climate Change Facility (ICCF)	Green Fin.	EU	€ 30m	
Triodos Bank	Priv. Bank	NL	€ 6m	Sustainability Bank

Explanations: Afr. = African; DE = German; Dev. Fin. = Development Finance Institution (DFI); DK = Danish; EU = European (Union); Exp. Cred. Bank = Export Credit Bank; FI = Finnish; FR = French; GIS = geographical information system firm; Govern. = Government of Kenya; Green Fin. = Climate or Renewable-energy finance instrument; KE = Kenyan; NL = Dutch; NO = Norwegian; Priv. Bank = Private Bank; Proj. Dev. = Project Developer; Turb. Prod. = Turbine producer; UK = British; US = US-American

[a] EU-AITF website as of April 27, 2019 (http://www.eu-africa-infrastructure-tf.net/activities/grants/lake-turkana-.htm)

[b] Proparco website as of April 27, 2019 (https://www.proparco.fr/en/lake-turkana-2013)

Sources: *Aldwych (2014); LTWP (2014); PFI (2015); Vestas WS (2015); Ecoreporter 2015 & 2017; Investor webpages; Information provided in interviews with AfDB, EIB and TDB experts (all 2019).*

The project's debt raising and arrangement was led by the African Development Bank (AfDB) together with the Standard Bank of South Africa and Nedbank Limited as co-arrangers. Debt funding was provided by various development banks, institutions and facilities (LTWP 2014). After the withdrawal of the World Bank in 2012 (see 4.3), the AfDB played an even greater role in building investor confidence on mitigation of environmental and governance risks (AfDB 2013; AfDB interview 2019). The prominent role of the AfDB as well as various development organizations was not only related to the project's energy-related benefits,[113] but also justified with the positive impact on local labor markets during construction and the "upgrade [of] the rural road network, significantly improving access to markets and business opportunities for the local communities, thus catalyzing additional jobs and income-generation opportunities in this poor and remote area" (AfDB 2013). Additional benefits were expected from the project's Corporate Social Responsibility (CSR) program which supported investments in local health, drinking water and school facilities (AfDB 2013; Aldwych International 2014; County Commissioners and County Government representatives interviews 2019).

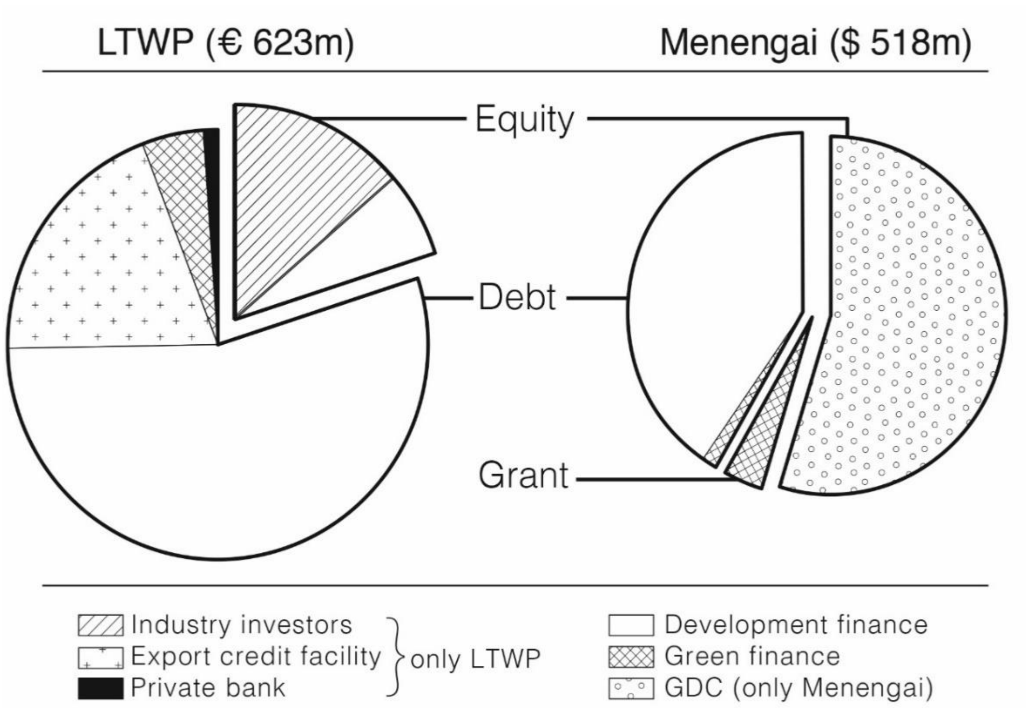
5.3. Equity-debt ratio and the enabling role of the national state

In the financing mix of renewable-energy projects, equity takes most of the risk, senior debt the lowest and mezzanine finance (incl. subordinate loans) is somewhere in the middle. The equity-debt ratio can therefore be interpreted as a signifier of how risky a project is perceived by potential investors. Whereas LTWP exhibits an equity share of only 20%, the percentage in the

[113] energy diversification and access to clean energy.

Menengai (Phase 1) assessment, exploration and drilling activities is well above 50% (Figure 3), which can be explained by the great risk associated with geothermal energy exploration. The so-far relatively low equity share – and overall capital – in Baringo-Silali (Table 2) is related to the early stage of exploration and to the fact that the drilling rigs are not newly acquired, but taken and transported from Menengai, after drilling for Phase 1 was completed. The different risk structures are also reflected in the specific roles of the (national) state in both projects.

Figure 3: *Shares of equity, debt and grant financings of the Lake Turkana Wind Power project (LTWP) and Menengai geothermal project (Phase 1; assessment, exploration and drilling)*



Source: Authors' illustration based on Tables 1 and 2

Whereas LTWP does not involve direct state investment (Table 3), in Menengai and Baringo-Silali geothermal projects, the Kenyan national state, through GDC, is the initiator and, so far, only equity investor (Tables 1 and 2). GDC, together with DFIs, absorbs most of the exploration risk before (private) IPPs will build, own and operate power plants (see 5.1). The IPPs will benefit from feed-in-tariffs for renewable energies in Kenya and associated power-purchase agreements with KPLC. In the LTWP project case, the state's involvement also included providing incentives in form of feed-in-tariffs (FITs) and by taking the responsibility of constructing the required circa 400km high-voltage transmission line for off-take of generated electricity. Overall, in both cases, the national state has played an important and enabling role, and without its support none of the projects would have materialized.

5.4. *Private-sector investment predominantly provided as equity by industry investors*

Private-sector participation in infrastructure development in the Global South is increasingly encouraged, and like in the Global North, often materialized through public-private partnerships (see 2.2). This is also true for LTWP and geothermal development, albeit in very different forms. In LTWP, private companies are the initiators and main owners of the plant (68% of equity). In contrast, in the Menengai project, and very likely also in Baringo-Silali, private firms are only becoming involved as equity investors after exploration was successful and steam has been discovered as IPPs who are selected in competitive bidding processes.

In the case of LTWP project, the four private companies involved in the initial project consortium are industry investors who also took other roles in project development: project managers (KP&P, Aldwych), turbine producer and maintenance services (Vestas)[114] and GIS services (Sandpiper). Apart from Sandpiper, which is incorporated in Kenya, these firms are international from the Netherlands, UK and Scandinavia. In debt financing, the only private capital provider is the Dutch Triodos Bank, which contributed a relatively small amount of debt capital and presents itself as a "leading expert in sustainable banking … [with] the mission … to make money work for positive change" (Triodos website as of February 27, 2019).

With private investment predominantly coming from industry investors, the assets in the two cases studies are neither tradable nor are they owned by large institutional investors or financialized firms. To further explore the relevance of financialization in our case studies, we now turn to the role of DFIs and other international support facilities.

5.5. *The large role of development finance and international public funding*

Development institutions are increasingly being structured into development financial institutions (DFI) which provide development assistance to the Global South with the usage of broader financial instruments (Mawdsley 2018). Furthermore, several international climate- and renewable-energy related green-finance facilities are increasingly complementing state government and DFI roles in providing investment incentives and mitigating risks for private investors. In addition to their – often relatively small – financial contribution, these facilities serve as proof of sustainability of the projects and thus not only mitigate risk, but also provide legitimacy for private and international investors to come into the project. Together with DFIs,

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[114] Meanwhile, after completion of the wind park in 2017, another industry investor, the US internet firm Google, has acquired Vestas' 13% share to provide its server farms with green power, thereby relying on an existing business relationship between Vestas and Google (Ecoreporter 2015 & 2017).

these facilities have therefore become a relevant financing source for large-scale renewable-energy projects. This is also true for our case studies.

DFIs are the by far most important debt capital providers and, in the case of LTWP, also important equity investors, thereby mitigating risk for private investors and supporting renewable-energy development. The equity financing for LTWP involves financing from three Scandinavian DFIs, providing almost a third of total equity. DFIs play an even larger role in LTWP debt financing, both in absolute and relative terms, accounting for 70% of debt financing (Tab. 3). Whereas DFI equity investment comes only from Scandinavian countries, DFI debt financing is more heterogeneous, originating also from several other European as well as African sources – with the African Development Bank as the lead arranger of financing and an important capital provider.

The DFI debt financing structure of LTWP matches, to some extent, that of its project consortium (equity), which has both European and African origins. The Danish and Dutch involvements present especially interesting matches and point to the use of international public funding for supporting (private) industry investors from the same country and thus facilitating export of their products and technologies in the process of delivering 'development'. To illustrate: Vestas, a Danish turbine producer charged with the supply and maintenance of the wind turbines, invests together with a Danish DFI in the LTWP equity consortium. They are supported by a large loan from the Danish Export Credit Bank (EKF), which absorbs some of the financial and political risks of exporting Danish products to other countries. Similarly, the LTWP project initiator KP&P B.V is a Dutch private company, while there is also debt financing from a Dutch DFI and even a private Dutch bank (Triodos). Together Danish and Dutch investors – including private investors and the Danish export bank – account for 44% of equity and almost a third of LTWP debt financing, all resulting to a share of 35% of total capital.[115]

In Menengai and Baringo-Silali, where start-up equity financing heavily depended on state-owned GDC, we did not find any obvious connections between DFIs and other project participants. In contrast to LTWP, DFIs are only involved in debt financing and include African, European and US-American institutions as well as the World Bank. Whereas in Menengai the African Development Bank and French AFD are the largest debt capital providers and account for more than 80% of debt capital, in Baringo-Silali German KfW is, together with the

[115] This does not include the two countries' "share" in EU debt funding sources (EIB, EU-AITF and ICCF), which accounts for 25% of total capital.

Geothermal Risk Mitigation Facility (GRMF), the only debt capital provider so far (Tables 1 and 2).

In sum, debt financing in our case studies is heavily dependent on DFIs. They are complemented by other publicly-funded international facilities, including export bank credit and climate- and renewable-energy-related instruments and schemes, albeit with relatively small shares. In comparison with international public funds, private debt capital plays no or only a very minor role. There is no evidence, yet, that DFIs or other international public funding agencies function as a vehicle for “transforming objects [here: our case study projects] into assets available to speculative capital flows”, as posited by Mawdsley (2018, 264). However, at least in the case of LTWP, there is evidence that they serve the interests of private firms from the same country and mitigate their risk. Furthermore, they also pursue their own institutional interests and, according to our interview partners, not only collaborate in the development of large-scale renewable-energy projects, but also compete for participation, for the sake of “pitching their flags” in “worthy” projects (AfDB, EIB, KfW, TDB interviews 2019).

5.6. Risk mitigation challenges in Kenya’s large-scale renewable-energy projects

The fact that the majority of investment capital comes from public sources is related to the relatively cumbersome risk involved in large-scale renewable-energy projects in Kenya. For, in addition to the risks associated with the long-term nature of these infrastructure projects, there are other pre- and post-completion risks which are peculiar to the Kenyan – and more generally the Sub-Saharan African – context. Pre-completion risks, on the one hand, include legal and regulatory issues (land rights, environment and social impact assessment) and are also related to implementing and developing relatively young technologies in the Kenyan context, where success cannot be guaranteed (Mariita 2002; GDC, NLC interviews 2019). In the case of geothermal energy projects, assessment, exploration and drilling pose a technology-specific risk and at the same time require large amounts of capital (GDC, MoE interviews 2019). The Kenyan government established GDC to take over these risks and costs specific to geothermal development, and KETRACO to construct the required new transmission lines which connect the new projects to the national grid (Eberhard et al. 2016; GDC GeoHydro Consulting, MoE interviews 2019). Both state agencies are supported by large amounts of international development and renewable-energy or climate finance (AFD, KfW, MoE, Tetra Tech, USAID interviews 2019).

Post-completion risks, on the other hand, are associated with the functioning of the Kenyan electricity market and its institutions. The payment of FITs and honoring PPAs and other contracts is not a completely assured condition, and there is still room for improvement in the provision of a reliable and institutionally sound investment environment in the country. And while the expansion of electricity generation has been successfully pursued, the continuation of these efforts poses some challenges. Our interviewees pointed out that electricity supply is already exceeding demand, because various development projects (e.g. LAPSSET corridor, expansion and electrification of Standard Guage Railway (SGR), the new standard-gauge railway) are delayed (AFD, AfDB, MoE interviews 2019). This could lead to higher tariffs which impede the desired industrial development, unless this is countered by injecting (additional) public money into the electricity sector. Furthermore, the current unsustainable public-debt-to-GDP ratio in Kenya, in addition to the complicated and bureaucratic government processes in closing contracts, increase private investors' wariness (Kodongo 2018; MoE interview 2019).

Interestingly, from our expert interviews, most of the developers, financiers and policy makers did not regard the risks associated with environmental and social impact assessments (ESIAs), land (rights), labor, permits, local acceptance and support as a major impediment to investment or development. While they saw community participation and benefit sharing as a great challenge in large-scale renewable-energy development, especially in Kenya's arid north, they were generally (optimistically) regarded as manageable through the following: compensation schemes (where applicable), local engagement and hiring policies as well as corporate social responsibility (CSR) measures (EIB, ERC, GDC, KenGen, KfW, MoE, TDB interviews 2019). All of these local engagement activities have been applied in the case-study projects and are important factors and (in most cases), a prerequisite for engagement of DFIs and other international investors. However, their success(ful implementation) is not guaranteed, particularly in the Northern arid areas of Kenya – which are inhabited by pastoralists and agro-pastoralists with a long history of violence (Greiner 2016, Schilling, Locham and Scheffran 2018; Ogola, Davidsdottir and Fridleifsson 2012). Furthermore, in the several informal interviews we conducted during our site visits, we learnt that there exist various uncertainties resulting from recent changes in land laws, the devolution of government functions in 2013, as well as resistances and conflicts associated with transformation of local livelihoods.

6. Conclusion

From the analyses we learn that the financing of the LTWP and the analyzed geothermal projects involves a mix of investors with a strong role of public investment, especially from the Kenyan state (as equity provider in geothermal projects) and development finance institutions.

The latter provide equity (in LTWP) as well as the vast majority of debt capital in both LTWP and geothermal projects. Private investors played an important role in initiating and provided about two-thirds of equity capital for, LTWP, whereas in geothermal development private investors become involved as IPPs after GDC hits steam.

The private capital providers in both LTWP and geothermal development are industry investors with defined stakes in project operations, but there are no private financial investors so far. The only exception is the Dutch sustainability bank – Triodos – which granted a very small loan to LTWP. Regarding the balance between domestic and international investment, there is a clear dominance of international investors in both equity and debt finance for LTWP, whereas in geothermal projects this is only the case for debt finance. However, with IPPs entering the scene, the equity balance for Menengai is also shifting towards a greater role of international as well as to private (industry) investors, thus typifying the process labelled as "liberalization & privatization" in Figure 1.

In contrast to Baker's (2015) expectation of financialization in South Africa's renewable energy sector, we have no such expectation or observation with regards to large-scale renewable infrastructure in Kenya – at least not in the sense that shares of the projects will be traded in stock exchanges or owned by institutional investors or large infrastructure firms. There is also no evidence so far that DFIs, though de-risking investment for private (industry) capital in the case of LTWP, support financialization or serve speculative financial investors' interests, as Mawdsley (2018) suggests. Rather, investment in large-scale renewable-energy projects in Kenya is and will very likely remain dependent on government and politics, both at the domestic and international level. This is mainly due to the various risks associated with the projects, which, together with the strong role of government and politics, deter most private and especially institutional-investor participation in such projects.

What are the implications of our findings for the international connections of large-scale renewable-energy projects and their relationship with local contexts? Our analyses have shown, that besides the Kenyan government, DFIs are the most important enablers and financiers for these projects in Kenya. Although they do not support financialization so far, they are important facilitators of internationalization. First of all, DFI provide capital from abroad and sometimes, as is the case for LTWP, also de-risk foreign investments of private investors from their respective origin countries. Furthermore, as some interviewees mentioned, DFI investment is often associated with the import of technology goods as well as technology-related services also from their respective origin countries (KfW, TDB interviews 2019). They thus strengthen international connections beyond capital flows and beyond just altruistic development support. This, however, is mitigated by the fact that, at least in geothermal-energy projects, domestic capacity building is a major part of the projects, and Kenya has started to become an exporter of geothermal expertise to other East African countries (GETRI, KfW, MoE interviews 2019). To what extent this will help to achieve the ambitious goal stipulated in the Vision 2030 – to become a middle-income country by 2030 – will also depend on whether and how large-scale renewable-energy projects support economic and social (including labor markets) development at the local level.

In Kenya, domestic and local-level activities are strongly shaped by state actors at various levels: national, local and county. The activities include, in addition to the government's provision of investment incentives, carrying out environmental and social impact assessments (ESIAs) as well as securing permits, land (rights), labor and also local acceptance and support (GDC, MoE, NLC interviews 2019). These activities are managed and monitored mainly at the domestic or even local level, e.g. by GDC, but require collaboration with, and among, various state agencies and other domestic stakeholders (GDC interview 2019). As a result, large-scale renewable-energy projects are characterized by an intricate web of international and national, including local, financial and other relations and (inter)dependencies which link national energy transition with international development and climate policies. This web entails an interesting, though not clear-cut division of labor between DFIs and other international investors, on the one hand, and the state as well as other domestic actors on the other hand. Whereas the former are mainly occupied with the financial and technological dimension, that is the international connections of the projects, the latter deal with its national challenges and local uncertainties. As we have focused on the international and financial dimension of large-scale renewable-energy projects in this article, future research can link our findings more thoroughly with the local level – and by so doing, contribute to the understanding of the extent to which large-scale renewable-energy projects change local economies and livelihoods and also how local elites are involved. Furthermore, research on the subject matter in different Global South contexts is needed, especially in Sub-Saharan Africa where research on infrastructure finance, its international connections and local contexts is still limited.

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Chapter 5

Assembling climate governing and financing actions in Kenya's large-scale renewable energy market.

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Abstract

Effects of climate change continue to exist and worsen despite efforts in setting up governance and financing systems of change, to correct this trend. Achieving the ambitious goal of the Paris Agreement limiting warming to 1.5ºC above pre-industrial levels, although feasible, would require structured, targeted, and transformative climate governing and financing actions, beyond the capacity of the current global climate governance system. This chapter explores the different forms and mechanisms of climate governing and financing actions in today's climate mitigation agenda, focusing on renewable energy markets. It argues that the assembling and structuring climate actions allow for better planning and impact appraisal of climate intervening actions, contributing to closing mismanagement and inefficiency gaps in today's climate mitigation governance and finance systems, especially in the global south context. The chapter structures a framework for assembling climate governing and financing actions in climate mitigation by classifying them based on their various roles and functions into policy, institutional, and catalysing actions. Drawing from this classification, the study goes on to assemble and analyse UNFCCC's climate governing and financing actions and to examine their roles and impacts in Kenya's large-scale renewable energy market, as well as possible manifestation of financialization processes thereof. The analysis draws on data from expert interviews with actors in the energy, environment, and financial management sectors in Kenya, as well as on document and reports analysis.

Keywords: climate actions, governance, finance, financialization, renewable energy markets, Kenya.

1. Introduction

Climate change has continued to be on the rise in the last two decades, notwithstanding several intervening actions to curb it. These actions include international agreements brokered by the United Nations (UN), national policies and climate friendly pledges, and countless nongovernmental organizations (NGOs) advocating actions and awareness campaigns. Despite these intervening actions, effects of climate change have barely slowed, with global emissions of carbon dioxide (CO2) and other greenhouse gases continuing to be on the rise (Sapiains, et al. 2020). Continually dealing with the effects and impacts of climate change and limiting it to $1.5^{O}C$ has become one of this century's most difficult challenges demanding new governance and financing strategies towards its mitigation and adaptation and to steer societies towards common transformational goals (Mahony & Hulme, 2016).

Climate governing actions involve changing many prevailing policies, practices and human behaviors, and catalyzing them through climate financing actions so that humanity collectively addresses climate change effectively. As such, climate governance can be generally understood as centered on actions and efforts to steer societies or human groups away from climate disasters and toward the maintenance of suitable climate temperature (Tosun & Schoenefeld, 2017). These climate governing actions are enabled by the various flows of climate financing directed towards facilitating and catalyzing them; flowing from, or through, multilateral development banks, the green climate fund and various private actors; and delivered in form of grants, debts, and equity (Buchner et al., 2011; IPCC, 2022). As these financial resources continue to flow and as financial geographies continue to evolve, the emergence of financialization – a process whereby financial markets, institutions and elites gain greater influence over the real economy – is also being increasingly observed (Bracking 2019).

As climate governance and financing actions for mitigating climate-changing pollution and to deal with its impacts are increasing in number, at every level; their roles, processes and impacts remain unclear. This chapter assembles and classifies the different forms and mechanisms of climate governance and financing actions in today’s climate mitigation agenda, focusing on renewable energy markets. It goes on to draw from this assemblage and classification, to examine the roles, processes and impacts of the UNFCCC (United Nations Framework Convention on Climate Change)’s climate governance and financing interventions in Kenya’s large-scale renewable energy market. The UNFCCC remains the most important international institution for the governance of climate actions (Hickmann et al., 2021) and has often argued in favour of climate interventions and financing negotiations, through its constituent institutions like the Green Climate Fund (GCF), Adaptation Fund, Least Developed Countries Fund (LDCF), the Strategic Climate Change Fund (SCCF) and the Global Environment Facility (GEF) (UNFCCC, 2015). Kenya's energy market has become more vibrant in recent years, involving more and diverse national and international investors, with a significant increase in generation capacity from about 1,600 MW in 2008 to 2819 MW in 2019 (IEA, 2019; Klagge & Nweke-Eze, 2020). This substantial improvement in the country's energy sector is a result of the accelerated development of large-scale renewable energies in the country, partly driven by commitments, frameworks, and financing under the UNFCCC, in addition to state interventions in the form of favorable laws, market incentives, and risk mitigation financing (GoK, 2018; Klagge & Nweke-Eze, 2020; Klagge, 2021). The study bases its analyses on data from expert interviews with actors in the energy, environment, and financial management sectors in Kenya[116], as well as from content analysis of various related documents[117].

2. Background and Conceptual Framework

2.1. Climate governance and climate governing actions

Notwithstanding the diversity of notions of climate governance in literature, the different perspectives generally reach a consensus on the emergence of new actors other than the state (such as community, sub-national, international and multinational corporations actors and institutions), new mechanisms and instruments (like cross-scalar and cross-level dynamics, blended finance, bottom-up approach, and soft law instruments), and new guiding principles and values (ecological justice, transparency, and inclusivity) (Bigger et al., 2018; Sapiains, et al., 2020). The importance of power dynamics in comprehending the challenges of both bottom-up and top-down approaches to climate governance is becoming increasingly recognized (Okereke et al., 2009). This body of literature from the perspective of multi-level governance, also emphasizes the role that new players are playing in climate governance and gives variables

[116] A total number of 41 in-person key informant interviews were successively carried out in Kenya from 2019 to 2020. 21 of the key informants work at national agencies and parastatals (National Treasury (NT), Ministry of Environment and Natural Resources (MoEN), Ministry of Energy (MoE), National Environment Management Authority (NEMA)). 7 of the key informants work in Development Finance Institutions ((DFIs), Trade and Development Bank (TDB), African Development Bank (AfDB), European Investment Bank (EIB), German Development Bank (KfW)). 11 of them work in the two main private and public renewable project development companies (PDs) in Kenya (Kenya Electricity Generation Company (KenGen), Geothermal Development Company (GDC)); and 2 informants work as independent consultants (ICs) in energy and environmental sectors in the country.

[117] Analyzed documents include the National Climate Change Action Plan (Kenya): 2018-2022 (GoK, 2018); the National Climate Change Framework Policy (GoK 2016a); the Climate Change Act (GoK, 2016b); the National Policy on Climate Finance (GoK 2016c); and the Paris Agreement (UNFCCC, 2015).

like community participation more weight (Aykut, 2016; Ostrom, 2010). From these perspectives, power disparities between stakeholders at the international, national and community levels should be considered when structuring climate governance, especially in the Global South context. Within the context, many literatures also allude to the role of both private and public actors (the state), in public–private partnerships (Tosun & Schoenefeld, 2017). This literature also addresses the challenges related to the sustainability over time of different transnational initiatives positing that the State, through its roles of law-making, remains a central actor within transnational governance (Aykut, 2016; Kahler, 2017).

Furthermore, domestic political institutions at both national and sub-national levels, structure climate policy outcomes, potentially leading to varieties of interventions, defined by interests (Zelli, 2011; Sapiains et al., 2020). While there is ample literature on the formal rules, processes, and organizational forms facilitating climate governance in institutions, much less attention has been directed to culture as an informal aspect in institutional analysis (Zelli, 2011). According to Ostrom (2010), cultures influence how locals interpret, apply, change, or disregard institutional rules and norms. As such, cultures also serve as crucial focal points for understanding how institutions within societies are changing due to climate change. Overall, a general embrace of neo-liberal theorizing of the environment and climate change (Pattberg & Widerberg, 2015) has influenced international climate agenda-setting and allowed the rise of market-based approaches and instruments in governing all manners of socio-economic concerns (Berndt, Rantisi & Peck, 2020), under the sponsorship of international organizations and institutions. As a result, market-based mechanisms such as trading schemes, commodification of the commons, marketization, privatization, technocratization, financialization, among others, have emerged in climate governance and finance literatures (see Christophers, Bigger & Johnson, 2020; Ouma, Johnson & Bigger, 2018; Asiyanbi, 2018; Bracking, 2019).

2.1.2 Climate finance and financing actions

Climate finance studies are important, especially in developing countries, because of the huge investments required in developing renewable energy projects and technologies, on the climate mitigation side; and because of the huge financial flows required to cushion impacts of climate change on the environment or socio-economic livelihoods, on the climate adaption side. Numerous studies have established that substantial financial gap exists to meet these goals (Buchner et al., 2011; IPCC, 2022). It is estimated that climate mitigation finance flows will need to increase to USD 5 trillion to meet the 1.5ºc target (Boehm et al. 2021). Climate finance can be delivered through direct transfers, deployed by the international community (e.g. via the Green Climate Fund (GCF)) either to recipient governments or the private sector to support implementation of climate projects (Buchner et al., 2011). Other options for delivery are the *market-based instruments*, such as international emission trading (IET) on the level of companies, emerging in countries adopting domestic emissions trading systems such as the European Union Emissions Trading System (EU ETS) (Flachsland et al. 2009). Instruments for mobilizing funds include Green and Climate Policy Performance Bonds (GCPPBs) and structured funds. Green bonds operate much like standard bonds, the distinction being that the proceeds from their sale go towards funding environmental initiatives. Climate policy performance bond, on the other hand, is a type of bond whose valuation is directly tied to performance in terms of carbon emissions, where the issuer will pay a higher interest rate than the market value if specified obligations are not fulfilled, thereby incentivizing the government to meet set targets (Polzin, 2017). Another instrument for mobilizing funds are structured funds, which are essentially the pooling of several project tranches into one. This gives the buyer of the structured fund more customization options because the fund can demonstrate varying degrees of risk and return by incorporating various tranches (Schwerhoff & Sy, 2017; Klagge 2021).

Other than the traditional equity and concessional and or non-concessional loans, instruments for deploying funds includes blended financing. Blended financing is used in the context of co-financing to refer to the mixing of public and private funds in the same projects to incentivize private investment and to insure the project from potential volatility issues (Christiansen, 2021). Credit lines are also effective instruments of funds deployment. It implies the giving of a "line of credit" from one financial institution to another to disperse per their own discretion with the aim of achieving greater efficiency (Schwerhoff & Sy, 2017). Additionally, grants are also effective instruments particularly in the Global South context, as they are non-repayable lump sum capital provisions with little risk of incurring debt stress, while preventing excessive leveraging (Pillay et al., 2017).

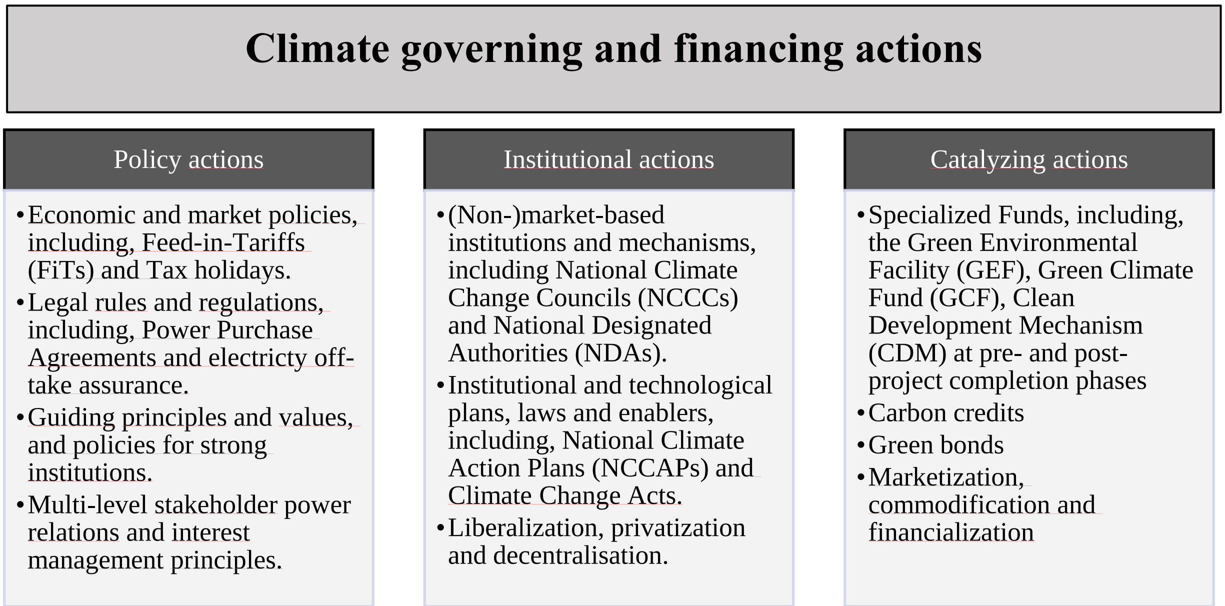
Furthermore, the changing proportional relation of climate finance flows has brought in the concept of financialization into climate financing studies, explaining a system where "a previously unpriced asset or service is entrained, or anotional one framed, and an income stream created from its existence in place, even if that place is virtual" (Pike & Pollard, 2010; Christophers, 2012; Bracking, 2019: 711).

2.2 Classifying climate governance and financing actions.

From the review and analysis above, we classify climate governance and financing actions into policy, institutional and catalyzing actions. Policy actions are interventions or "the rules of the game" intended to guide and regulate economic processes of the climate change market. They include economic and legal rules and regulations, guiding principles and values, and rules for power and principles of multi-stakeholder social relations and interest management. This set of actions is aligned to indirectly avert the market's erroneous tendencies. Institutional actions, on the other hand, are organizing action which includes a whole range of social and legal institutions and mechanisms, technological enablers, and ecological parameters that are geared towards stimulating markets. Actions such as privatization and technocratization are directed towards the creation of enabling and incentivizing the market and are necessary for the efficient interaction of the market forces to allow for a more efficient allocation of resources. Lastly, catalyzing actions refer to the various financing interventions on the conditions of the market, available in the forms of equity, loans, grants, guarantees, mezzanine, blended financing, funds, bonds, and other securities. They include direct funds transfer, structural funding, blended financing, (non-)concessional lending, equity investment, marketization and commodification; and perform roles of market catalyzation, incentivization and risk mitigation, which are of particular importance in risky and capital-intensive climate markets of the Global South.

The figure below (Figure 1) summarizes the assemblage and classification of climate governing and financing actions.

Figure 1: Classification of climate governance and financing actions



Source: *Author's own*

3. UNFCCC and the Kenyan large-scale renewable energy market

3.1. UNFCCC's market-based governance mechanisms in climate mitigation

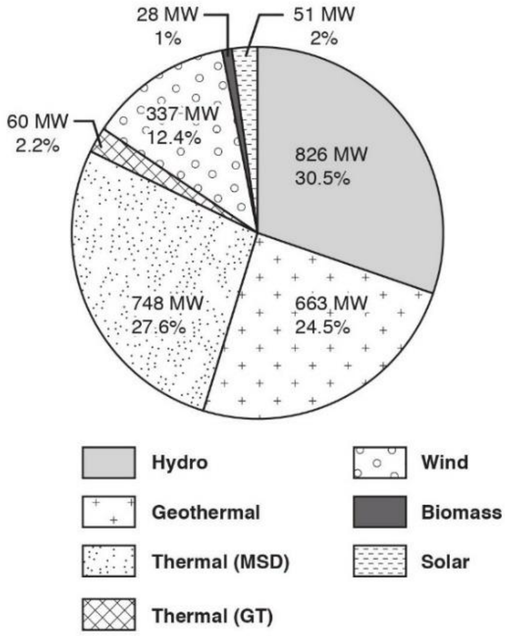
In order to enforce its climate mitigation mandates contained in its Kyoto Protocol and Paris Agreement, the United Nations Framework Convention on Climate Change (UNFCCC) created market-based mechanisms and instruments, through which it increasingly continues to intervene in climate-related markets, seeking to enforce its agenda for reducing GHG emissions in the earth's atmosphere. One of such mechanisms can be grouped as Specialized Funds. Specialized funds were created through funds pulled from developed countries in the Global North for assisting developing countries of the Global South in financing their climate mitigation and adaptation projects and activities, all in compliance with emission reduction commitments (Watson & Schalatek, 2019). The largest of such funds is the Green Environmental Facility (GEF), created in 1991, which provides upfront funding, in co-financing arrangements with Development Financial Institutions (DFIs) and other public organizations, for climate mitigation or adaptation projects and programs in the Global South (GEF, 2010; Graham, 2017).

Another more recent Specialized Fund under the UNFCCC is the Green Climate Funds (GCF), which was instituted in 2010 as a major effort to increase the funding base for the financing of climate mitigation and adaptation projects in developing countries (GCF website, 2020). GCF provides funds for enhancing climate projects, policies, programs, and activities according to its established themes (GCF website, 2020). These Specialized Funds are accessed via competitive application processes, which are organized and administered at the national level of recipient countries by selected National Designated Authorities (NDAs) (NT & MoEN interviews, 2019; GCF websites, 2020). Despite the growing financial base of Specialized Funds, their efficacy and impacts in incrementally achieving their goals in the Global South remain debatable (Bracking & Leffel, 2021). A more market-orientated mechanism created by the UNFCCC was the Clean Development Mechanism (CDM). Before its phase out in 2020, the CDM was created under the Kyoto protocol in 2006 with the dual role of assisting developing countries in achieving sustainable development while helping industrialized countries in fulfilling their climate mitigation commitments (UNFCCC, 2020). The CDM functioned through the commodification and marketization of carbon for gaining carbon credits (formally called certified emission reduction (CERs), trading at 1 CER = 1 metric tonne of Carbon dioxide (CO2) (UNFCCC, 2019).

3.2. Kenya's large-scale renewable energy market

Large-scale renewable energies currently dominate Kenya's electricity grid, accounting for more than 70% of installed electricity production (see figure 2). The capacity contributions of these renewable energies to the electricity grid have boosted the country's electricity access rate in recent years, with the number of connected households increasing from 32% in 2013 to 75% in 2018 (IEA, 2019; MoE interviews, 2019). Kenya plans to build further on these efforts in line with its UNFCCC commitments (GoK, 2016d, 2018). In its socio-economic development roadmaps, the country expresses its desire to increase its installed electricity capacity by an additional 2700MW, mainly from "*clean and sustainable sources*" (GoK, 2007, 2016d; MoE interviews, 2019 & 2020). To this end, large-scale renewable energy development has come to the forefront of Kenya's climate mitigation efforts as well as its efforts to increase its electricity generation capacities (MoE interviews, 2019, 2020).

Figure 2: *Pie chart showing the installed electricity generation mix in Kenya (2019)*



Source: *Author's own, generated from IEA data (2019), and validated with interview data from the Kenyan Ministry of Energy (MoE, 2019).*

MSD = Mean square displacement, GT= Gas Turbine

To accelerate the achievement of these goals, the Kenyan state created Special Purpose Vehicles (SPVs) to drive and support the development of renewable energy potentials in the country by taking up risks and providing market incentives in order to attract more financing from the public and private sector investors at international and national levels (MoE and NT interviews, 2019). Two of such SPVs are the Geothermal Development Company (GDC), with the mandate of conducting explorations and other initial developments of geothermal fields in the country, and the Rural Electrification and Renewable Energy Corporation (REREC, formerly called Rural Electrification Agency), which is charged with expanding electricity access to rural areas using mainly renewable energy technologies (MoE interviews, 2019, 2020). As a result of these state efforts, combined with technical and financial interventions from international Development Financial Institutions (DFI) and the UNFCCC (through its market-based mechanisms), several large-scale renewable energy projects that utilize the country's geothermal, wind, solar, hydro, and biomass resources are currently ongoing in the country, while others are already completed.

4. UNFCCC's intervening actions in Kenya's large-scale renewable energy market

During recent years, Kenya has increasingly adopted UNFCCC interventions in its climate mitigation efforts, especially in large-scale renewable energy markets, as part of a broader initiative to boost the country's energy sector development. (GoK 2018; MoEN, MoE, NT interviews, 2019). The sub-sections that follow assemble and discuss UNFCCC commitments and regulations, frameworks and organizations, and financing actions in Kenya's large-scale renewable energy market, classified into policy, institutional and catalyzing actions.

4.1. Policy actions

The UNFCCC, through its policies and commitments, indirectly structures the behavior of constituent parties by providing shared signification to stabilize greenhouse gas (GHG) emissions in the atmosphere through climate mitigation actions. Kenya, despite its negligible contribution to GHG emissions (less than 0.1% in 2018), shares many of these commitments and seeks to implement them through policies in accordance with its national interests for sustainable development (MoE, NT, MoEN interviews, 2019). These policies and commitments, especially with regards to climate mitigation, are embedded in the country's medium- and long-term development plans, officially called Medium Term Plans (MTPs) and Vision 2030, respectively (GoK 2007, 2016d; MoE, MoEN interviews, 2019). The Kenyan Vision 2030 states that Kenya aspires to be *"a newly industrializing, middle-income country providing a high quality of life of its citizens by 2030 in a clean and secure environment"* (GoK, 2007). In its Nationally Determined Contributions (NDC), ratified under the Paris Agreement, Kenya committed to achieving a GHG emission reduction contribution of 30% amounting to 42.9 MtCO2e of net emission reduction, relative to the baseline of 143MtCO2e, by 2030 (GoK, 2018; MoEN interviews, 2019). In its latest submitted NDC, the country increased its GHG reduction contribution pledge to 32% (that is, to 46 metric tonnes of carbon dioxide equivalent (MTCO2e) (GoK, 2021). To meet these targets, the country prioritizes increasing the share of renewables energies in its electricity generation mix (GoK, 2010, 2016a, 2018; MoE & MoEN interviews, 2019). On the rationale for the country's prioritization of large-scale renewable energies in its climate mitigation efforts, an interviewed director of climate change at the MoEN states:

"The capacity of these projects [large-scale renewable energy projects] to reduce emissions is huge, it happens in a snap. Once the project is online, you can start counting emissions reduction [credits], whether it is going towards the carbon markets or going towards achieving

our NDC [Nationally Determined Contribution]. The emission reductions are real, and they are much easier to monitor, compared to other sectors."

To vitalize its renewable energy market for meeting these climate mitigation commitments, the Kenyan government implemented several investment-friendly policies and incentives at both the national and sub-national levels. These include policies on Feed-in-Tariffs (FiTs), the waving or reduction of duties for imported renewable energy technologies, as well as tax holidays for large-scale renewable energy project developers (MoE, NT, PDs, DFIs interviews, 2019). Furthermore, the state also provided "bankable" power purchase agreement (PPA) frameworks, electricity off-take assurances, and good regulatory institutions – all of which are directed towards encouraging the adoption and development of renewable energy technologies on large scales (MoE, NT, PDs & DFIs interviews, 2019). On Kenya's success in providing enabling environment for its renewable energy market vitalization, the interview partner at the Trade and Development Bank (TDB) elaborates:

"… The effort on the government side is huge in creating enabling environment for people to develop, adopt and access renewable energies. As a result, investors' attraction is just amazing. So many investors are looking into investing in the energy sector, especially the generation of electricity. Kenya is quite competitive, you find the EIB [European Investment Bank], the World Bank …the attraction is just massive. And you know, this competition amongst different financiers brings down the cost of borrowing for renewable energy projects."

4.2. Institutional actions

Following its ratification of the UNFCCC's Paris Agreement in 2016, Kenya enacted its Climate Change Act (2016) – a legal apparatus that guides and coordinates national efforts towards addressing climate change in the country (GoK, 2016b, MoEN interviews, 2019). The Climate Change Act (2016) establishes the National Climate Change Council (NCCC) as the highest institutional body responsible for oversight and coordination and the Climate Change Directorate (CCD) as the secretariat of the NCCC responsible for the technical aspects (measurements, monitoring, reporting and capacity building support) of the implementation of its climate change agenda at the national and sub-national levels. The Climate Change Act further made provision for the formulation of the National Climate Change Action Plan (NCCAP), which is a five-year plan that stipulates guidelines for integrating and mainstreaming UNFCCC climate actions in all sectors of the national economy, including the County Integrated Development Plans (CIDPs) at the sub-national levels (GoK, 2016a & b, GoK, 2018; MoEN interviews, 2019). To further organize and coordinate UNFCCC interventions at multigovernmental levels in Kenya's large-scale renewable energy market, the Ministry of Environment and Natural resources (through its related parastatals, such as the National Environment Management Agency (NEMA)) and the National Treasury (Kenya's equivalence for Ministry of Finance) act as linking institutions between the UNFCCC and the government of Kenya. They do this by acting as National Designated Authorities (NDAs) in organizing climate mitigation actions in Kenya. To optimize their performance, staff members from these linking institutions periodically receive short-course training and orientations in the management and administration of UNFCCC mechanisms. On this training, an interviewed policy advisor working at the National Treasury explained:

"We receive several capacity-building trainings from the UNFCCC. It is a continuous process. We had one in May and June, we will be going for another one next week, and other ones are planned in the future – so it is a continuous process. The training usually starts with introductory aspects to climate change, and then goes to its response and governing mechanisms. The Ministry of Environment and Natural Resources and the National Treasury often take part in these training, at the national level. Afterward we then train other ministries at national and county [sub-national] levels – that is why it [the training] is often called, Training of Trainers [ToT]."

Many of the interview partners believe that these skills, acquired through training received by UNFCCC staff members, will not only serve their intended purposes but will be transferred to the governance of subsequent market-based environmental mechanisms in the country. As the interview partner at the MoEN explained:

"Yes, the Kyoto Protocol is ending in 2020, but it came with a lot of learning and experience for us. These lessons will be transferred into the Paris Agreement and other subsequent ones. We cannot throw the baby out with the bathwater. So yes, the window might close on the Kyoto Protocol but the lessons from it, especially with the carbon trading, will be carried on into new agreements."

4.3. Catalyzing actions.

Climate financing, under the UNFCCC, is an important catalyzing action in Kenya's large-scale renewable energy market (GoK, 2016c; NT, MoE, MoEN interviews 2019). Kenya strategically uses financing from Specialized Funds (the Green Environmental Facility (GEF) and the Green Climate Fund (GCF)), as well as from the Clean Development Mechanism (CDM) to mitigate risks and attract investors at different development stages of large-scale renewable energy projects in Kenya (GoK, 2016c; NT, DFIs interviews, 2019). Financing from the Specialized Funds are targeted and role-specific, flowing through various implementing and accredited agencies, including international development financial institutions such as the World Bank and the European Investment Bank (EIB), as well as through international private banks, such as the Deutsche Bank (see tables 2 & 3).

Table 2: *Approved and funded GEF projects and programs relating to large-scale renewable energies in Kenya (1991 - 2019).*

Project/Program Title	**Grant & Co-financing**	**Implementing Agencies**	**Other beneficiary countries**	**Periods**
Sustainable Conversion of Waste to Clean Energy for Greenhouse Gas (GHG) Emissions Reduction	$1,999,998 $9,824,718	UNIDO	---	GEF-5
SolarChill Development, Testing and Technology Transfer Outreach	$2,712,150 $8,033,500	UNEP	Colombia, Eswatini	GEF-5
Lighting the "Bottom of the Pyramid"	$5,400,000 $6,750,000	The World Bank	Ghana	GEF-3
African Rift Geothermal Development Facility (ARGeo)	$4,750,000 $74,261,652	UNEP	Eritrea, Ethiopia, Rwanda, Tanzania, Uganda	GEF-3
Joint Geophysical Imaging (JGI) Methodology for Geothermal Reservoir Assessment	$979,059 $0	UNEP	---	GEF-3
Building Sustainable Commercial Dissemination Networks for Household PV Systems in Eastern Africa	$693,600 $0	UNEP	Eritrea, Ethiopia, Tanzania, Uganda	GEF-3
Solar and Wind Energy Resource Assessment	$6,512,000 $2,508,000	UNEP	Multiple countries	GEF-2
Photovoltaic Market Transformation Initiative	$30,000,000 $90,000,000	IFC	India, Morocco	GEF-1

Explanation of abbreviations: IFC = International Finance Corporation UNIDO = United Nations Industrial Development Organization. UNEP = United Nations Environment Programme.

Sources: *Author's own, compiled from GEF (2010); complemented and validated with interview information (2019).*

Table 3: *Approved and funded GCF projects and programs relating to large-scale renewable energies in Kenya (2010 - 2019)*

Project/Program Title	**Total Project Investment (million USD)**	**Accredited Entity (AE)/ Delivery Partner**	**Lead Executing Entity (EE)**	**Other beneficiary countires**
Global Energy Efficiency and Renewable Energy Fund (GEERF) NeXt	765	EIB	Ministry of Energy	Multiple countries
KawiSafi Ventures Fund	110	Acumen Fund Inc.	Acumen Capital Partners LLC.	Rwanda

The Universal Green Energy Access Program (UGEAP)	301.6	Deutsche Bank	Ministry of Energy	Kenya, Benin, Namibia, Nigeria, Tanzania
Climate Investor One (CIO)	821.5	FMO	Local financial partners	Multiple countries
Transforming Financial Systems for Climate (TFSC)	745	AFD	Local financial partners	Multiple countries

Explanation of abbreviations: EIB = European Investment Bank. AFD = Agence Française de Développement (the French government-owned development bank).

Sources: *Author's own, complied from GCF (2020); complemented and validated with interview information 2019.*

At the pre-completion stages of the renewable energy projects, climate financing from the Specialized Funds is used to cover cost-intensive and risky activities of the projects' development, mainly relating to project feasibility studies, resource prospecting and exploration, training of staff, and the procurement of certain heavy equipment in cooperation with the project developers (Interview information, 2019). This financing helps to mitigate investment risks that would otherwise be passed on to investors and project financiers (MoE, DFIs interviews, 2019), making projects more appealing to investors, especially private sector developers and investors, who are then more confident to participate in the market (GDC, NT interviews, 2019). In addition to its risk-mitigation roles, the financing from the Specialized Funds also served as debt-blending instruments, as they were issued as concessionary funds in combination with loans from Development Financial Institutions (DFIs), thereby lowering the final debt costs for borrowing project developers and investors (DFIs interviews, 2019). The provision of this climate financing, as both debt-blending instruments and grants, facilitated the completion and commissioning of the many large-scale renewable energy projects in the country (PDs, NT, DFIs, and MoE interviews, 2019). On the effectiveness of climate financing as blending instruments in Kenya's large-scale renewable energy market, an interviewed energy project-financing specialist at the Trade and Development Bank (TDB) explains:

"*Our treasury is always pushing us to get a 'renewable energy pipeline'. Although the projects are riskier, we find other strategic initiatives in the bank, like the blending instrument. What we are doing with 'blending' is that we get a pool of concessionary funds from the GCF [Green Climate Fund], for instance, that we can blend with our market debt – so that the final cost to the borrower becomes very low. …Like the transaction we did with ADB [Asian Development Bank], the CTF [Clean Technology Fund] brought in US$20 million into the transaction, at the pricing of just approximately 0.75% per annum. Other lenders – ADB, Finnfund, and our loans* *were priced high. But when we combined it with the cheap climate financing and worked out the weighted average cost, the debt financing became very attractive to the developer, the tariff was very competitive."*

At post-completion project stages, developers who had registered their projects with the UNFCCC's Clean Development Mechanism (CDM) in their pre-completion phases become eligible to earn carbon credits upon completion of the projects. In Kenya, large-scale renewable firms – Kenya Electricity Generating Company PLC (KenGen – a 70% government-owned company) and Mumias Sugar Company (a privately owned company) – are among the beneficiaries of financing under this mechanism. So far, KenGen has registered three geothermal, one wind, and two hydro projects totaling about 1.4billion total carbon dioxide (tCO2) (KenGen interviews, 2019; see table 4).

Table 4: *Large-scale renewable energy projects in Kenya registered under CDM (2008 - 2019).*

Projects	**Renewable Energy Type**	**Capa city (MW)**	**Date of registratio n**	**Start of Crediting Period**	**Estimated tCO_2 equiv/year**	**Estimated Cumulative CER's up to 2020 tCO2 equiv (USD)**
Mumias Sugar	Biomass	35	03-Sep-08	01-Oct-08	129,591.00	24.418.20
Olkaria II	Geothermal	35	4-Dec-10	4-Dec-10	149,632.00	1,047,424.00
Tana	Hydro	19.6	11-Oct-11	11-Oct-11	25,680.00	231,120.00
Kiambere	Hydro	20	24-Oct-12	1-Nov-12	41,204.00	288,428.00
Ngong	Wind	5.1	19-May-14	1-Jul-14	9,941.00	59,646.00
Olkaria I, AU 4&5	Geothermal	140	28-Dec-12	1-Jan-15	635,049.00	3,810,294.00
Olkaria IV	Geothermal	140	28-Dec-12	1-Jul-14	651,349.00	3,908,094.00
Total					**1,512,855.00**	**9,345,006.00**

Sources: *UNFCCC (2020, CDM Registry); validated with interviews information (2019).*

Following the signing of the Emission Reductions Purchase Agreement (ERPA) with the World Bank for the sale of the Olkaria II U3 CER, KenGen has so far earned US$1,047,424.00 (KenGen interviews, 2019; UNFCCC, 2020). Likewise, Mumias has also earned US$24,418.20 from the trade of carbon to Japan Carbon Finance Limited (JCF) (NEMA interviews, 2019; UNFCCC, 2020). These carbon credits earned through the trading of carbon reduces the cost of investment and adds to the profits of the developers and investors (NT, MoEN, KenGen interviews, 2019).

Beyond being beneficial to the project developers and investors, CDM in Kenya also enabled the delivery of projects and other initiatives for the benefit of the project host and surrounding communities. Under the World Bank's Community Development Carbon Fund (CDCF), 10% of carbon credit revenues generated from Olkaria II geothermal projects CERs have been used to implement four projects for the host and surrounding communities (Schade, 2017; KenGen interviews, 2019). They include classrooms, water pipelines, and water pans for domestic uses and for livestock (Schade, 2017; KenGen interviews, 2019). In the same vein, the construction of the Mumias Biomass electricity project has generated employment for host-community members and has led to the expansion of electricity access to the rural community where the project is hosted (Schade, 2017; NEMA interviews, 2019).

In Kenya, however, accessing these UNFCCC financing at both the pre- and post-completion stages of the project is not easy for the project developers and industry investors. It involves certain bureaucratic processes, which many of the applicants (project developers and investors) find complicated (NT Interviews, 2019). As one of the interviewed staff members at the National Treasury (National Designated Authority for GCF accreditation) noted:

"*The GCF is a very bureaucratic institution with lots of developments here and there. It takes a lot of time before they issue accreditation*".

Like the Specialized Funds, CDM uptake was also limited in the Kenyan large-scale renewable energy market due to its many bureaucratic procedures and regulations (KenGen Interviews, 2019). An interviewed KenGen's Chief Officer for Environment and CDM at the time of the company's CDM application describes the nature of complications in accessing carbon credits for the Olkaria geothermal energy project as follows:

"During the first verification mission of the UNFCCC/CDM verifier to the Olkaria II expansion project, issues regarding the project boundary came up. The boundary issue revolved around the possibility of steam sharing between Olkaria I [a non-CDM registered project] and Olkaria II, Unit 3 [a CDM registered project]. To resolve this issue, we had to prove that the CDM project in Olkaria II did not compromise power generation in Olkaria I. To this effect, studies showing records of steam output from the wells supplying Olkaria I were provided, in addition to other studies. If it had been determined that the Olkaria II project negatively affected power generation and steam supply in Olkaria I, it would have meant that we would have been forced to modify the project boundary in the registered CDM Project Design Documents (PDD) to include Olkaria I. The inclusion of Olkaria I in the project boundary would have increased monitoring and staffing requirements as well as caused further delay in issuance of the CERs

[carbon credits]. The KenGen [the state-owned developer of the project] team worked closely with the World Bank Carbon Finance Unit (WBCFU) to rectify this issue."

These challenges in accessing UNFCCC financing in Kenya's large-scale renewable market create opportunities for further interventions by other actors. Other than the intervening roles of the Development Financial Institutions (DFIs) in closing climate finance leveraging gaps, private for-profit firms have also emerged to play similar intervening roles, and by so doing, could give room for the manifestation of financialization processes in UNFCCC's catalyzing actions in Kenya's large-scale renewable energy market (MoE and NT interviews, 2019). These emerging private for-profit firms serve as consultants for accessing specialized climate funds or as carbon trading intermediaries, offering services to the Kenyan government agencies (National Designated Authorities) as well as to public and private sector renewable energy project developers and investors who are seeking to leverage climate finance (MoEN, NT, ICs interviews, 2019). One prominent example of such firms in the Kenyan climate-financing landscape is the English *ClimateCare* – a for-profit firm with headquarters in Oxford, which provides carbon-offset services to public and private actors in climate mitigation sectors of the country (NT and ICs interviews, 2019).

5. Concluding discussion

A growing literature involving climate governance and financing is evolving and should advance the discussion on transformations and the involvement of different actions for addressing climate change. Moreover, Global South's particularities have to become better integrated in articulating climate change actions (Kane & Boulle, 2018). This chapter contributes to this literature by assembling, classifying and analyzing the different forms and mechanisms of climate governance and financing actions in today's climate mitigation agenda, focusing on renewable energy markets. Based on their roles and functions, the study classifies these interventions into policy actions, which act on economic processes to regulate and set the rules in the climate market; institutional actions, which are apparatuses, mechanism and frameworks which allow for organized interventions; and catalyzing actions, which constitute financing interventions which acts as catalysts for climate mitigation and adaption project development. By analyzing UNFCCC's climate governance and financing actions in Kenya's large-scale renewable energy market, the study demonstrates the usefulness in assembling and structuring multifaceted climate intervening actions and how it contributes to better understanding their different roles, processes and impacts.

In the Kenyan context, the study finds that these global interventions are welcome at national levels insofar as they align with national interests. It is this perception, at the national level, that then brings about the dedicated implementation of interventions with direct effects on climate mitigation, particularly in the renewable energy market sector of the country. The study also finds that in addition to their intended roles, these UNFCCC actions perform other roles that are unintended but that have positive cascading effects in the market. For instance, the training and skills in project financing application, management, and evaluation, which are provided to the staff members of the UNFCCC Nationally Designated Agencies in the country, are applied beyond the achievement of their intended aims of translating interventions into implementations in the country. These valuable skills are also transferred to the management of other institutional responsibilities in environmental governance and beyond. Similarly, the uptake of the Clean Development Mechanism (CDM) was for the benefit of not only the project developers and investors, but also of the project-hosting communities by enabling the development of certain community projects. Furthermore, the participation of the UNFCCC in projects is perceived by investors and financiers as a signal that the projects are viable and sustainable (PDs interviews, 2019, see also Mawdsley, 2018). Such altruistic values placed on the project further help in attracting investments from both public and private sector investors (PDs & DFIs interviews, 2019). The growing importance of finance as part of the market logic in climate change governance is evident in the growing and diverse climate financing instruments, including grants from Specialized Funds and carbon trading. Steckel et al. (2017) show that, when properly channeled in line with national socio-economic development priorities, climate financing can become a key pillar in fighting climate change while also driving sustainable development, especially in the Global South (also see Metz and Kok, 2008 and Naess et al., 2015).

Analyzing UNFCCC’s catalyzing actions in the Kenyan large-scale renewable energy market, reveal how financing is strategically leveraged in pre- and post-project completion stages as blended financing, as risk mitigation loans and grants, and as market-incentivizing concessional loans. The result, as the study shows, is improved market efficiency, evident in the increase in public and private sector investments as well as in the deployment of more large-scale renewable energy projects in the country. Although financialization is not yet observed in the project financing of these large-scale projects because of the dominance of financing from development financial institutions and other public investors as risk-mitigating actors (Klagge and Nweke-Eze, 2020), the findings of this study point to possible emergence of financialization in the financial interventions on the conditions of the market for better efficiency. These financialization processes manifest as private for-profit firms increasingly emerge as intervening consultants, seeking to close the leveraging gaps created due to bureaucratic challenges in leveraging climate financing for profit. This observed emerging financialization is expected to continue to widen (Knox-Hayes, 2010; Johnson, 2015; Bracking, 2015, 2019), insofar as more market-based mechanisms and tools are used in the governance of climate mitigation in the country. Observing the emergence of such financialization patterns in climate finance in the future and researching their dynamics, especially in the Global South context, requires more research. This is worthwhile, as the use of market-based instruments in climate mitigation and adaptation continues to deepen with the signing of the Paris Agreement.

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Chapter 6

Infrastructures of large-scale geothermal energy projects in Kenya: Materialization, generativity, and socio-economic development linkages.

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Abstract

The linkages between infrastructures and socio-economic development have become increasingly complex and varied in transdisciplinary human science scholarship. In the Global South context in particular, these linkages entail unusual geographies of diffusion that defies many easy narratives. Using the case of geothermal energy projects in Kenya, this article explores the materialization and generativity of infrastructures in large-scale projects and their complex linkages to socio-economic development. The paper shows how the delivery of 'core' infrastructure projects enables the provision of 'other' infrastructures – 'required' and 'generated' infrastructures, all of which entail different socio-economic development linkages for different interest groups at national and local community levels. In exploring these processes, the paper engaged with multi-disciplinary scholarship on the materialization and generativity of infrastructures and their variegated and multifaceted linkages to socio-economic development. A methodological combination of expert and informal interviews, document analysis, and project-sites observations form the basis of the analysis.

Keywords: Infrastructures, large-scale geothermal energy projects, materialization, generativity, socio-economic development linkages, Global South, Kenya.

1. Introduction

Infrastructures are apparatuses such as dams, highways, geothermal plants, canals, airports, and harbors, in energy, transport communication and water sectors of an economy or society, which enable other things to happen (Star 1999). In his influential review essay, Larkin (2013) further describes infrastructures as "built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space" (p. 328). For him, the "peculiar ontology" of infrastructure "lies in the facts that they are things and the relation between things" (Larkin 2013 p. 329). Following these lines of thinking leaves us with the understanding of infrastructures as a critical and necessary element for rapid socio-economic transformation. Yet, the existence of infrastructures or attempts to create them have generated critical debates on their potential causes of undesirable processes and outcomes such as human dispossessions, displacements, environmental degradation, and global warming (Beevers et al. 2012, Campbell et al. 2017, Divine et al. 2017). This paradox has increasingly become a subject of inquiry in interdisciplinary human science scholarship as many developing countries in the global south increasingly "turn to infrastructure" with increasing mix of actors (Glass et al. 2019, Addie et al. 2020).

Infrastructures materialize through several complex processes of configurations, involving multifaceted actors with different interests and intents (see Lawhon et al. 2018). The paper calls this process 'materialization of infrastructure'. The materialization of infrastructures also sets off other regeneration processes which lead to the materialization of other infrastructures for both intended and unintended purposes and consequences, which can go beyond the agency of the original developers (see Silver 2014, Maringanti and Jonnalagadda 2015). The paper calls this the 'generativity of infrastructure'. These processes of infrastructure materialization and generation typically hold implications for broader socio-economic development in the spaces of their existence, through several linkages.

Using the case of the development of large-scale geothermal energy projects in Kenya, this paper explores the materialization and generativity of infrastructures of large-scale renewable projects and their complex socio-economic linkages in the developing countries context. The paper argues that a more complete appraisal of the socio-economic impacts of large-scale renewable projects should prelude a process-tracing analysis of their materialization and generativity potentials. It demonstrates this argument by showing how the materialization of large-scale geothermal energy infrastructures ('core' infrastructures) generates other infrastructures ('required' and 'generated' infrastructures), all of which, when considered as a whole, have multifaceted socio-economic implications, and impacts for interest groups at national and local levels. By so doing, this study responds to the growing calls to situate and understand infrastructure provisions in the realities faced by many countries in the Global South (Jaglin 2015, Coutard and Rutherford 2015). Empirical analysis of large-scale infrastructure projects in the Global South begs for wider thinking of the complexity and dynamism of infrastructure configurations, which challenges the predominant binary notion of their materialization and impacts (Lawhon et al. 2014, Silver 2014, Greiner 2016, Lawhon et al. 2018, Chambers 2019, Barry 2020).

The paper continues in the next section by discussing the infrastructures, their materialization, generativity, intents, interests, and their socio-economic development nexus. Afterwards, it presents the methodology and the cases of the study projects. Based on these cases, it goes on in subsequent section to analyze and discuss the materialization and generativity of geothermal infrastructure projects and their complex and differentiated socio-economic development interests and linkages at national and local community levels. The paper concludes by summarizing its findings and presenting its implications for socio-economic impacts analysis and appraisal of large-scale infrastructure projects.

2. Conceptual Framework

2.1 Materialization and generativity potentials of infrastructures

The materialization of large-scale projects consists of a combination of infrastructure artefacts with generativity potentials to necessitate or enable the creation of other infrastructures in a networked configuration (Barry 2020). Heterogenous Infrastructure Configurations (HIC) formulated by Lawhon et al. (2018) provides an analytical lens which serves as a starting point in understanding these networked configurations. The HIC analyses infrastructure artefacts "not as individual objects but as parts of geographically spread socio-material configurations: configurations which might involve many different kinds of technologies, relations, capacities and operations, entailing different risks and power relationships" (Lawhon et al. 2018 p. 722). In doing so, Lawhon et al. (2018) push thinking around infrastructures to better consider and incorporate the numerous other complexities embedded within infrastructure construction, including stakeholder interests, thereby allowing for a distinguishing or separating infrastructural artifacts from one another, based on their interests and rationale for materialization and generativity. In this sense, infrastructures of large-scale projects are therefore not independent apparatuses but are often geographically embedded and networked in wider socio-material configurations of relations and operations, possibly in network with other technical and social infrastructures, with socio-economic and political implications (Silver 2014, Chambers 2019, Thekdi and Chatterjee 2019).

Before Lawhon et al. (2018), existing accounts attempted to frame the complex materialization and generativity potentials of infrastructures as hybrid and mixtures (Furlong 2020, Larkin 2008), continuous and incremental (Silver 2014, Maringanti and Jonnalagadda 2015), post-networked (Coutard and Rutherford 2011, Monstadt and Schramm 2017), as well as people-centered and lived (Graham and McFarlane 2014, Simone 2004, Scott 1998). The hybridity of infrastructures materialization and generativity reflects in the diverse and different ways in which infrastructure artefacts connects and embeds into existing infrastructure geographies, sometimes causing the creation of other new infrastructures (De Boeck and Baloji 2016, Kimari and Ernstson 2020). Although similar literature focuses on the spread of networked infrastructure, Meehan (2014) suggests the consideration of 'informal' infrastructures which can emerge in large-scale projects, and which often serve as conduits outside of state control. These networked infrastructures often inspire new possibilities for social collective organizing, ownership and power relations as well as generating new platforms for engagements outside of the state, which may or may not be initially intended (Schouten and Mathenge 2010, Ernstson et al. 2014, Silver 2014).

Infrastructures are also continuous and incremental in the sense that it involves constant socio-material production, maintenance, expansion and reconstruction (Silver 2014, Coutard and Rutherford 2015, Maringanti and Jonnalagadda 2015), with diverse involvement of people as actors in shaping its constitution and determining its generativity in mutual constitution – leading some authors to argue for the wider notion of infrastructure that includes 'people as infrastructure' (Simone 2004, Anand 2011, Larkin 2013, McFarlane and Silver 2017). These processes involve a wide range of actors at public and private, local and international, formal and informal levels, consisting of project developers, investors, of local entrepreneurs, grassroots social movements, international non-government organization (NGOs), and individual community members, each with different interests, motives, incentives, and perceptions (Lindell 2008, Pieterse 2019, Cirolia 2020). These increasing and diversified involvement of actors in infrastructure provision and the resulting generativity which they are increasingly creating, have inspired works that seek to show how infrastructures have become layered by additional and partial infrastructures, with different other uses, coverages, logics, and ownerships (Anand 2011, Chattopadhyay 2012, Graham and McFarlane 2014, Silver and Marvin 2017).

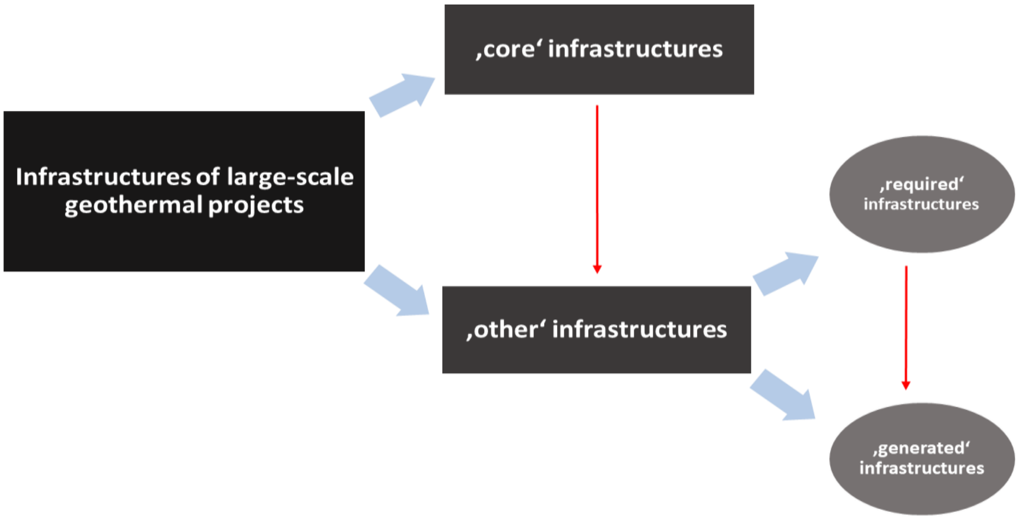
2.2 *Materialization and generativity of large-scale infrastructure projects*

Intended large-scale infrastructure projects become generative in the process of their materialization, allowing for the construction of other technical and social infrastructures in project-host communities. Infrastructures of large-scale projects primarily materialize in two forms 'core' and 'other' infrastructures. It starts with core infrastructures, which are the actual intended infrastructures, made up of the geothermal plants and machineries. It then goes on to show how the construction of these core infrastructures both enables and necessitates the construction of other new or additional infrastructures – 'required' and 'generated' infrastructures. 'Required' infrastructures are additional technical infrastructures, which are provided to enable the construction of the core infrastructure projects. Such infrastructures usually consist of access roads and large water supply and storage systems. As the project proceeds, these 'required' infrastructures then further enable the provision of other 'generated' technical and social infrastructures – network roads, water abstraction points, schools, hospitals, housing, which are often provided as resettlement plans for Development Induced Displaced Persons (DIDPs). These 'generated' infrastructures would not have been provided[118] if the 'required' infrastructures were not initially provided. In general, the required and the generated infrastructures do not only enable the construction of core infrastructures, but they also exist to ensure their continuous functionality.

These materialization and generativity processes (Figure 1) reveal how infrastructures assume lives of their own and catalyze the materialization of further infrastructures, which have a multiplier effect on social-economic development patterns in project host-communities, especially in the peripheral and marginalized geographies where infrastructures are already scarce.

[118]Or would have at least been very difficult to provide or take a long time to be provided.

Figure 1. *Materialization and Generativity of Infrastructures in Large-scale Geothermal Energy Projects*



Source: Author's own

2.3 Intents and interests in infrastructure materialization and generativity

The materialization and generativity of infrastructures in large-scale projects reflect and are conditioned by a combination of intents of diverse actors at international, national and community levels (Cirolia 2020, Nweke-Eze and Kioko 2021). Infrastructure rush in the Global South can be captured in the infrastructure-development nexus concept, which emphasizes the importance of industrialization particularly through infrastructure as the key to economic growth and development (Cooper 1996, Luiz 2010). Investments for development infrastructures are, however, limited in the Global South, leading to greater push to attract more infrastructure investments from new classes global funders (Terrefe 2020, Van Noorloos and Kloosterboer 2018). These realities have contributed to the widening of the scope and scale of interests and intents to include the geo-political and economic interests of fund providers and financiers (Goodfellow 2020, Klagge and Nweke-Eze 2020).

At the same time, large-scale projects are associated with intents and interests at national and community levels. At the national level, interests in infrastructure provision are encapsulated by the national government's intent to foster national development and to deliver on national promises (Ballard and Rubin 2017, Cirolia and Smit 2017). Regardless of intent and interest, some of the infrastructure investments in the Global South have proven to be poorly coordinated leading to debt traps which result in dangerous continuities of macro-economic quagmires (Banerjee et al. 2008, Foster and Briceño-Garmendia 2010, Furlong 2020). At the community level where infrastructure projects are constructed, interests and intents are mainly directed towards meeting socio-economic requirements, while conserving the environment (Nweke-Eze and Kioko 2020). In some cases, community leaders have been shown to have vested interests in large-scale infrastructure projects, with the power to oppose and obstruct state provision of infrastructure and initiatives (Arrobbio et al. 2014, Klagge et al. 2020, Greiner et al. 2021).

2.4 Infrastructures and their complex linkages to socio-economic development

Studies have shown that the degree of development linkages of infrastructures depend on specific geographies, timing, and politics (Edwards 2002, Straub 2011, Howe et al. 2015, Anand et al. 2018, Furlong 2020). The benefits from infrastructures can be significant and vary depending on specific local contexts (Turner 2018, Weinhold and Reis 2008). Constructing new infrastructures or improving existing ones can increase access to new markets by of helping rural farmer access urban markets, increase prices of their products and make more profits; as well as increase access to social and institutional infrastructures such as schools, hospitals (Jacoby 2000, Mu and van de Walle 2011, Aggarwal 2018). However, the positive impacts of new roads can be heavily outweighed by other socio-economic livelihood losses, bio-diversity disruptions, and environmental damages (Foley et al. 2007, Mandle et al. 2015, Beevers et al. 2012). For instance, in certain local contexts, new infrastructures can adversely affect access to water for domestic purposes or fishermen who depend on the water bodies for their socio-economic livelihoods (Appiah et al. 2017).

The extent of positive impacts of infrastructure on development in a particular country also depends on what Calderon et al. (2011), Estache and Garsous (2012), Garsous (2012) and Estache and Wren-Lewis (2011) refer to as the “the development stage” of a country. The more developed a country is, the higher its infrastructure stock and hence the lower the payoff from additional investment, unless it aims at addressing a major bottleneck or introducing a major technological improvement (Estache and Garsous 2012, Garsous 2012). On the other hand, the less developed a country is, the more significant is the impact of an additional infrastructure (Estache and Garsous 2012, Garsous 2012). These literatures, however, also note that some infrastructure projects, such as energy and transport infrastructures, do have positive impacts regardless the development stage of the country (Estache and Wren-Lewis 2009, Estache and Garsous 2012).

Studies have shown that the time-period over which the impact is assessed also matters. The significance of the positive impact of infrastructures from the 1950s to the 1980s were more prominent than after the 1980s (Estache and Fay 2010). Studies that observe infrastructure impacts over longer time-periods were more likely to observe more significant positive impacts

(Albala-Bertrand and Mamatzakis 2004, Estache and Fay 2010) – this has been attributed to the long payback period of most infrastructures (Estache and Garsous 2012). The degree of impact an infrastructure may have on socio-economic development also depends on the type of infrastructure (Dethier et al. 2008, Estache and Garsous 2012). Most findings show that direct-impact infrastructures, such as energy and information and communication technology (ICT) infrastructures tend to have higher positive significance on development indices than other more indirect-impact infrastructures such as water and sanitation infrastructure, which often depend on other infrastructures (example, energy infrastructures) to function (Garsous 2012).

Large-scale infrastructure projects often have far-reaching socio-economic impacts, often extending beyond the immediate spatiality of the project site, into nearby and further spaces, with varying temporal (short, medium, and long-term or even permanent) effects (Batey et al. 1993, Korytárováa and Hromádkaa 2014). Studies such as Enns and Bersaglio (2020) and Bryceson et al. (2008), contend that infrastructures connect to socio-economic development in a selective and uneven manner – stating with empirical evidence that certain infrastructures have increased socio-economic development for some, while at the same time worsening socio-economic development and welfare for others.

Infrastructures are only useful to the degree they help to facilitate activities. Such facilitating activities of their provision, accessibility, reliability, scale, durability, and maintenance, allows us to differentiate the degree and extent of impacts of infrastructures in different geographical contexts (Amin 2006, Hall et al. 2013, Talen 2019). As Bryceson et al. (2008) argue, infrastructures in themselves are blunt instruments which must co-exist with certain other enabling conditions and means to effectively translate or contribute to socio-economic development. The variegated impacts created by the differentiated quality of infrastructure facilitating activities has led to non-uniform outcomes of infrastructure provision (Lawhon et al. 2018).

2.5 Infrastructures and their multifaceted socio-economic development impacts

Large-scale infrastructures such as energy projects (electricity generation, transmission, and distribution systems), water projects (pumping, boreholes and sanitary systems), transportation projects (roads, railways, ports, pipelines), information and communication technology projects (broadband masts, telecommunication systems) have long been part and parcel of human socio-economic life. The development of these infrastructures is often connected to and/or justified in the mainstream development circles by grand narratives of development/underdevelopment, as conditions in which prosperity of nations are bound (Kanai and Schindler 2019). This infrastructure-development nexus has come to dominate national and international development policy agenda, subsequently leading to a surge of interest in infrastructural development, investments, and financing spear-headed by state and regional governments and supported by several old and new, international, and regional development institutions, multi-donor, and climate agencies (Boyer 2019, Howe 2019, Klagge and Nweke-Eze 2020).

The ideology and perspective on infrastructure-development nexus have been subject to discourse, starting from Arrow and Kurz (1970) and Aschauer (1989). Since then, many other (inter- and multi-) disciplinary studies have begun to analyze, discuss and debate the subject matter. Generally, the findings of these studies are bifurcated. Many studies from national economic growth and development perspectives predominantly highlight the positive impacts of infrastructures based on macro-economic indices. These studies generally report that increase or improvement of infrastructures brings about positive impacts on several socio-economic and development indicators, including long-run economic growth, international trade enhancement, productivity and efficiency, economic development; poverty alleviation and the achievement of the Millennium Development Goals (MDGs) (Asher and Novosad 2020). Exemplary for this literature are studies by Easterly and Rebelo (1993) and by the World Bank (1994) who conducted global, multi-country research in both the Global North and South; studies by Seethepalli et al. (2008), Straub (2008) and Straub and Terada-Hagiwara (2011) who focus on East Asia; and Calderon and Serven (2008) Calderon and Chong (2009) who conducted research in Sub-Saharan-Africa.

In contrast, however, studies researching from mainly local community development and bio-diversity perspectives report mainly negative impacts of infrastructure projects on biodiversity and environment (Trombulak and Frissell 2000, Laurance et al. 2006, Coffin 2007, Campbell et al. 2017), and their disrupting effects on indigenous people’s livelihoods (Kenley et al. 2014, Barker et al. 2021). They report incidences of human-vehicle collision and accidents, animal-vehicle collision and accidents, noise pollution during construction of project or usage of infrastructure projects such as roads, restriction of movements, reproduction patterns and other disruptions of wildlife, increased spreading of invasive plants, landscape disasters such as landslides and erosions, and increased hunting, poaching, deforestation and other human-wildlife interferences.

3. Methodology and Case Studies

3.1 Methodology

The analyses and discussion of the study is based on expert interviews (2018-2020) with interview partners who work at different levels of government[119] (MoE[120], the National Treasury, County and national commissioners), and in energy-related and other state agencies (ERC, GDC, KenGen, KETRACO, KWS, NLC)[121]. It also features interview partners in development finance institutions (AFD, AfDB, EIB, KfW, TDB, USAID)[122], in private consulting firms (Tetra-Tech, GeoHydro Energy Consultants Limited) and in an energy research institute (GETRI)[123]. In addition, the study analyses are also based on analysis of project reports, several project sites visits and observations as well as informal interviews with project staff and local community members and in the projects host communities (2018-2020).

3.2 Case studies: Large-scale geothermal energy projects in Kenya

In this section, we discuss the three geothermal projects in Kenya that constitute our case study, namely: Olkaria, Menengai and Baringo-Silali (see Figure 2). The Olkaria project is the oldest and most advanced of the projects. It already generates about 623MW of electricity (KenGen interview 2019-2021, Figure 2). This is followed by the Menengai project, which was as at the period of fieldwork in 2019-2021, power plant construction by independent power producers (IPPs) for the first generation of 105MW of electricity is being planned (Figure 2). At the same period, the Baringo-Silali project was still in project exploration and test drilling stages (Figure 2).

Olkaria geothermal project is located in a semi-peripheral area of Naivasha town, Nakuru county, partly in Hell's Gate National Park (a touristic Wildlife Reserve) and in partly on the homeland of Maasai people. Menengai geothermal project is located in semi-peripheral area of Nakuru town also in Nakuru county, with most parts within the Menengai Crater in Bahati sub-county and a smaller part encroaching in previously privately-owned land (NLC interviews 2019). Nakuru county spans an area of 2,325.8 sq km with a population of 1,503,325 according to the 2009 census. Communities in both Naivasha and Nakuru town mainly engage in trading and farming. In contrast, the Baringo-Silali project (consisting of Paka, Korosi and Silali) is

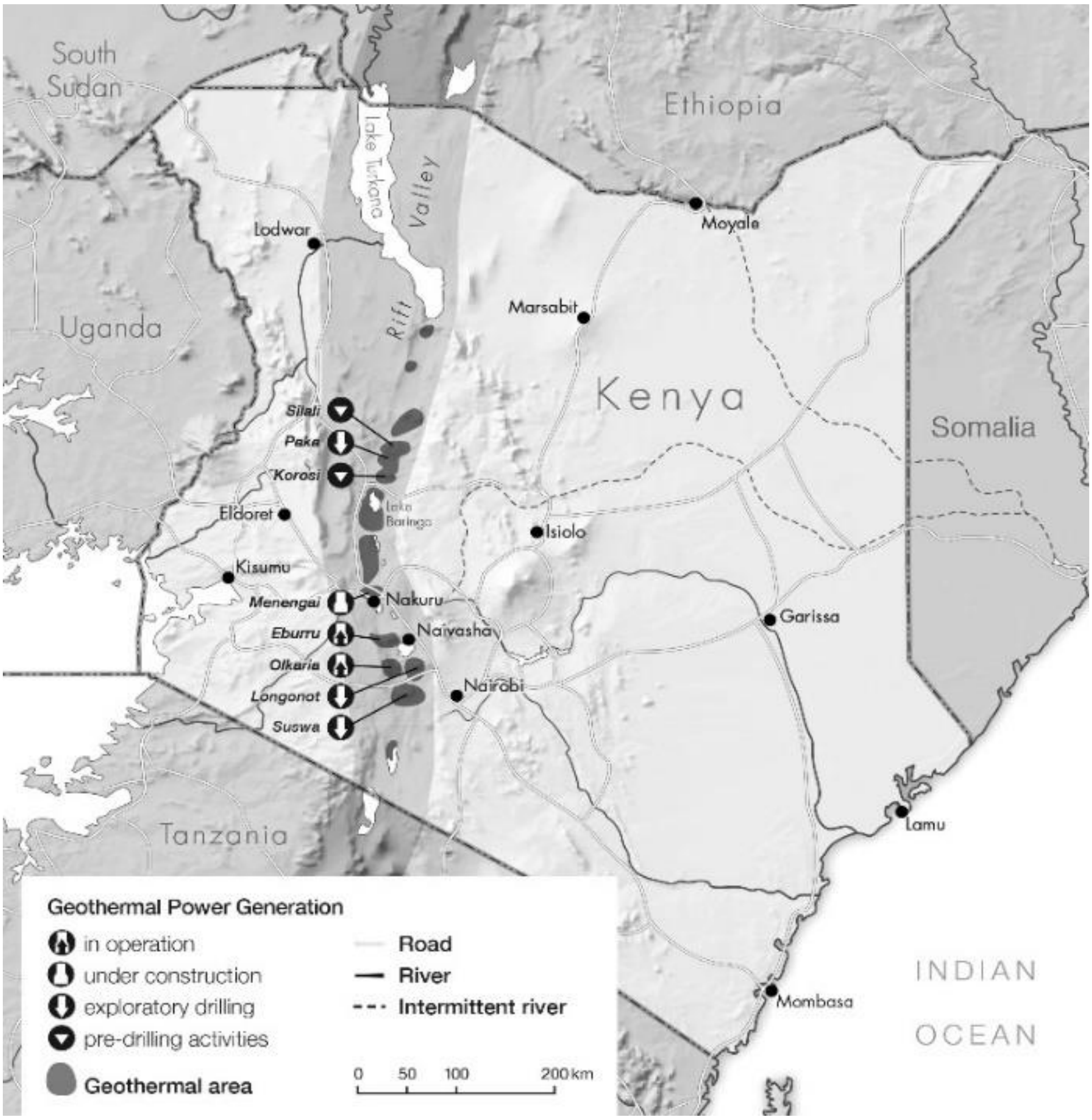
[119]National, local and, since 2013, county levels – following the devolution of government functions in Kenya.
[120]Ministry of Energy.
[121]Energy Regulatory Commission, Geothermal Development Company, Kenya Electricity Generating Company, Kenya Electricity Transmission Company, Kenya Wildlife Service, National Land Commission.
[122]Agence Française de Développement, African Development Bank, European Investment Bank, Kreditanstalt für Wiederaufbau, Trade and Development Bank, United States Agency for International Development
[123] Geothermal Energy Research and Training Institute.

located in the peripheral, semi-arid Baringo county in Kenya, on communal land (NLC interview 2019). Baringo covers an area of 11,015.32 square kilometer (sq km) with a population of 555,561 according to the Kenya Census data 2009.The dominant ethnic groups are the Pokots, Tugens, Endorois and Ilchamus. These communities mainly keep livestock, although the people living in the highlands practice farming.

The several components of Olkaria Geothermal project are majorly developed by KenGen as well as by OrPower4 Inc and Oserian Flowers Ltd, while Menengai and Baringo geothermal energy projects are developed by GDC. The three geothermal energy projects received technical and debt and grants financing support from development financial institutions such as AfDB, TDB, EIB, KfW, AFD, JICA, USAID and the World Bank, as well as by climate agencies such as SREP and the GEF, at various stages of the projects' development (GDC, KenGen, National Treasury, DFI interviews 2019).

Although geothermal energy projects differ depending on their location, they generally go through similar stages and processes before their commissioning and operation. Preliminary surveys and exploration, test drilling and reservoir confirmation and feasibility studies, are first carried out to confirm the viability of the project development. This is then followed by actual site development, which then leads to start-up and commissioning of the project.

Figure 2: *Map showing geothermal fields and sites in Kenya, their locations, and their stages of development.*



Source: *Authors' illustration based on interview information and Klagge & Nweke-Eze (2020).*

4. Results and Discussions

4.1 Infrastructures in large-scale geothermal projects: materialization and generativity

Using the case of large-scale geothermal projects in Kenya, this section shows and discusses how intended large-scale infrastructure projects become generative in the process of their materialization, allowing for the construction of other technical and social infrastructures in project-host communities. It reveals how infrastructures of large-scale projects primarily materialize in two forms 'core' and 'other' infrastructures. The following three sub-sections further discuss the materialization of these infrastructures in categories of their generativity potentials.

4.1.1 Geothermal plants and machineries as 'core' infrastructures

Generally, the geothermal power plants use steam obtained from geothermal reservoirs to generate electricity. Prior to commencement of the work for the power station, production and injection wells are drilled at the appropriate locations to bring this geothermal energy up to the surface (GDC 2010). A mixture of steam and water is then collected from the production well, which are then separated using the steam separators. The steam is used to operate turbines which powers the generators, hence, generating electricity. The condensed steam and the water collected from the production well are injected back into the reservoir through the injection well (GDC 2010).

Other than the above-described power plants, other facilities in the geothermal power project sites are called Steam-field Above Ground System (SAGS) (GETRI interview 2019). They consist of the steam pipelines, brine/condensate pipelines, separators, scrubbers, and the rock mufflers (GETRI interviews 2019). Geothermal steam & fluid from production wells is piped downhill from the separators as two-phase flow (GETRI interviews 2019). The pipelines are made of carbon of robust inches (GDC 2010, Fieldwork 2019). First, there are pipelines from each well pad to separator (GETRI interviews 2019). These are then followed by the steam pipelines from the separator to the power station, the brine pipeline from the separator to each injection well pad, and the condensate pipeline from the cooling water piping to the injection well pad (GETRI interviews 2019). Necessary pipe loops are provided on those pipelines to absorb thermal expansion (GETRI interviews 2019).

The cyclone-type separators are used to separate steam from two-phase liquid coming from production wells (GETRI interviews 2019). Steam goes to power station while the brine goes to injection wells (Project sites observations 2019). Scrubbers of corrugate type are provided just before the power station to eliminate further moisture (GETRI interviews 2019). Surplus steam is released to the atmosphere through vent valves (Project sites observations 2019). Rock mufflers are provided near the separator station to reduce the noise level of the released steam (GETRI interviews 2019).

4.1.2 Access roads and water systems as 'required' infrastructures.

The construction and operation of these 'core' infrastructures necessitate the delivery of 'required' infrastructures, namely: access roads and water pumping and storage systems. The access roads, as the name implies, provide access to the project site, and connect the core project sites to stand-by water system and the equipment-offloading storage sites (Project sites observations 2019, 2020; GDC interviews 2019). These access roads are necessary for transporting heavy well exploration and drilling equipment such as exploration and drilling gears and pumps, drilling rigs, hydraulic excavators with large diameters and thickness; the Steam-field Above Ground System (SAGS) as well as other materials such as diesel fuel, cement and concrete and (in some cases) water with bulk mass; into the project field or site (Project sites observations 2019, 2020; GDC interviews 2019).

The access roads are provided either by improving the capacity of already existing roads through expansion, or by constructing entirely new ones, usually in marginalized peripheral areas where there were no prior existing roads leading to the project sites (GDC 2010, 2013, 2019). Access roads for the projects are fortified with several layers of gravels before surfacing in other to withstand the frequent movement of heavy vehicles, equipment and materials, over-time (GDC 2010, 2013, 2019; Project sites visit 2019, 2020).

Geothermal project construction will typically not materialize on site without the delivery of water pumping and storage systems, which come in different scales depending on the size of the project. The pumped water is used for testing steam and for mixing materials during the construction phases of the project (Project sites observations, 2019). Other than for the development of the project, water also plays an integral role of steam generation in flash and binary geothermal power plants[124] (GDC and KenGen interviews 2019). During the operation of the geothermal power plant, water is used in both high- and low-pressured form to generate steam, which is used to drive the geothermal turbine for the generation of electricity. The pumped water is sourced from nearby water bodies, using diesel-fuel-power generators and through laid-pipes, into large water storage systems (Project sites observations, 2019; GDC 2010, 2013, 2019). Stored water from the storage tanks is then pumped or excavated through other pipes which connect the stored water systems to the project sites, when needed (Project sites observations, 2019; GDC 2010, 2013, 2019). Projects which are developed in areas that are far from water bodies, where construction of laid-pipe are non-feasible, often depend on large water-tank-vehicles which carry water over long distances using already existing or constructed access roads (Project sites observations, 2019; GDC interviews 2018). 'Required' infrastructures also include other infrastructures, such as temporary or sometimes permanent

[124]Most modern geothermal power plants are flash or binary. Binary geothermal power plants are said to be the power plants of the future (KenGen interviews 2019).

water and housing structures for project workers in host communities (Project sites observations, 2019; GDC interviews 2018).

4.1.3 Other technical and social infrastructures as 'generated' infrastructures.

'Generated' infrastructures are the infrastructures that follow and because of the provision of the 'required' infrastructures, in the development of large-scale geothermal projects. These 'generated' infrastructures are provided in several forms: as extension of already existing required infrastructures, as Corporate Social Responsibility projects or activities, as part of resettlement schemes for project affected person (PAPs) (GDC 2010, 2013, 2019, Fieldwork 2019, 2020). These 'generated' infrastructures include technical and social infrastructures such as road networks, water abstraction points, and community housing structures like schools, hospitals, residential buildings, etc. (GDC 2010, 2013, 2019, Project sites observations, 2019, 2020).

4.2 Infrastructures of large-scale geothermal projects: socio-economic development linkages and interests

In this section, we use our case study of three different geothermal projects in Kenya to contextualize and illustrate the socio-economic development linkages of infrastructures in large-scale projects. As shown in section 3 (Figure 2), the projects are in different stages of their development, with Olkaria being the most advanced consisting of already existing plants (see Olkaria II in Figure 3), generating over 600MW of electricity. As at the time of the fieldwork, Menengai is at the final phases of development and was readying for fitting in steam capturing plants for electricity generation; while the Baringo-Silali block is in its preparatory stages of drilling and was recording its preliminary steam striking successes.

4.2.1. Infrastructures of Olkaria geothermal projects

The Olkaria geothermal plants, as 'core' infrastructure projects, were constructed primarily for the purpose of electricity provision at the national level, because of the centralized nature of the Kenyan national electrification plan (MoE interviews 2019, 2020). Therefore, although the geothermal electricity is generated at the local project-host community level, access to electricity in the community is determined in top-down decision framework originating from decisions and planning at the Kenyan Ministry of Energy (MoE interviews 2019, 2020).

Figure 3: *Aerial view of Olkaria II geothermal plants and SAGS*

Source. *ArGeo archives (2020).*

The project development was preceded by the provision of access roads and water supply systems as initial required infrastructures. The 24 km Moi South Lake Road (MSLR)[125] had existed for a long time but had mostly remained in a bad condition. The planned development of geothermal projects and the existence of the Hell's Gate National Park and flower farms in the area, sparked the discussion for and eventually led to the tarmacking of the road (Kuiper 2019, KenGen and MoE interviews 2019). The tarred road is sporadically maintained and repaired by flower farms, hotels and several other non-government organization (NGOs) operating in the area, with some contributions from KenGen (Kuiper 2019; KenGen interviews 2019). The access road was used for transportation of construction equipment and materials used for the construction and maintenance of the different components of the Olkaria geothermal project. The access road additionally provided right-of-way for the construction of transmission lines for the evacuation of generated electricity to the national grid (KenGen interviews 2019). The MSLR is the only paved class D road[126] in Naivasha district of Nakuru county so far, providing quicker access to the main Nairobi-Naivasha highway. This connectivity has enabled quicker transportation of farm produce from the project region, as well as increased access to social infrastructures in nearby towns (Ogola 2013, Fieldwork 2020). The road, however, also increased air and noise pollution from vehicles and increased the number of illegal and informal settlements in the area.

[125]Code named D-323.

[126]Class D roads are secondary roads according to the classification of roads in Kenya

Other than access roads, water pumping, and storage systems were also constructed from water sourced from Lake Naivasha. The water systems were used as a drilling fluid during construction and for well-testing during construction stages of the project. The water systems are also maintained and utilized for pumping water for operating the Olkaria geothermal power systems (GIBB Africa 2009, Fieldwork 2019). The pumped water was then purified by KenGen and piped for use by the surrounding communities at several community water-points, as part of CSR (Ogola 2013, Fieldwork 2020). Four Maasai villages[127] were resettled due to concerns for noise pollution and the emission of Hydrogen Sulphide gas (H_2S) at dangerous levels during the construction of the Olkaria IV project (Fieldwork 2019). The resettlement action plan (RAP) provided for the resettlement of the four villages as one entity with the provision of resettlement infrastructures including roads, pipe-borne water[128], electricity, houses, schools, health centres, lands and land title deeds[129], all of which cover a space of 1700 acres (KenGen interviews 2019, Schade 2017, pp. 13–14). There are however concerns over the efficiency and suitability of the resettlement scheme, because of the massive records of dissatisfaction among many of the resettled community members (Schade 2017, Nweke-Eze and Adongo forthcoming).

4.2.2. Infrastructures of Menengai geothermal projects

At the time of Menengai geothermal project development, the region surrounding the project site was already well serviced by a network of earth roads and all-weather roads, linking up the Nairobi-Kisumu Railway line and trans-Africa highway passing through the southern part of the area (GDC interviews 2019). The Menengai crater, which constitutes a major part of the project's site, had long been an attraction site for tourists and a site for excursion for school pupils and students. The already available access roads leading up to the project site were, however, widened to make it adequate for transporting heavy plant and equipment, personnel, and project supplies (GDC interviews 2019). New network roads connecting to these already existing access roads, were then constructed to further open access to the region for the host communities, for new business creation and expansion of existing ones.

In addition, the government-owned developer Geothermal Development Company (GDC) constructed a 20-million-liters water storage system for storing water sourced from Lake Naivasha (see Figure 4). The stored water was used for cooling the power plants during drilling

[127]The four villages were: Cultural Centre, OloNongot, OloSinyat and OloMayana Ndogo.
[128]5 water structures were constructed for the benefit of humans and livestock in the resettled communities as well as in Narasha, Maiella and Iseneto.
[129]The provision of land title deed was very significant in the resettlement process, as it was the first-time project affected persons (PAP) would become official landowners upon resettlement.

and for well-testing; and is further maintained for use to operating the power plants when they are constructed (GDC 2013, Project sites observations, 2019). As the Menengai geothermal project is located in the Menengai crater, there were no displacements of the communities in villages of Bahati sub-county (GDC 2013, Project sites observations 2019, GDC interviews 2019). However, private farmers whose lands were acquired for road expansion and whose farmlands were affected by the passing of the power transmission lines were compensated in monetary terms (GDC & NLC interviews 2019, Fieldwork 2019).

Figure 4: *Menengai geothermal project water storage systems*

Source: *GDC archives (2020).*

4.2.3 Infrastructures of Baringo-Silali geothermal projects

Unlike the Olkaria and Menengai geothermal projects located in Nakuru county – a semi-peripheral area with some existing infrastructures before the development of the projects, the Baringo-Silali geothermal project is in Baringo county – a peripheral and marginalized area of northern Kenya where infrastructures were scarce. For this reason, ample time was taken to build access roads, out of bare pathways, before the project developers were able to move plant machineries and equipment to the project site (GDC 2019, GDC interviews 2019). A 70km access roads were completed and more than 100km of existing roads were expanded and paved[130], creating a robust road network[131]. These roads are, however, not tarred (see Figure 5), leading to air pollutions (dusts) as heavy and light vehicles drive in high speed along the roads (Project site visits 2018, 2019). The construction of roads was followed by the construction of water pumping systems together with 4.5-million-litre water tanks for storing water sourced

[130]The paved B4 road running upward-north through Marigat ending in Chemolingot.
[131]Paka – Silale; Kadingding – Korossi; Korossi – Lomuge; Naudo – Akwichatis; Chepungus – Kadokoi.

from Lake Baringo in Paka, Korosi and Silali (Project site visits 2018, 2019). The water pumping and storage systems were constructed for sourcing water for drilling and cooling activities during geothermal site development and will be maintained and utilized for operating the geothermal power plants at a later stage (GDC interviews, 2019, (Project site visits 2018, 2019).

Figure 5: *Aerial view of 'required' infrastructures in Baringo-Silali geothermal project site.*

Source: *GDC archives (2020)*

Water from the storage tanks is purified and piped for domestic use in the community[132] through 20 newly commissioned watering points and water treatment plants[133], as part of CSR (Project site visits 2018, 2019, GDC 2019, see Figure 6). These watering points were however not initially planned; they were constructed upon the request of the host communities during negotiations (GDC interview 2019, Community members interviews 2019). Before the construction of the watering points, portable water was, for the meantime, periodically provided using large water-tank-vehicles, which carry water over long distances using already existing or constructed access roads (GDC interview 2019, Community members interviews 2019). GDC is also involved in further CSR activities in the project area (GDC 2019, Fieldwork 2019). It constructed an Early Childhood Development (ECD) classroom at Kibenos in the North Rift Valley and provided scholarships to needy students in the project area to attend universities, secondary and primary schools (GDC 2019, Fieldwork 2019). Since, there is no project

[132]For both humans and animals.

[133]Kadingding, Mesori, Nakuórojang, Moinonin, Cherisan (Pump station I), Tuwo, Chepungus, Reong'o, Chemoril, Natan, Naudo, Angromit, Ponpon, Orus, Katungura, Kwokwototo, Nasorot, Korossi (tank site), Adomejong, Akwichatis. As the time of the fieldwork (2018-2019), some of the provided water points were still under construction at the commissioning, while some of the finished ones were not functioning at full capacity – lacking water at times.

displaced persons so far, there were no resettlement infrastructures in the development geothermal energy in the area (GDC 2019, Fieldwork 2019).

Figure 6: *Provided community water point in Baringo, as part of Corporate Social Responsibility.*

Source*: GDC archives (2020).*

Table 1 summarizes the three categorizations of infrastructures in large-scale geothermal energy projects in Kenya; depicting their types, means of materialization and socio-economic development linkages.

Table 1: *Infrastructures of large-scale geothermal projects and their socio-economic development linkages.*

Categorization of infrastructures in large-scale projects, based on their generativity	**Infrastructure types**	**Materialization**	**Socio-economic development linkages and interests**
'core' infrastructures	Power plants Steam-field Above Ground System (SAGS).	Actual projects	Electricity provision, serving interests at the national level
'required' infrastructures	Access roads	Project development requirement	Access to project sites and to markets, serving interests at both national and community levels
	Water pumping and storage systems	Project development requirement	Water for construction and geothermal steam production, serving interests at project developers' level. By generating electricity, the infrastructure ultimately serves interests at national levels
'generated' infrastructures	Network roads	Corporate Social Responsibilities	Market connections and mobility, serving interests at community levels

	Community water points	(CSR) or community improvise	Water supply for domestic and agricultural use, serving interests at community levels
	School buildings	CSR, Resettlement schemes*	Education, serving interests at community levels
	Health centres		Health services, serving interests at community levels
	Housing	Resettlement schemes*	Modern shelter, serving interests at community levels (while and fulfilling resettlement criteria of the investors)

*The suitability and impact of these modern housing infrastructures, which were provided as part of the resettlement schemes, are however questioned and debated (Schade 2017, Nweke-Eze and Adongo in-print).

***Source**: Author's own*

4.3 Differentiated provisions of infrastructures in large-scale geothermal projects

The analysis in the previous sections reveals how the provision of infrastructures in their various forms differ in their nature, types, and quantity, depending on where they are provided, why they are provided, for whom they are provided, and who is providing them. Olkaria and Menengai geothermal projects are in semi-peripheral areas of Nakuru county where there were already some existing technical and social infrastructures (Fieldworks & interviews 2019, 2020). In these areas, we see that more 'generated' infrastructures and relatively less 'required' infrastructures were provided. In contrast, in the case of Baringo-Silali project, which is in the peripheral and marginalized Baringo county, considerably more 'required' infrastructures had to be provided, as they were either too little or non-existent, in addition to the provided 'generated' infrastructures (Fieldworks & interviews 2019, 2020). So far, the total number of 'required' and 'generated' infrastructures as well as the capital and maintenance costs for providing them, are more for the Baringo-Silali geothermal projects in Baringo county when compared to Olkaria and Menengai geothermal projects in Nakuru county (Fieldworks & interviews 2019, 2020).

The provision of different 'required' infrastructures unveil interesting stakeholder involvement conditions and dynamics based on whose interest and purpose they serve. The reconstruction or tarmacking of already existing roads in semi-peripheral areas, which serve the interest of not only the project but also the interests of other actors, are often not solely delivered by the project developers and investors (GDC, KenGen, DFI interviews 2019). As the MSLR in the Olkaria geothermal projects illustrates, other actors or stakeholders who also benefit from the infrastructure make contributions for their construction and maintenance (Fieldwork 2019, Kuiper 2019). In contrast, the new roads usually constructed in formerly marginalized peripheries (example, the access roads for the Baringo-Silali project) as well as the water pump and storage systems provided in all the projects specifically serve the interest and purposes of the project and their developers at the time of their construction (GDC interviews, GDC 2019). As such, the project developers and investors in the geothermal project bore the sole responsibility of delivering the 'required' infrastructures.

Projects with more involvement of international development institutions and agencies as investors or financiers, so far, recorded a greater number of 'generated' infrastructures provision in form of corporate social responsibility and resettlement schemes for project affected persons (PAPs). There is currently more involvement of international development institutions and agencies in Olkaria and Menengai geothermal projects, and subsequently a greater number of 'generated' CSRs (Fieldwork 2019, 2020, GIBB Africa 2009, GDC 2010, 2013). However, this can be explained by the fact that Baringo-Silali project is just completing its exploratory stage. More CSR projects are expected to be provided in Baringo-Silali host communities in the future as the project proceeds into steam gathering and plant construction stages (GDC interviews 2020). By so doing, these development institutions and agencies (including the German KfW, the EIB, the AfDB and the French AFD) seek to establish their reputation as players who abides by sustainability principles (EIB, AfDB, KfW interviews 2019).

Furthermore, the level of engagements and negotiations between the project developers and host communities depends on whether the 'required' infrastructures are provided as a new project or as a reconstruction of already existing ones. The reconstruction of the MSLR roads leading to the Olkaria projects or the expansion of the roads leading to the Menengai Caldera, required less engagements with the host communities, except in specific cases where land had to be bought from their private owners (like in the case of Menengai geothermal projects) or in cases where project affected persons (PAPs) had to be resettled (like in the case of Olkaria geothermal projects) (Fieldwork 2019, 2020, GIB Africa 2009, GDC 2010, 2013). In contrast, the construction of new access roads for Baringo-Silali project development entailed constant and meticulous negotiations between the project developers and the host communities (Fieldwork 2019, GDC interviews 2019, Greiner et al. 2021). In this case, non-adherence to negotiated terms either due to change of contractors or ignorance of workers in the project sites often present protests and risks of conflicts (Fieldwork 2019, Klagge et al. 2020).

5 Conclusion

This paper analyzed the infrastructures in large-scale geothermal energy projects in Kenya, depicting their different processes and forms of materialization, and their complex socio-economic development linkages. We see how the materialization of 'core' infrastructure projects become generative, enabling the provision of other 'required' and 'generated' infrastructures. We also see that while the 'core' infrastructures of the projects are determined by and serve electrification interests at national level, their associated 'required' and 'dependent' infrastructures, mainly serve socio-economic development interests of project-host communities at local levels. Furthermore, by comparing the degree and scale of the provision of these infrastructures, the study reveals that the provision of these infrastructures is differentiated based on the local socio-economic and spatial contexts of the project-host communities. These findings demonstrate the complexity of sustainable large-scale projects planning and implementation in the Global South. It further shows how impact evaluation studies of large-scale development projects will be more encompassing and complete, when we consider the socio-spatial and socio-economic generativity potentials of their infrastructures. Overall, the socio-economic impacts of large-scale infrastructure projects are better appraised when the materialization and generativity potentials of the infrastructures are considered. The materialization of these infrastructures often leads to the emergence of other technical and social infrastructures – which also assume lives of their own, serving different interests. It is the combination of these infrastructures and their connections and interaction that allows for a more encompassed appraisal of the socio-economic impacts of large-scale infrastructure projects, especially in the Global South context.

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Chapter 7

Cross-scale linkages of centralized electricity generation: Geothermal development and investor-community relations in Kenya's Semi-arid North.

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Abstract

Based on a study of Kenya's geothermal-energy development in Baringo-Silali, we explore how and with whom government actors and local communities in rural and peripheral areas interact in planning and implementing large-scale power plants. Starting from a comparison of decentralized and centralized energy systems, we demonstrate that the development of these large-scale infrastructures and their associated investor-community relations are governed by various cross-scale linkages. To this end, we adapt the concept of cross-scale linkages from the literature on natural-resource governance in order to explore actors, rules and practices at local, regional, national and international levels.

Keywords: Baringo, Centralized electricity generation, Corporate social responsibility (CSR), Cross-scale linkages, Geothermal development, Governance, Infrastructures, Investor-community relations, Kenya.

1. Introduction

Centralized electricity generation, with large-scale power plants feeding into national grids, is mainly associated with top-down planning, centralized control and negative, often unsustainable local impacts at the generation facilities' sites. In this contribution, we question this dominant narrative. We argue that cross-scale linkages in the implementation and governance of large-scale electricity generation and in associated investor-community relations need to be taken into account in order to understand local impacts of centralized energy systems. Based on preliminary results from an ongoing qualitative study of geothermal-energy development in Kenya's semi-arid north, we will show that there are various cross-scale linkages at work that govern the relations between local, county, national and international actors, rules and institutions. In our paper we will explore how different types of cross-scale linkages shape the implementation and governance of geothermal development and what potentials for local development they (might) entail. The expansion of geothermal-energy provision in Kenya provides an interesting case to study such linkages in centralized electricity generation, because it has become the most important source of grid-connected electricity in the country and has large future potential. It is therefore one of the main pillars of Kenya's ambitious development strategy Vision 2030 with far-reaching implications for economic and social development in the country's (semi-)arid and peripheral North where future geothermal development will take place.

Our approach is inspired by recent research on large infrastructures which demonstrates that such projects are the result of combining technology with diverse actors, rules and practices (Harvey et al., 2017; Sovacool & Cooper, 2013). Such complex, multilayered and heterogeneous structures do not follow clear plans and cannot be implemented and governed in a straight-forward and top-down manner. Rather, we follow Li (2005), who, in response to Scott's (1998) seminal work on high-modernist, state-planned schemes, has argued that "(r)ather than emerging fully formed from a single source, many improvement schemes are formed through an assemblage of objectives, knowledges, techniques, and practices of diverse provenance" (2005, p. 386). Infrastructures, such as geothermal power projects, thus can rather be understood as open-textured, large-scale social experiments (Wynne, 1988). This is not to say that power relations do not matter. Yet, in order to understand how power is exercised within such large-scale projects, we need to take into account uncertainties and contingencies resulting from the multi-layeredness of their governance.

In the following we first explore the specificities and governance implications of decentralized versus centralized electricity generation. After situating geothermal development in Kenya's electricity sector and introducing our study region and methodology, we present our empirical results. This will be followed by our conclusions.

2. Governance and Cross-scale Linkages in Electricity Provision

Governance structures in the electricity sector can take various forms but are usually subject to national legislation and policies. This is not only because electricity is regarded a critical infrastructure and prerequisite for most other activities. It is also due to the electricity sector's network character and its socio-technical nature, which require coordination between different levels and places as well as between technological and social elements to function smoothly (Hughes, 1983). Nonetheless, there is a great diversity of generation technologies, grid architectures and resulting geographies. An important distinction is made between centralized and decentralized electricity systems and generation facilities. Apart from technical and geographical differences, they also differ in their ownership and financing, thus resulting in specific governance structures and cross-scale linkages (Table 1).

Table 1. *Comparison of Decentralized and Centralized Electricity Systems from a Technology, Geography and Governance Perspective for Rural Global South Contexts.*

	Decentralized		**Centralized**
	Stand-alone	**Mini-grid**	**(National) Utility**
Grid connection	Off-grid	Isolated (*local*) network	*National* grid
Generation facilities' size and geography	Small-scale *local*, Production-site = consumption-site	Medium-scale *local*, Production-sites close to consumption-sites	Large-scale *centralized*, Production-sites far away from consumption-sites
Power-availability challenges	Low electricity volumes	←→	Frequent outages
Local technology challenges	Repair & maintenance	←→	Maintenance, protection against power theft & sabotage
Ownership	Private household or firm, often *local*	*National* or other government and/or private firm	*National* providers (plus independent power producers – IPPs)
Financing	Owners, often with *international* donor/DFI and/or *national*-state support	Owners, often with *international* donor/DFI and/or *national*-state support	*National* state, *local*-connection charge often paid for by consumer, sometimes *international* DFI support
Local governance dimension	Strong, with cross-scale linkages to national and international actors		Small, apart from (possibly) at power-generation sites

Source: *Own compilation based on various sources.*

In much of the Global South, public electricity infrastructures have until recently mainly been provided in the form of large-scale generation facilities, mostly hydro- and coal-powered, feeding into national grids. Rural and peripheral regions, however, are often not connected to these centralized infrastructures, and electricity can only be provided in a decentralized way. This includes small-scale off-grid electricity infrastructures like diesel generators and, more recently, solar home systems as well as mini-grids, which have emerged as another alternative in the past years (Alstone et al., 2015), often donor-driven and provided by non-state actors. Because of the close connection between power-generating facilities and off-takers, as well as its flexibility and scalability characteristics, decentralized electricity provision is often regarded as advantageous from a local-development perspective and in terms of sustainability (Boliko & Ialnazov, 2019; Bouffard & Kirschen, 2008; Kirubi et al., 2009). In contrast, centralized electricity generation is mainly associated with inflexibility, centralized control and negative local impacts at the power-plant locations (Alanne & Saari, 2006; Boamah, 2020). These often include environmental damage, large-scale resettlements and generally the deterioration of local livelihoods. As connecting people to national grids in peripheral areas is expensive, large-scale power plants might not even provide electricity access to neighbouring, hitherto unserved local communities (Alstone et al., 2015). In sum, decentralized electricity systems are regarded as supporting local development, whereas centralized electricity-generation facilities are not or to a much lesser degree.

While the governance of decentralized electricity systems has a strong local dimension, the governance of centralized electricity generation is overwhelmingly shaped by cross-scale interactions. Power plants are usually implemented and operated from a distance either directly by national power companies or by government-commissioned IPPs (independent power producers), since the electricity can be transported via national grids to where it is required. Decisions on the location of large-scale plants follow factors such as, in the case of renewable-electricity generation, the availability of natural resources (water, wind, solar radiation, geothermal reservoirs). Such power plants are therefore often located far away from economic and population centres and entail cross-scale linkages in the realms of planning, development, financing, ownership, and management. These linkages encompass national- and often also international-) level investors and local-level communities, they are complex and bear challenges in need of careful consideration.

2.1. Cross-scale linkages and multilevel governance

With reference to Berkes we define cross-scale linkages as interactions of different actors, institutions, and rules "both horizontally (across space) and vertically (across levels of organization)" (2002, p. 293). Scale challenges and cross-scale linkages play an important role in the literature on human-environment relations and common-pool resources (Cash et al., 2006; Ostrom, 2005). These ideas are helpful in conceptualizing cross-scale linkages in investor-community relations of electricity-generation facilities. Generally, addressing scale issues is seen as for sustainable resource management (Cash et al., 2006), where top-down approaches have proved to be "*too blunt and insensitive to local const[r]aints and opportunities, ... [whereas] bottom-up approaches ... are too insensitive to the contribution of local actions to larger problems*." Instead, Cash et al. (2006) propose "a middle path that addresses the complexities of multiple scales" and distinguish between three "responses to problems of scale and cross-scale interactions: institutional interplay, co-management and bridging organizations", all of which play a role in our case study.

Institutional interplay means the vertical interplay of governments and administrations at different levels. In Kenya this includes, for example, royalty-sharing from natural-resource exploitation and the distribution of government functions as a result of devolution. The creation and empowerment of legislative and executive actors at the county level has increased the options for institutional interplay and, more generally, added complexity to a political system which has been characterized by corruption, patronage and inter-ethnic competition (Mwangi, 2008). Institutional interplay can reach from highly asymmetric to relatively balanced relations. The latter comes close to what Cash et al. (2006) call co-management, i.e. "*a continuum of arrangements that rely on various degrees of power- and responsibility-sharing between governments and local communities*". We adapt this notion of co-management to denote cooperation between local communities and other actors, as for example in the management of water points associated with geothermal development.

The establishment of bridging organizations as the third response to scale challenges goes beyond intergovernmental or government-community activities. Bridging organizations are deliberately designed to act across (administrative) scales, thereby sidelining administrative hierarchies to some extent. They are similar to what Hooghe and Marks (2003) call Type II multilevel governance. Whereas Type I multilevel governance refers to general-purpose jurisdictions at a limited number of levels as part of a systemwide architecture – thus reflecting traditional government levels and interactions –, Type II multilevel governance is characterized by task-specific jurisdictions with intersecting memberships. Its main advantage is that it can respond flexibly to newly emerging or changing stakeholder preferences. In our case study, the Geothermal Development Corporation (GDC) acts as such a bridging organization.

The three forms of multilevel governance organization revolve mainly around the interaction of administrative government levels within a country. However, international actors as well as communities as an active and possibly resistant part to such forms need closer consideration. The concept of context shaping put forward by Hay (1997) helps to better understand their roles in the multilevel governance of large-scale power generation projects. We will demonstrate later that local communities have – to some extent – the power to re-define what is possible for the investor and "alter the parameters of subsequent action" (Hay, 1997, p. 51).

3. Study Context and Methodology

Kenya, with its ambition to achieve universal electricity access by 2020/2022, now pursues a national-government strategy to combine centralized and decentralized electricity provision. While, on the one hand, grid access is to be expanded along and through extending and densifying existing grids, the remaining areas, on the other hand, are supported in the development of off-grid and mini-grid systems (MoE, 2018). The comprehensive electrification effort is part of the Vision 2030, which aspires to make Kenya a middle-income industrializing country by 2030 (GoK, 2007). It also aims at improving livelihood conditions in hitherto unserved rural and peripheral areas.

3.1 Overview of Kenya's Power Sector and the Role of Geothermal Electricity

The recent development in Kenya power sector is characterized by an impressive growth of grid-connected electricity generation and a transformation from hydropower and fossil-fuel to geothermal electricity (Table 2). Geothermal resources have been used for electricity generation in Kenya since 1981, when the first geothermal power station started operation south of Lake Naivasha. Today, there are four geothermal power stations in operation (Olkaria I–IV), all located in Hell's Gate National Park, which was created in 1984 (Hughes & Rogei, 2020). Two more are under construction (Olkaria V) or planned (Olkaria VI). The development of Olkaria steam-fields has become infamous for involuntary resettlements and evictions of local Maasai and other communities. Attempts to mediation have been unsatisfying so far and local activists are in contact with the World Bank as the major international funder about their grievances (Hughes & Rogei, 2020; Koissaba, 2018; Schade, 2017; but also see Mariita, 2002).

Table 2. *Grid-connected Electricity Generation by Sources in Kenya, 1995, 2005, 2015.*

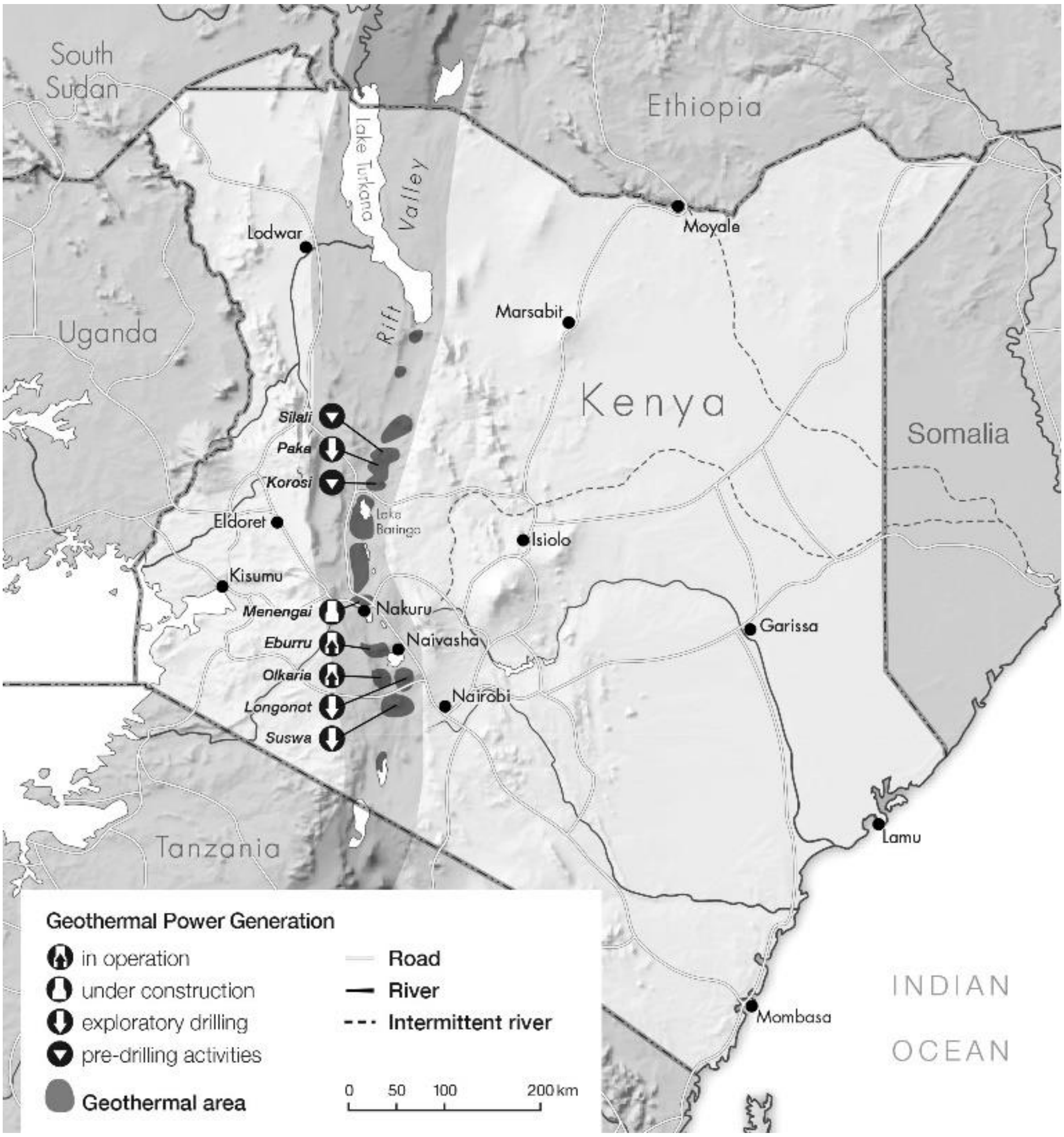
	1995		**2005**		**2015**	
Energy sources	GWh		GWh		GWh	
Oil	416	10,2%	1645	28,3%	1206	12,4%
Biofuels	122	3,0%	131	2,3%	122	1,3%
Hydro	3163	77,3%	3026	52,0%	3787	39,1%
Geothermal	390	9,5%	1003	17,2%	4479	46,2%
Solar PV			13	0,2%	37	0,4%
Wind					57	0,6%
Total	4091	100%	5818	100%	9688	100%

Source: *Data from www.iea.org/statistics.*

The further tapping of its rich geothermal resources is Kenya's most important strategy for increasing centralized electricity generation. In 2008 the Kenyan government incorporated the Geothermal Development Corporation (GDC), a parastatal under the auspices of Ministry of Energy (MoE), to fast-track the exploitation of geothermal energy with the ambitious aim to realize a geothermal capacity of 5,000 MW by the year 2030 (Eberhard et al., 2016). GDC was established due to the high upfront costs and risks involved in geothermal development, which makes it unattractive for private investors (Klagge & Nweke-Eze, 2020). These include the costs for establishing the necessary ancillary infrastructures, such as roads and water provision, and the risk of not hitting the anticipated steam capacity. GDC covers these risks and costs, supported by loans and grants from foreign donors and development partners, with the aim to sell the generated steam to the national power-generation company KenGen or to private IPPs.

GDC has taken the responsibility to develop geothermal-energy production from Lake Naivasha northward along the Rift Valley, starting in 2011 with Menengai, a caldera bordering the northern side of the city of Nakuru (Figure 1). It has an estimated total potential of 1,600 MW of which 160 MW are realized (GDC, n.d. a). Currently, the so-called Baringo-Silali Block with an estimated total potential of 3,000 MW is developed. The first three phases will develop 100 MW each with funding from the Government of Kenya and KfW (GDC, n.d. b). Detailed surface studies were concluded in 2013 in three exploration sites, Korosi, Paka and Silali. In December 2018 drilling started after a first rig was transported from Menengai to Baringo-Silali, and in September 2019 steam was hit in Paka (GDC, 2019).

Figure 1. *Map of geothermal areas and power generation in Kenya*



Source: *Authors' illustration based on interview information and* *https://www.researchgate.net/figure/Map-showing-location-of-geothermal-area-along-the-Kenyan-Rift-Valley_fig1_271614652 (29.2.2020).*

3.2 Study Region and Methodology

Baringo is part of Kenya's Central Rift Valley. It is a semi-arid acacia-bush savanna with high inter-annual variations in rainfall and recurrent droughts. Lake Baringo, one of two freshwater lakes in the Rift Valley, is the only perennial water source. The largest part of the Baringo-Silali complex falls into Baringo County, which is inhabited almost exclusively by Nilotic-speaking Pokot. The Pokot in Baringo have been semi-nomadic pastoralists for much of the past 200 years and constituted a close-knit, egalitarian and rather inward-looking community (Anderson & Bollig, 2016; Bollig, 2016). Since about the 2000s, however, an increasing number of households have started to diversify their livelihoods, settled down more permanently and started rain-fed cultivation. This has caused conflicts regarding ownership and usage of land, which had been almost exclusively used as communal rangelands before, and an increasing fragmentation of the Pokot into territorially-based communities (Greiner, 2017). The area is remote and has been marginalized in the past with high illiteracy rates (Baringo County Government, 2014), a poor road network and strong population growth rates. Frequent outbreaks of violence and cattle raids between the Pokot and their neighbours have worsened the situation (Greiner, 2013).

Our findings on geothermal development in Baringo are based on ongoing ethnographic fieldwork in the area (Bollig et al., 2014; Greiner, in press), which includes a multitude of informal interviews with community members and representatives in the years 2009-2020. This is complemented by expert interviews, the analysis of relevant investment and policy documents and site visits in Baringo-Silali, Menengai and Olkaria geothermal fields (2017-2020). We conducted interviews with key experts involved in the development of geothermal energy in Kenya, working at different government levels (MoE, National Treasury, County Commission, County Government), in energy-related and other state agencies (ERC, GDC, KenGen, NLC) and in development finance institutions (AfDB, KfW). As many of the interviews were granted on the condition of anonymity, we do not provide further details on the interviewees.

4. Results

In the following paragraphs we will focus on actors, rules and practices in the context of the implementation of infrastructures for geothermal development. Starting with the parastatal Geothermal Development Cooperation (GDC) and other important actors, we then highlight the most important formal rules and regulations that govern the local and community aspects of infrastructure implementation. Following this, we illustrate some of the practices and institutions that have emerged in the negotiations of the investor (GDC), local communities and other stakeholders with a focus on corporate social responsibility (CSR) measures, community responses and local practices.

4.1 GDC as Bridging Organization, its Partners and Stakeholders

The most important actor in geothermal development in Baringo-Silali is the Geothermal Development Corporation (GDC), which is headquartered in Nairobi. Incorporated by the government of Kenya in 2008, GDC performs the function of a bridging organization. Its tasks include exploration and drilling in promising geothermal sites, development and management of steamfields, associated legal processes, and community engagement. GDC has become a specialist in these activities – even acting as advisor in neighbouring countries – and involves various partners and stakeholders (Table 3). Partners and stakeholders include public-government actors at the national level, such as ministries and agencies. Private national- or even international-level actors include consultants, contractors and, at a later stage, power-plant developers and operators.

Table 3. *GDC Tasks, Important Partners and Stakeholders.*

Tasks	**Important partners & stakeholders**
Sensitization of local communities and management of community relations	Local populations, community representatives (especially elders), SACCOs (Savings and Credit Cooperatives)
Obtain land-access rights	County governments, local communities & (other) land owners, NLC (National Land Commission)
ESIA (Environmental and Social Impact Assessment)	NEMA (National Environment Management Authority), local communities, county governments, DFIs, consultancies
Other regulatory issues	EPRA (Energy and Petroleum Regulatory Authority), MoE (Ministry of Energy), other ministries plus various others
Financing	MoE, Ministry of Finance/National Treasury, external funders (in Baringo-Silali: KfW, GRMF)
Exploration & drilling	Consultants (geology, engineering), contractors (construction, catering, guarding), SACCOs & local labour
Management of steamfields	Power-plant developers and operators (KenGen, IPPs)

Source*: Authors' compilation.*

Most important for cross-scale linkages are international as well as local- and county-level actors and stakeholders. International actors include financing institutions, in Baringo the German Development Bank (KfW) and the Geothermal Risk Mitigation Facility (GRMF) of the African Union Commission (Klagge & Nweke-Eze, 2020). While the financing contract is negotiated and administered by the Ministry of Energy and the Treasury on behalf of GDC, KfW is also involved in the project itself and has its own guideline on environmental, social and climate standards (KfW Development Bank, 2019), which follow World Bank and IFC (International Finance Corporation as part of the World Bank Group) standards and which GDC must meet to continue to get the funding.

Interestingly, there are, to our knowledge as of March 2020, no international, national or local NGOs (non-governmental organisations) or CSOs (civil-society organisations) active in Baringo. This stands in contrast to other large renewable-energy projects in the wider region, like the Bujagali Hydropower project in Uganda (Linaweaver, 2003), Lake Turkana Wind Park in northern Kenya (Enns, 2016) and geothermal development in Naivasha in southern Kenya (Hughes & Rogei, 2020). The reason for this is related to the so far relatively little involvement of international investors (Klagge & Nweke-Eze, 2020), to the history of the Pokot people and the marginalization of the region (see 3.2). The representation and inclusion of local and community interests in Baringo geothermal development therefore hinges on formal and informal engagement activities by GDC and government actors as well as on community responses and local practices beyond these activities.

At the regional and local level, the county government and the communities have to grant land-access rights and participate in the Environmental and Social Impact Assessment (ESIA). The local population is involved in the community engagement as part of ESIA and the development and implementation of related CSR measures. They also provide labour, mostly unskilled and casual, to GDC and its contractors. This happened primarily in the early implementation stage through locally-based SACCOs as important intermediaries between GDC and contractors on the one hand and the local population on the other hand. Furthermore, once electricity is generated, the county and the communities will receive a share of the royalties according the new *Energy Act* (2019), which stipulates that 75% remain with the national government, while 20% and 5% go to the county and the community respectively, the latter to "be payable through a trust fund managed by a board of trustees established by the local community" (Nr. 85/3b). So far, the communities are represented by their informally constituted elders, who frequently meet in the council of elders. These community representatives act as major contact for GDC and the county government and, in turn, communicate community grievances to GDC.

The importance of interaction with local- and county-level actors is highlighted by the fact that GDC has community-relations officers and a Regional Administrator for Baringo-Silali. Furthermore, GDC's departments for "Environment Management" and "Community Engagement" are located in Nakuru, close to both Menengai and Baringo-Silali (Figure 1). The rationale behind this is that GDC staff members in these departments can reach the project sites more easily. In contrast, corporate planning, financing and dealing with national and international partners are done from the headquarter in Nairobi. The relationships between GDC and its partners and stakeholders are mainly governed by national legislation or regulations.

4.2 Formal Rules and Regulations Governing GDC's Activities in Baringo

The geothermal development process is Baringo is subject to a variety of laws and other types of regulations, which govern important aspects of investor-community relations such as land access, environmental issues and community engagement. Negotiations over these issues take place between different actors, representing an interplay among different levels of formal administrations and agencies as well as between formal and traditional authorities.

4.2.1 Access to Land

Land acquisitions for geothermal operations are complex. To access the resource, pastureland had to be provided for establishing local infrastructures including well pads, water systems, storage facilities and workers' camps. Ownership- and use-rights had to be negotiated with the traditional authorities and in some cases private owners. The construction of the local road network was started 2014 by a local contractor, followed by levelling the terrain for the well pads, i.e. the actual drilling sites. During all these construction processes GDC and contractors were involved in negotiations with community representatives. If, for example, livestock trails were affected by road construction, or the levelling of a well pad required cutting down ritual trees, a negotiation between the parties was facilitated by the GDC community-relation officers to explore changes in route or possible compensations.

Land acquisition happened in a phase of profound legal transformation. The *Community Land Act* only became effective in 2016. With this Act, former community trust land was replaced by community land, which is adjudicated to the respective community. The Community Land Act protects the community land rights, defines the role of counties in land matters and provides rules for compensation in case of compulsory acquisition by the state. The process of land adjudication, however, whereby local communities have to be registered as rightful owners of the land, had not happened yet in Paka, Silali and Korosi when GDC started their operations. In this opaque situation, GDC went forward to negotiate where necessary on an informal basis with community representatives and postponed such negotiations where possible.

4.2.2 ESIA and Community Engagement

An ESIA, officially referred to as Environmental Impact Assessment (EIA), is "a critical examination of the effects of a project on the environment. An EIA identifies both negative and positive impacts of any development activity or project, how it affects people, their property and the environment. EIA also identifies measures to mitigate the negative impacts, while maximizing on the positive ones" (NEMA, 2020). *The Environmental Management and Co-*

ordination Act (1999, amended 2015) regulates that geothermal-energy projects have to undergo EIA, and there are additional *Environmental (Impact Assessment and Audit) Regulations* on its scope and procedure, with NEMA as supervising government agency. Viewed in the light of multilevel governance, ESIA represents an institution imposed on project developers in a top-down manner, thereby constituting cross-scale linkages and requiring institutional interplay of actors at different levels (Table 3). In Baringo-Silali, this includes KfW as major international funder with its own guidelines, and we were told that the ESIA for Baringo-Silali had to be updated in 2016/2017 due to request by KfW. As the ESIA for Baringo-Silali has not been made available so far, the following information on community-related activities is drawn from other sources, mainly our interview material.

The first ESIA report was submitted to NEMA in 2012 and approved in 2013, which marked the official start of the project. It was followed by the acquisition of land, the construction of roads and other facilities as well as the establishment of a community-engagement framework, which includes, according to GDC representatives, twelve community public meetings per year as open forums where usually around 50-150 people show up. The GDC representatives both in Nakuru and Nairobi regard community engagement as an important and critical part of GDC activities. They say it is important to involve local people from the early stage and step-by-step so that everybody is carried along. This is reiterated by a MoE interview partner who stresses that it is the GDC's responsibility to make sure that they have the buy-in of the communities, which he sees as a critical success factor: To achieve "community buy-in", GDC has to integrate with the communities in the project operations, reaching from local jobs to investing in social infrastructure. Here lies the rationale for various CSR measures implemented by GDC. It remains unclear, however, to what extent CSR measures are (also) required by NEMA as part of the ESIA process or by KfW as major international funder.

4.3 Water Points and Other CSR Measures

From 2016 onward, GDC started with the construction of the water infrastructure to supply water for drilling, including water basins for contaminated water. The water is pumped with high pressure from Lake Baringo into four basins on the volcano tops. From there it is released by gravity to the drilling sites. Additionally, GDC has started building a "robust community water supply program with 20 watering points for domestic and livestock use" (GDC, 2019), which includes treatment plants to filter water for human consumption.

The 20 community water points (CWPs) are planned as freely accessible infrastructures, which – according to the NLC County Coordinator for Baringo – are one form of CSR by GDC. This view, however, is not shared by representatives of the local communities, who understand the CWPs as part and parcel of the initial agreement with GDC. According to GDC representatives, it was community representatives who initially demanded access to water. This request was then taken up in GDC headquarters, where water provision was identified not only as a major leverage to buy-in the community, but also as key development factor. This apparently convinced KfW to approve the water-supply programme to safeguard the project in the future.

The actual sites of the CWPs were determined by the communities. To manage the CWPs, GDC has encouraged them to form a committee for each water point. These committees are meant to regulate water access and to prevent sabotage through unplanned usage, which turned out as a major problem in some areas. Since repair of leakages and damage caused by illegal tapping is done by GDC or a contractor, these water-point committees (WPC) can be classified as institutions of co-management.

CSR-related institutions and regulations were also introduced to facilitate recruitment and payment of temporary workforce from the communities by GDC and contractors. To this end, the communities were encouraged to form Sa (SACCOs) that ensure fair distribution of jobs and decide on the usage of an overhead paid to the communities. Another labour-related CSR measure, however not yet realized, is an agreement between GDC and Baringo County government about vocational training of 400 youth for equipment maintenance, thereby facilitating a form of human capital investment. Further CSR measures mentioned in the interviews were the donation of two “medical outreach vehicles”, classroom renovations, a sponsorship programme for students, the establishment of Early Childhood Development Centers (ECDC), food donations to local schools and water-trucking during extremely dry seasons.

Overall, there is no public and clear information on CSR measures in Baringo-Silali and their implementation status. Meanwhile, the local communities have developed their own ways to deal with the challenges and opportunities provided by GDC.

4.4 Community Responses and Local Practices

Like much of Northern Kenya, Baringo is a difficult area for investors, not only due to the lack of basic infrastructures, but also for security reasons (Lind, 2017). Since decades, the area is conflict-ridden, and automatic weapons are widely available (Mkutu, 2007). Disguised as traditional cattle raids, assaults on neighbouring communities are increasingly used to achieve political goals; and more recently also police and army have become involved and suffered losses (Greiner, 2013). Since the Kenyan state never managed to establish its monopoly on violence in the area, GDC – like other investors – is vulnerable and has to negotiate their presence with care (Greiner, 2020).

To communicate grievances to GDC, the local communities have resorted to roadblocks. Often symbolic in nature, these consist of a few stones or branches, but in the context of the general insecurity, they have proved as an effective means to enter into negotiations, regarding the non-payment of salaries by contractors or the lack of water in CWPs. As roadblocks can become a serious problem for work schedules and sometimes also for the workers' safety, GDC is usually keen on dealing with these issues quickly, though solutions are often short-term or postponed nonetheless (especially regarding payments from contractors). There are also cases in which GDC vehicles just take alternative routes to the project sites to avoid roadblocks. Roadblocks can be initiated by individuals (mostly regarding non-payments), but also together with elders (especially regarding lack of water at schools) or youths (regarding lack of employment). There are also other cases of "ad-hoc negotiation" during construction, e.g. welders were forced to weld holes in pipes so that a leak could occur through which locals could get water (information provided in this and the following paragraph was gathered and cross-checked in several community and expert interviews, 2018-2020).

While GDC and the water point committees try to sensitize communities about the intended use of water, unauthorized usage and consumption of unfiltered water constitute a major problem. Leakages and breakages of pipelines are common, and people tend to use the closest water source available, sometimes waiting hours for water to be pumped at frequent leakage points. Vandalism, e.g. tampering with pressure-relief valves or cutting the 5-inch community pipelines, frequently happens along remotely located pipelines. Since maintenance by contractors or GDC staff can be slow, people also try to fix community pipelines with ropes or stones, whereby those make-shift fixes usually cannot handle the pressure for a long time and even baboons are destroying those fixes to get water (interviews and observation in February 2020). Apart from human and animal consumption, leakages and overflows of livestock water points are also used for farming activities.

Despite the implementation of CWPs, the local population still perceives water as a main issue and complains, for example, that livestock water points are not enough for the number of livestock in the area. Apart from more water points, the communities also demand more employment opportunities and other benefits. Whether the recent striking of steam in Paka will lead to more CSR measures is an open question right now. Notwithstanding, and partly due to the threat of armed violence and resistance, community responses figure highly in GDC's strategy. This provides a good example of how local communities can – to some extent – "alter the parameters of subsequent action" (Hay, 1997, p. 51) and influence the investor and its strategies. As has been shown, KfW as the international funder is also a player in this context, which also tries to protect its reputation by ensuring adequate consideration and adherence to environmental and social standards. This demonstrates the importance of cross-scale linkages in geothermal development and the associated investor-community relations.

5. Summary and Conclusions

Geothermal development for centralized electricity generation is still in exploration and drilling stage in Baringo-Silali. Even in this early stage, its implementation and governance is much more complex than top-down, with various cross-scale linkages spanning from the local community shaping context conditions for GDC activities on the ground to international funder KfW with its impact on ESIA and CSR measures. The resulting types of multilevel governance in geothermal development in Kenya include institutional interplay, co-management and GDC as bridging organization. Our case study also shows that centralized electricity generation can, like de-centralized electricity systems, have strong local impacts, with local communities playing an active part.

The legal situation in Kenya with its progressive new constitution and environmental legislation, the new Community Land Act (CLA) and royalty-sharing rules as well as recent devolution plays an important role in enabling and enforcing cross-scale linkages and multilevel governance. As of now, the county level seems to be less important in the case at hand. This, however, might change with both the ongoing implementation of devolution and the progress of geothermal development. While there is evidence that devolution did not dismantle, but rather restructure patronage and rent seeking in Kenya (D'Arcy & Cornell, 2016), it would be premature to draw conclusions regarding the county's role regarding geothermal energy infrastructures. This also due to the fact, that the regulating Energy Act has only recently been issued (in 2019), and the project is still in its infancy. Most significant, however, is the fact that no royalties have yet been distributed, which could lead to irregularities and conflicting claims. As soon as centralized electricity generation is established in Baringo-Silali, the county receives 20% of the royalties, which could, for example, be used to provide connections to the national grid. Starting electricity generation will also involve new actors like IPPs and climate finance organizations, thereby making governance structures more complex and international and strengthening cross-scale linkages through further requirements regarding sustainability and community benefits.

Regarding sustainability and local impacts, it will crucially depend on GDC and its management of investor-community relations how – and whether – geothermal development in Baringo-Silali will benefit the local population. So far, it is hard to say whether community engagement and impact assessments are "more about improving legitimacy rather than benefitting local communities" (Sovacool & Cooper, 2013, p. 241). The community in Baringo, however, is not a passive recipient of benefits; rather it actively engages in negotiations as well as in acts of resistance and sabotage if important demands are not met or GDC activities are regarded as unfair. Community action and responses therefore have the potential of disrupting project advancement, not only in technical terms, e.g. through roadblocks, but also through legal and political action along cross-scale linkages, as has already happened in Olkaria. Up to now, we could not observe interventions by NGOs and CSOs in these matters. It therefore remains an open question, to what extent more private, international and civil-society participation would improve the benefits to the community. This is one among many questions that certainly require further research into the future development of geothermal development in Baringo.

In conclusion, this case study has demonstrated, that cross-scale linkages need to be considered in order to understand how power relations impact on the implementation and governance of large-scale electricity generation and in associated investor-community relations. To analyze actor and governance constellations, we applied a concept of cross-scale linkages from research on socio-ecological systems. While the original concept mainly refers to the interactions between state actors and communities, we have adapted and used it for a wider group of actors, including also parastatals, companies and international agencies. This has revealed the limits of this approach with its focus on institutional interplay, co-management and bridging organizations, which can only partly reflect the complexities of large-scale energy projects with a multitude of state, community, private and international actors as well as their various competing interests and accountabilities.

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Appendices

Appendix 1 – Interview Questions Guide

SCOPE

Large-scale renewable energies (LSRE, defined as capacity that is more than 25MW)

Geothermal

Wind Energy

Solar Energy

Biomass

Hydropower

Geography

Renewable energy infrastructures

Kenya Rift Valley

LAPSSET

Vision 2030

THEMES

Roles and strategies of expert & organization in developing LSRE projects.

Organizational and personal roles in LSRE development

Interests and intentions in LSRE development

Drivers and incentives of LSRE development

Actors, governance and financing structures of LSRE development

Actors in the space

Governance structure for decision making.

Roles and responsibilities

Financing arrangements and coordination

Positive and negative impacts on the different unbundled sectors

Communication and interactions with other stakeholders in the sector

Cooperation among public and private sector players

Possible competing points among public and private sector players

Influences of international actors, ideologies and policies

Complexities and challenges in implementation

Resource management and agreements (land, compensations, revenue allocations?)

Infrastructure planning for LSRE development

Planning and Strategies of Materialization

Integration of different stakeholder interests

Connection to other national landmark projects

Socio-economic development linkages and impacts

Connection to the broader development visions

Conclusion

Lessons so far

Successes and challenges

Future outlook

Missing points and other issues?

Referrals, contacts, published reports and documents

Appendix 2 – List of Interviewees

Sectors	**Organizations**	**No. of interview partners**
Expert Interviews with actors at international and regional levels		
Public	Deutsche Investitions- und Entwicklungsgesellschaft (DEG), World Bank, Africa Development Bank (AfDB), Kreditanstalt für Wiederaufbau (KfW – the German government development bank), European Investment Bank (EIB), Agence Française de Développement (AFD – the French government development bank), Trade and Development Bank (TDB), United States Agency for International Development (USAID), Africa Trade Insurance Agency (ATI), African Conservation Centre (ACC), Ministry of East Africa Community, SNV Netherlands, Hivos, Power for All. Society for International Development (SID), Tetra-Tech: Power Africa Transactions and Reforms Program (PATRP), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).	28
Expert Interviews with actors at the national level		
Public	Ministry of Energy and Petroleum (MoEP), Ministry of Environment and forestry (MoEF), National Treasury, Geothermal Development Corporation (GDC), Energy Regulatory Commission of Kenya (ERC), Kenya Power and Lightening Company (KPLC), Kenya Electricity Transmission Company (KETRACO), National Environment Management Authority (NEMA), National Crime Research Centre (NCRC), National Land Commission (NLC), Kenya National Bureau of Statistics (KNBS), Kenya Wildlife Service (KWS), Geothermal Training and Research Institute (GETRI), Rural Electrification and Renewable Energy Corporation (REREC), Hell's Gate National Park (HGNP).	56
Public-Private	Kenya Electricity Generating Company Ltd (KenGen).	10
Private	Virunga Power Ltd, Eco-entrepreneurs Ltd, Botto Solar Ltd, Kenya Bankers Association (KBA), M-Kopa Ltd.	4
Expert Interviews with actors at sub-national (county) levels		
Public	Baringo county commission, Nakuru county government, Laikipia county government, Isiolo county government, Rural Electrification and Renewable Energy Corporation (REREC).	17
Informal Interviews with actors at community levels		
Public representative	Geothermal Development Corporation (GDC), Hell's Gate National Park (HGNP)	2
Private persons	Anonymous	3
Total no. of interview partners		**120**

Appendix 3 – CV

CHIGOZIE NWEKE-EZE

Work Experiences

Visiting Fellow, Africa Program European Council on Foreign Relations (ECFR), Berlin, Germany	Since 09/2023
Contributor, Future Thought Leaders Illuminem, Venice, Italy.	Since 08/2022
Head for Strategic Intelligence and Africa Program Renewable Energy for the 21st Century (REN21), Paris, France.	09/2022 – 05/2023
Research Associate, Geopolitics and Economics of Hydrogen. Research Institute for Sustainability (RIFS Potsdam), Potsdam, Germany.	08/2021 – 06/2022
Research Associate, CRC228 Future Rural Africa. Institute of Geography, University of Bonn, Germany.	04/2018 – 08/2021
Researcher, EU Energy Initiative Partnership Dialogue Facility Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Eschborn, Germany.	10/2016 – 03/2017
Energy Advisory, Technology Cooperation in the Energy Sector. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Eschborn, Germany.	07/2016 – 10/2016
Teaching and Research Assistant, Department of Economics. Nnamdi Azikiwe University/ Paul University, Awka, Nigeria.	10/2010 – 09/2014

Educational Qualifications

PhD Geography Institute of Geography, University of Bonn, Germany	Since 04/2018
MA Development Economics and International Studies University of Erlangen-Nuremberg, Germany	10/2014 – 03/2017
MSc Economics Imo State University, Owerri, Nigeria	10/2012 – 03/2015
BSc Economics Nnamdi Azikiwe University, Awka, Nigeria	10/2008 – 09/2012

Selected Publications (excluding doctoral papers)

Forthcoming

Nweke-Eze, C., Ebisi, C. (forthcoming): *Green hydrogen development in Africa: A scoping review of opportunities and challenges.* Energy for Sustainable Development.

Bülow, N., Nweke-Eze, C. (forthcoming): *Investigating green colonialism and energy justice in the development of Lake Turkana Wind Power project in Kenya.* In Irene et al. (eds.), The Emerald Handbook of Sustainable Energy Transition and Social Justice: Contemporary Issues and Debates in the Global South.

Ebisi, C., Nweke-Eze, C. (forthcoming): *Biomass resources and energy access in Nigeria: A scoping review*. Energy for Sustainable Development.

2024

Adaramola, A. B., Oderinde, L. O., Nweke-Eze, C. (2024): *Electricity pricing, electricity access and household welfare in Lagos State, Nigeria: A household survey*. Advances in Science and Technology 142:115-128.

Owusu-Acheampong, D., Nweke-Eze, C. (2024): *Economic growth, population dynamics and electricity consumption in Ghana*. Advances in Science and Technology 142: 129-146.

2023

Chigbu, E, Nweke-Eze, C. (2023): *Green hydrogen production and its land tenure consequences in Africa*: An interpretive review. Land, 12(9), 1709.

Nweke-Eze, C. (2023): *Africa has what it takes to supply green hydrogen to the world – but what must be considered?* Illuminem.

Nweke-Eze, C. (2023): *Bloc profile: the African Union at COP28*. Illuminem.

Nweke-Eze, C. (2023): *Global critical minerals market is booming: Africa can maximize gains through regional cooperation*. Illuminem.

Nweke-Eze, C. (2023): *Hydrogen development in Africa presents employment opportunities along the value chain: how can it be leveraged?* Illuminem.

Nweke-Eze, C. (2023): *Not just hot air: Realizing the potential of the EU-Namibia green hydrogen partnership*. European Council on Foreign Relations (ECFR).

2022

Nweke-Eze, C. (2022): *Green hydrogen of Africa*. PV Magazine.

Nweke-Eze, C., Quitzow, R. (2022): *The promise of African clean hydrogen exports: Potentials and pitfalls*. Brookings Institution.

Adow, M, Wemanya, A, Opfer, K, Nweke-Eze, C., Njamnshi, A., Fernandez, J., Singer, S. (2022): *Green Hydrogen production and Power-to-X products in Africa*. Position Paper. GermanWatch.

Nweke-Eze, C., Ewere, E., Nevo, C. (2022): *Electricity sector reforms, Private sector participation and electricity sector performance in Sub-Saharan Africa*. In Asif M (ed.), Handbook of Energy Transition, Taylor and Francis.

Nweke-Eze, C. (2022): *Governance of cross-border electricity pooling and trading in the West African Power Pool*. Integrated Africa Power (IAP).

2021

Anyokwu, C., Nweke-Eze, C. (2021). *Institutional settings, renewable energy development, and forest cover changes in Sub-Saharan Africa*. In Osabuohein et al (eds.), Handbook of Research on Institution Development for Sustainable and Inclusive Economic Growth in Africa.

Nweke-Eze, C. (2021): *Neoliberal reforms in Sub-Saharan Africa's electricity sector: implementation, experiences, and impacts*. In Osabuohein et al (eds.), Handbook of Research on Institution Development for Sustainable and Inclusive Economic Growth in Africa.

Nweke-Eze, C. (2021): *What will cost- and service-reflective tariffs mean for the Nigerian Electricity Sector?* Energy for Growth Hub.

2020

Nweke-Eze, C. (2020): *The political economy of energy transition in Africa: The case of Ghana and South Africa*. Energy Review 2 (4), 7-9.

Selected Lectures and Conferences

2024

Watt's Up Africa: Electrifying the future. Keynote Speaker at Siemens Energy Breakfast. Hamburg, Germany, 2024.

Harnessing clean hydrogen for local use in African industries. Panelist at the United Nations Industrial Development Organization (UNIDO) Panel, Afrika Verein Energy Forum, Hamburg, Germany 2024

Green energy investments in Africa and ESG standards. Panelist at the Commerzbank Panel, Afrika Verein Energy Forum, Hamburg, Germany, 2024.

2023

Infrastructures and connectivity for hydrogen development in Africa. Panelist at the Afrika Verein Hydrogen Forum, Hamburg, Germany 2023.

Skills development in green hydrogen development in South Africa, Namibia and Kenya. Keynote at the GIZ/ii2030 Hydrogen Event. Cape Town, South Africa & Windhoek, Namibia, 2023.

Integrating green hydrogen in African energy systems. Keynote at the GIZ/AHK First Southern Africa-Germany conference on Green Hydrogen. Launda, Angola, 2023

Financing green hydrogen development in Africa. Panelist at the GIZ/AHK First Southern Africa-Germany conference on Green Hydrogen. Launda, Angola, 2023

Green hydrogen production for use in off-grid applications in Nigeria. Moderator at the AHK Digital Information and Networking Event. Abuja, Nigeria, 2023.

2022

Green hydrogen in Africa: Opportunities for energy trade and export market or for local economic development. Presenter at the 4th Edition of the Africa Green Hydrogen Forum. Czech Republic, 2022.

Green hydrogen production in Africa. Presenter at the Climate Week Conference. Frankfurt, Germany, 2022.

Status of renewable energy pursuits in Africa. Presenter at the Global Perspective Initiative (GPI) dialogue. Berlin, Germany, 2022.

Green Hydrogen in Africa: Fueling export markets or local economic development? Panelist at the RENdez-vous Africa in Renewable energies. REN21, Paris, France, 2022.

Energy, business and sustainability in Africa. Presenter at the 21st International Business Conference. Kahramanmaras Sutcuimam University, Turkey, 2022.

Energy transition and the place of hydrogen in Nigeria. Panelist at the FES/IASS with the German Parliament. Berlin, Germany, 2022.

Geopolitical economy of hydrogen production in Nigeria. Presenter at the Nigeria technocrat delegates meeting, Ministry of Foreign Affairs. Berlin, Germany, 2022.

Climate and financing actions in large-scale renewable energy projects in Kenya. Presenter at the Green Economies Workshop. University of Luxemburg, 2022.

Hydrogen opportunities in Nigeria. Panelist at the Nextier Power Dialogue. Nextier Power, Abuja, Nigeria, 2022.

Africa in the green hydrogen race: *Geopolitical and socio-economic implications*. Panelist at the Germanwatch Seminar on CSO position on Hydrogen development in Africa, Bonn Germany, 2022.

Geopolitical economy of hydrogen production in Nigeria. Panelist at the AHK/KAS Hydrogen Series, Lagos, Nigeria, 2022.

2021

Investments in large-scale renewable energy projects in Kenya: Findings and experiences. Panelist at the Expert Discussion: CRIC – Sustainable Investments in Africa, Frankfurt, Germany, 2021.

2020

Infrastructures of large-scale renewable energy projects in Kenya: Materialization, generativity, and socio-economic development linkages. Deutscher Kongress für Geographie in Cologne, Germany, 2020.

The widening of the electricity sector in Kenya: Processes, structural transformations and implications. 5th NEST Conference, ETH Zürich, Switzerland, 2020.

2019

Climate-mitigation finance instruments as risk-ameliorating tools in renewable energy projects. The case of geothermal energy in Kenya. Presenter at the Financial Geography Workshop, Gelsenkirchen, Germany, 2019.

Financialization of renewable energies? The example of geothermal and wind energy development in Kenya. Presenter at the 8th Nordic Geographers Meeting, Trondheim, Norway, 2019.

Research Projects

GET Hydrogen (2021-2022): Geopolitics of Energy Transformation (GET): Implications of an international hydrogen economy. Principal Investigator: Dr. Rainer Quitzow. Funded by the German Federal Ministry of Foreign Affairs (AA). *Research Institute for Sustainability (RIFS Potsdam), Research Associate.*

Research Grant Program for Policy Research (2020 – 2021): ECOWAS/Konrad Adenauer Stiftung (KAS) initiative on youth leadership development in energy. Funded by Konrad Adenauer Stiftung (KAS). *KAS, Fellowship holder.*

Future Rural Africa (2018 – 2021): Future-making and social-ecological transformations in rural Africa. Subproject C02 'Energy Futures'. Principal Investigator: Prof. Britta Klagge/ Dr. Clemens Greiner. Funded by the German Research Organization (DFG). *University of Bonn, Research Associate.*

GIZ "Between Lecture Hall and Project" (2016-2017): Evaluating the Nigerian Energy Support Program (NESP). Funded by the German Agency for International Cooperation (GIZ). *GIZ, Fellowship holder.*