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ARTICLE

Sustainable Energy Transition in Russia and Ghana Within a Multi-Level Perspective

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ABSTRACT
This paper is a case study based on a critical review of existing literature and primary data through interviews to investigate energy transition framing and manifestation in the Global South. It provides critical insights into sustainable energy transition in Ghana and Russia within a multi-level perspective (MLP). We argue that whereas Ghana's energy transition concepts and policies are mirrored by landscape, regime, and niche, practical transitioning has been slow due to inadequate resources and incentives, limited historical culpability in global greenhouse gas, and the country being locked-in to existing hydrocarbon socio-technical systems. The MLP approach is useful in describing energy technologies, markets, and consumption practices. But in Russia, social policy at distinct levels is united by centralised energy law and technical systems, as well as institutional rules and differences based on costs in economic regions. This paper contributes to the energy transitioning discourse within the Global South using Russia and Ghana as cases to highlight how

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transition policies and practices differ from country to country, driven by economic, political, social, cultural, and historical elements with global frameworks serving as guides. Rigid application of landscape, regime, and niche concepts is challenged in describing and analysing the context-specific nuances in sustainable energy transition policy across spaces. There is a fundamental challenge of mechanically fusing a one-fits-all approach to sustainable energy transitioning in developing countries and societies due to differences in historical contributions to climatic issues and inequality of access to resources and technologies. Energy transition processes and practices should be compatible with social justice.

KEYWORDS
energy, renewable energy, multi-level perspective (MLP), sustainable energy transitions (SET), development

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Introduction

Energy has been a lifeline of the global economy, powering factories and homes with diverse energies: non-renewable (oil and coal) and renewable (solar, wind, and bioenergy). It has, however, become obvious in recent years that over reliance on hydrocarbon as the main source of energy is unsustainable due to climate change, environmental degradation, and human health concerns. The idea of energy transition has become topical in development and sustainability discourses. Sustainable energy transition (SET) is being used to conceptualise and operationalise energy transition (Araújo, 2014; The Energy Transition, 1983). Despite SET’s appeal and potential in explaining energy transition, researchers, policymakers, scientists, and non-governmental organisations (NGOs) across the spectrum have raised questions relating to sustainable energies transition both in the developed and developing world.[1] Fukuyama (2002), Kaku (2008), Rifkin (2011), Toffler (1980), and Wallerstein et al. (2013) have written about the sustainability and environmental dimensions of energy

[1] We proceed from the definition of developed and developing countries based on the criteria proposed by the UN. See: Committee for Development Policy & United Nations Department of Economic and Social Affairs (2021).

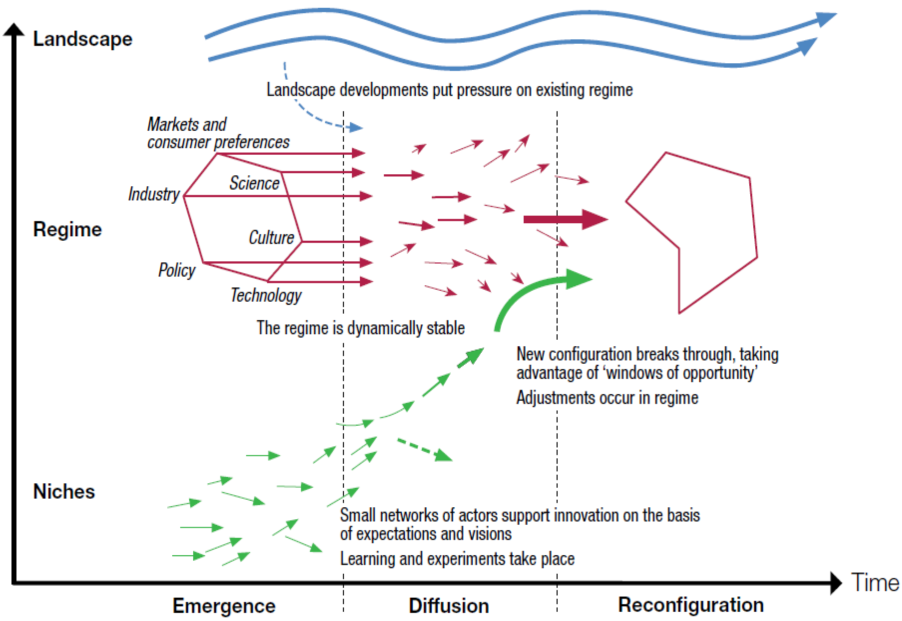
as a component of the world economy and the engine of culture that determines the future of mankind, and how energy transition is equally important for both the economy and environment. Transitions are viewed by some researchers, policymakers, and scientists as the fundamental sustainable energy pillars, although how and where this process may occur might differ based on circumstances. According to Rifkin (2011), global transitions may take place in several different ways in the political strategy for energy, and these include transitions to renewable energy sources, distributed generation (mini-power plants that generate electricity at the place of consumption), the use of hydrogen and other alternative energy technologies, the use of Internet technology to turn the energy system of each continent into an intelligent electric grid, and transitioning to electric cars. It is of fundamental importance that efforts be made to move to more sustainable energy sources.

There are, however, some problem areas with the transitional process such as centralised and decentralised options, carbon and renewable generation combined. The energy space is complex with different interests and actors, and this will require negotiations and trade-offs. Energy transition has geopolitical dimensions (Downie, 2022). Wallerstein et al. (2013) argue that this includes supporters of hydrocarbon energy (oil-producing and exporting states), start-ups and established leaders in the field of renewable energy production (consumers, environmentalists, scientists, organisers of advanced industries), and intermediate types who focus on the short-term or long-term benefits of energy production. But transition can happen together with economic transformations in the management of the energy complex, for example, when a new public communication technology changes together with new energy systems and goals. The main direction of renewable energy development globally seems to have been the transition from a hierarchical structure (centralised) to a horizontal arrangement of economic and energy management. But the distributed nature of renewable energy sources requires cooperation, and not a hierarchical command system of redistribution of resources, which changes the model of socio-economic interaction; the role of the regions as a “knot” connected by energy, communication, and transport systems is important (Wallerstein et al., 2013). Thus, conceptualisation of energy transitioning has to make room for diverse actors, institutions, and a scale of (re-)negotiation.

A multi-level perspective (MLP) framework has been used over the years to conceptualise and explain energy transitions, identifying and assessing institutions and actors within the energy space: landscapes, regimes, and niches (Figure 1). Rip and Kemp (1998) developed the MLP but it has since been refined by others (Geels, 2005; Geels & Schot, 2007). The framework has been used to analyse and explain sustainable energy transition. As a framework, MLP views transition as transpiring through interactive processes within and among three analytical levels: socio-technical landscapes, regimes, and niches (El Bilali, 2019; Geels & Schot, 2007; Rip & Kemp, 1998). Thus, transition becomes a product and function of interactions between and among niche-level innovations, established regimes, and exogenous landscapes (Bridge, 2018; Geels, 2002, 2005, 2011; Geels & Schot, 2007; Rip & Kemp 1998). Transition also encompasses shifting from a socio-technical system to

Figure 1

The Scheme of the MLP Methodology



Note. Source: Adapted from Geels (2011) and Genus & Coles (2008).

another (El Bilali, 2019), through dialectic interactive processes at the niche–regime–landscape interface. Thus, sustainable energy transition is *socio-technical* since the process entails changes in social and cultural values and behaviour, and technological changes in how society appreciates and uses energy resources. *Niche* innovations build up internal incentive and change momentum, while *landscape* changes create pressure that destabilises the *regime*, with the resulting destabilisation creating avenues for niche innovations within the system and replacement of an existing regime (El Bilali, 2019, p. 2; Geels, 2006; Markard & Truffer, 2008). The socio-technical transition often results in "deep structural changes" over extended periods in specific systems (e.g., transport or energy), and it involves reconfigurations of technologies, markets, institutions, knowledge, consumption, and cultural norms (Geels, 2011; Swilling et al., 2016, p. 654). But as a change process, transition entails complex non-deterministic interrelations between the three levels of landscape pressures (macro), regime structures (meso), and niche innovations (micro) (Swilling et al., 2016). Macro, meso, and micro are the systems through which transitions are sustained and reconfigured (Power et al., 2016). They become spaces of change and reconfiguration.

Baker et al. (2014) explain landscape as the external environment or influences at the macro level. The landscape comprises of the structuring forces of ideologies, institutions, discourses, political, and economic trends at the macro level (Power et al., 2016). According to Geels (2011, p. 28), landscape entails the demographical trends, political ideologies, societal values, and macro-economic patterns that impact the dynamics of the regimes and niches. Landscapes in energy transitions are the entrenched structural societal relationships that change only gradually (Foxon et al., 2010), including international trends and technologies, funding institutions (e.g., the World Bank), and market-based policy instruments (e.g., Clean Development Mechanism [CDM]) (Baker et al., 2014). These structures, institutions, and discourses are ingrained to shape entities at the level of regimes and niches. Regimes are the patterns of technologically determined behavior shaped by "cognitive routines," shared by engineers, and influenced by policymakers, scientists, energy users, vested interests, and professional groups (Baker et al., 2014, p. 794). Within the sustainable energy space, Unruh (2000) noted that regimes are national governments' policies to stimulate socio-economic development, with a tendency of predictability and "lock-in" mechanisms. Niches are protected spaces at the micro level for innovations (Geels, 2011) and shaped and conditioned by technologies, policies, and practices from dominant regimes (Baker et al., 2014; Lehtonen & Kern, 2009). Niches are operationalised by networks of dedicated actors (Geels & Schot, 2007). As protected spaces, niches encompass networks of actors with innovative technologies and their uses. We can, however, disagree with the designation of niches as protected spaces at micro level as they can occur at multiple spaces, both at the meso and macro scales. Innovation gradual processes are championed by multiple networks of actors (Bawakyillenuo et al., 2018).

Whereas MLP fits some of the energy transition in the developed economies, with some of these high-income countries making significant strides in energy transitions despite high energy consumption (Bridge, 2018; Geels, 2005, 2006, 2011), the same cannot be said for developing economies. There are only some publications on MLP and energy transitions in developing countries such as Brazil (Basso, 2018; da Costa et al., 2019), South Africa (Baker et al., 2014; McEwan, 2017), Asia (Berkhout et al., 2010), and Africa. The paper addresses this gap by reflecting on sustainable energy transitions in Ghana and Russia. This paper provides critical insights and reflections on the sustainability of energy transition in developing countries using Ghana and Russia as cases under the methodological lenses of MLP. The study highlights the various efforts at promoting energy transition, framing of the debate and practices of transition, and possibilities of alternative framing within developing countries contexts. We raise the question as to what extent the MLP approach is applicable and effective in describing change in the developing economies. We argue that mechanically transferring a one-fits-all approach such as the MLP to developing countries is problematic as it does not sufficiently explain changes in energy transition across spaces given the differences in social, economic, and political systems in specific countries.

Background of Study Areas and Methodology

This research, in the form of an exploratory case study, used a multiple methods approach. It includes two cases, Russia (Eastern Europe and Northern Asia) and Ghana (West Africa), that can be classified conceptually as developing countries, even though we admit there are variations in the levels of development. The selection of cases is rationalised by both their similarities and differences. Although they are very heterogeneous in terms of geography, climate, culture, and social issues, they share similar problems as a result of emerging economies such as limited indigenous capital, political instability and poor governance, clientelism, too strong/weak state regulations and the drive to attract foreign direct investments (FDIs). Natural resources broadly and energy in particular are important for these economies as sources of export for foreign exchange and local economic development. There are more than 600 million people in Africa who still have no access to any form of energy, while Russia is one of the leading producers of oil and gas, providing energy to fuel the economies of Europe. Thus, the solution for Africa and Russia in terms of cooperation may include the creation of jobs and the export of technology from Russia based on traditional energy for regions that need it. Among other things, Russia plans to export its nuclear technology to Africa by building expensive nuclear power plants throughout the continent.

The cases were selected to reflect countries on sustainable energy transitions in the Global North (Russia) and Global South (Ghana). Broadly, these countries can both be classified as developing though are at various stages, with Russia more advanced economically and technologically. And even though both countries are natural resources dependent, Russia is more extractive industry intensive than Ghana. Each of the countries contributions to global greenhouse emissions differ; hence, the incentive to adopt green technologies also differ. It is within this context that we interrogate how MLP's landscape, regime, and niche is suitable for describing and analysing change in the sustainable energy transitioning systems in these two countries specifically and developing countries generally. We raise the question as to what extent MLP approach is applicable and effective in describing change in the developing economies on two different cases irrespective of the social, economic, and political contexts.

Russia is the world's fifth largest CO_2 emitter. The country has also not yet ratified the Paris Agreement up to date. At the same time, warming in Russia is occurring twice as quickly as the average for the rest of the world, increasing the risk of floods and wildfires across the country. The energy intensity of the Russian economy decreased by 16% in 2005–2015 (an average of 1.7% per year). Russia has the largest known natural gas reserves of any state on earth, along with the second largest coal reserves and the eighth largest oil reserves. This is 32% of the world's proven natural gas reserves (23% of the probable reserves with the monopoly Gazprom, which produces 94% of Russia's natural gas production; in a global context Gazprom holds 25% of the world's known gas reserves and produces 16% of global output), 12% of the proven oil reserves, 10% of the explored coal reserves (14% of the estimated reserves), and 8% of the proven uranium reserves. Russia is the largest oil producer in the non-OPEC countries and second biggest in the world after Saudi Arabia, has the world's second largest coal reserves, with 157 billion tonnes of reserves (Ministry of Energy of the Russian Federation, 2023). The energy system of the Russian Federation consists of the United Energy System (seven combined energy systems and geographically isolated energy systems). From 2017 to 2018 Russia had high changing dynamics of energy production 630.7 billion kWh (a decrease of 1.3%); 193.7 billion kWh at hydroelectric power stations (an increase of 3.3%); 204.3 billion kWh at nuclear power plants (an increase of 0.7%); 62.0 billion kWh at power plants of industrial enterprises (an increase of 2.9%); 0.8 billion kWh SES[2], (an increase of 35.7%); 0.2 billion kWh at wind farms (an increase of 69.2%). The Russian government has approved a plan to support renewable energy from 2025 to 2035, investments in the construction of green stations will amount to 360 billion rubles. In 2020, 40.4% of the electricity generated in Russia came from nuclear and hydropower (including large hydroelectric power plants). Thermal power plants provided 53% of the production. The share of renewable energy sources, which includes wind farms and solar stations, in electricity generation was 0.3%, or 3.36 billion kilowatt-hours (based on data from the System Operator).

In the Russian case study, desk-based research and semi-structured elite interviews were conducted. Desk research analysed international and national trends in energy transition and was used to identify the initial group of stakeholders for the interviews; other stakeholders were identified through snowball sampling. Interviews with professionals were selected based on their high level of professional knowledge and expertise on the subjects, the diversity in status, age, and gender. The sample of 60 people included ecologists based in state institutions, representatives of environmental NGOs and grassroots organisations, academics (climatologists, ecologists, sociologists, social geographies, human ecologists), and environmental regional proponents. Their roles in energy policy are very different; most of the Russian environmental NGOs and researchers have only symbolic power to influence the policymaking. Desk research was conducted in 2018 and the interviews in 2019.

Ghana is situated in West Africa with a population of about 29.6 million (The World Bank in Ghana, 2023). The country has made significant strides in social, political, economic, and industrial development. As a member of the global institutions like the United Nations, energy and sustainable discourses including the Paris Agreement on Climate Change in December 2015 (Conference of Parties, COP 21) have engaged the attention of Ghana civil society organisations and citizens. As Ghana aspires to industrialise and modernise its agriculture, unreliable and costly power is a constraint. Maintaining Ghana's macro-economic stability and middle-income status can be hampered by energy challenges (Ministry of Energy, 2010). Ghana's energy mix has changed over the years, with some energy sources becoming more prominent than others. In 2010, since most people still lived in rural areas, biomass (fuelwood and charcoal) constituted about 60% of Ghana's energy consumption, with electricity, petroleum, and other sources accounting for the rest. In the industrial and service sectors, electrical power is dominant, representing 70% of usage (Ministry of Energy, 2010). Ghana has a total installed 4,398.5 MW electricity capacity, including hydropower

[2] Sustainable Energy Solutions.

(1,580 MW), thermal (2,796 MW), and renewable (22.5 MW) (Power Africa, 2019). But the power actually available rarely exceeds 2,400 MW due to rain fluctuations, fuel inadequacies, and dilapidated infrastructure. Natural gas from Ghana's oil fields since 2010 is supposed to mitigate the fuel challenges, while renewable energy sources like biofuels, solar, and wind are viewed as the future of power generation. Placing Ghana's energy policies in perspective reveal some ad-hoc tendencies in policies and implementation. The limited renewable energy sources in Ghana's energy mix raises earnest future questions about energy transitions and framing.

The Ghana case study uses desk-based methods to conduct the analysis of international and national trends in energy transition. Data for this study was gathered from document sources such as Ghana Renewable Energy Act (2011), Ghana Sustainable Energy for All (SE4ALL) Action Plan (2012), Ghana's National Energy Policy (2010), and other published and policy documents on energy on Ghana. These data sources were critically read, themes developed and analysed to illustrate how MLP explains changes within the energy transition discourse in Ghana. Although the study employed a mixed-methods approach, it was not conducted in the traditional comparative design manner. To minimise the possible biases and provide robust evidence for each case, we tried to triangulate quantitative and qualitative data from various reliable sources in each case, respectively, to draw on comprehensive credible findings.

Interrogating Energy Transition in Developing Economies

In this section, we investigate energy transition in Ghana and Russia through analysing how the issues of landscape, regime, and niche operate in these developing countries.

Sustainability Energy Transitions in Russia

Landscape. The Russian energy policy is very clearly positioned as the raw material export economy model that is based mainly on gas generation. Energy export directions are fundamental for the Russian economy for both traditional and green energy and create exchange networks within developing countries. The reliability of the joint energy system is increased and ensures the energy flow of the united energy system without technological disruptions in the networks or the threat of energy shortages. This system allows the efficient export of surplus capacity to promising markets in a number of Asian countries, at the moment with a low level of competition. Some of the exporters (European countries, Southeast Asia) have long-term purchasing power, while the Commonwealth of Independent States (CIS) and neighbouring countries, on the contrary, have low, which makes these markets unpromising. An export-based economy links to the dependency on the price and demand on oil, mineral resources, and gas, and policy changes that will define opportunities and benefits too.

The potential use of renewable energy (further renewable energy sources) in Russia is enormous. According to various estimates, it amounts to 270 million tons of equivalent fuel, including the main types of energy sources. There are various economic and technical potentials in regions determined by natural and climatic factors and energy consumers' requests. The positive factor for the development of renewable energy sources is the reliability of the co-joint energy system increases; the negative factors include the differences in national legislation and energy independence plans of the potential countries of exporters of renewable energy, and geopolitical situations in the CIS countries and near abroad that block transition to renewable energy sources.

During the special military operation in Ukraine, the West imposed sanctions on Russia, and this led to:

(a) neutralising the dependence of the latter on mineral and energy raw materials from Russia, and Russia is looking for opportunities to export energy resources and products in other directions: for the BRICS countries (Brazil, Russia, India, China, and South Africa), the Asian, and African region;

(b) hindering the development of the Russian economy, the implementation of an energy-efficient and energy-saving programme for traditional energy, since it needs both internal resources, dependent on GDP for the export of mineral and energy raw materials, and external resources built on cooperation in the exchange of resource-saving programmes with a number of Western countries;

(c) the green energy agenda, implemented within the country and involving an increase in the percentage of renewable energy, also stayed on a "pause" because in turbulent times of special military operation it is important for Russia to find a new balance for the development of the Russian green energy sector in the broadest sense, which already includes many different aspects (such as renewable energy sources, storage, hydrogen, carbon dioxide capture), and leaves only really necessary competencies. For example, it makes sense to develop autonomous power supply systems (renewable energy sources, storage, or backup generation) for remote areas, including northern regions, the issue of import substitution for a wide range of technologies, equipment, and materials.

Regime. This level is constituted by the resource-driven economy, highly dependent on fossil fuels, the monopoly of big oil companies, and a low share of renewable energy (however, the dynamics are positive). The sustainable energy transition policy varies greatly at the municipal level. The energy system of Russia and natural energy resources are monopolised by the state and distributed centrally. The Russian unified energy network is unique and centrally distributed energy in each region is cheap for the consumers.

In Russia, the problems of energy modernisation in the federal regions differ qualitatively depending on the existing ecological, economic, and cultural capital of the region; the country has energy support tools for different prices for centralised and decentralised zones. The Russian strategy for the development of the energy policy of the country until 2035 proposed that the dependence of the Russian economy on the fuel and energy sector increased in exports (70%), federal budget revenues (50%), and investments (40%). In Russia, the problems of regional modernisation varied enormously, suggesting the development of separate local measures and energy support tools for different prices, non-price, and decentralised zones. Legal and administrative organisational aspects highlight the need to include administrative regulation in the area of responsibility of the developer and their motivation.

According to the federal programme of energy transition, dependence on carbon resources will be minimised or can be eliminated. The energy strategy considers nuclear power plants and large hydropower plants as an alternative opportunity to reduce oil production and exports and increase the availability of electricity in the regions. Eight priority areas and 34 critical technologies were approved by the President of the Russian Federation. The direction "Energy and energy saving" is one of them. Critical technologies include six technology groups aimed at improving energy efficiency and energy conservation, including technologies of new and renewable energy sources; nuclear energy, nuclear fuel cycles; management of radioactive waste; hydrogen energy technologies; technologies for the production of fuel and energy from organic raw materials; technologies for creating energy-saving systems for transportation, distribution, and consumption of heat and electricity; technologies for creating energy-efficient engines and propulsors for transport systems.

Niche. The renewable energy minority are grouped into niches driven by primarily economic factors and the huge hydrocarbons lobby.

Table 1

Stakeholders' Interests in Russian Energy Transition

<table>
<tr><th>Stakeholder</th><th colspan="2">Interests</th></tr>
<tr><td>Government and municipal structure</td><td colspan="2">Safety, profitability, large projects, international position</td></tr>
<tr><td>Citizens</td><td colspan="2">Safety, timeliness of energy supply, low tariffs</td></tr>
<tr><td>Workers from energy industry</td><td colspan="2">Developing the industry in terms of its human and economic resources, social security, and market stability.</td></tr>
<tr><td>Business+ government production</td><td>Investors: Profitability, risk, return on investment, protection of their rights and interests.</td><td>Producers of energy: Compliance with contractual obligations and legislation by energy companies, timeliness, and completeness of payment for delivered products.</td></tr>
</table>

Note. Source: Authors.

Few major independent corporations manufacture the equipment. Their interest is focused on autonomous provision for consumers in areas within individual farms, installation of energy-saving equipment in multi-storey buildings based on or through renewable energy sources, and the scientific community working with companies.

Western investors in wind farms have acted as the main force: for example, the Finnish Fortum in partnership with Rosnano with the technological partner of Danish Vestas. Domestic corporations are also participating: Rosatom by Lagerwey, Enel Russia, a generating company controlled by the Italian Enel with the technological partner, Siemens Gamesa.

The main investors in solar generation are Photon Solution (the new alliance of Hevel, Renova, and T-Plus Solar Systems), founded by the Chinese Amur Sirius, Finnish Fortum. Key investors in the small hydropower sector are RusHydro and its subsidiaries, TGK-1 (Gazprom), En+. The state-owned RusHydro is also independently building (without feed-in tariffs) wind farms, solar stations, and geothermal sources in the Far East.

The ministries and departments are only responsible for making the final decision in the legislative sphere; specific functions are assigned to agencies that can provide comprehensive information on local problems. Agencies are under state regulation, but are also representatives of the commercial infrastructure, which gives them a double advantage. Non-profit partnerships arise from the professional expert community, and are also included in the regulatory apparatus. The energy efficiency of a business is determined more by economic factors than environmental ones; there are no subsidies from the state to support these initiatives. A mixture of actors may lobby the state (directors of companies are representatives of the state). In management, establishing mutually beneficial communication and economic activity between the energy conservation programme and private enterprises may offer tax benefits. There are restrictions on the sources of traditional energy generation, on the extraction of resources, and their distribution (Bushuev, 2020).

The social improvement of the energy infrastructure as a social institution and the creation of rules and patterns increased civilian control, self-management, resource-saving behaviour, and eco-friendly education. Citizens living in old buildings in Russia cannot regulate heating individually, which means that people often keep their windows open in winter when the heat in apartments is too high, but the energy consumption practices in new households have been positively changing. The individual heating systems have the technical capacity to regulate the heating. Reduced energy consumption is promoted by financial incentives; better housing insulation has started to decrease the heat losses by changing the window frames (Romanov, 2022).

Thus, while the share of the renewable energy in general is pretty low, SET varies greatly according to the policy at municipal level and local SET “regimes”. The “niches” are grouped by coal, gas, atomic suppliers of a certain type of energy and technology. The major SET barriers in the Russian context are associated with the energy justice and energy poverty issues, including low public ownership and engagement in the energy policy; the infrastructural barriers (the post-soviet legacy of houses where people cannot regulate the thermostats); undeveloped green technologies and legal base, etc. Renewable energy is too expensive in comparison with the traditional model for the development of small regions and could be developed at the expense of a private business that produces equipment and a scientific institute that creates new developments. The tense international situation causes issues of decarbonisation and energy transition, which until recently were considered in the Western world as one of the main challenges for humanity, to temporarily fade into the background. However, these issues become more acute in order to implement sustainable development with equal access to the benefit of civilisation, including mineral and energy resources, which mutual sanctions can significantly complicate and tighten, leading entire regions of the world to economic and social collapse.

Sustainable Energy Transition in Ghana

In order to understand energy transition in Ghana, we analysed developments in the energy space within the framework of the Sustainable Energy Transition through the prism of landscape, regime, and niches.

Within the concept of *landscape* in energy transition, Ghana is positioned in the global energy system as an exporter of raw material. The main sources of commercial energy in Ghana are thermal, hydro, biomass, and limited solar energy. Ghana exports oil while at the same time relying on power generated from thermal sources fuelled by diesel, gas, and hydro. These energy sources serve industrial and domestic purposes. The national energy architecture of Ghana is shaped and conditioned by international conventions, frameworks, and policies, which constitute the *landscape*. For example, the report of the World Commission on Environment and Development (WCED), the Brundtland Report in the 1980s, central to the concept of sustainability including limiting greenhouse gas emission, is part of the broader global landscape that guides Ghana's energy policy. Other global frameworks that continue to guide Ghana's energy policies are the United Nations Conference on Environment and Development (UNCED) (Rio Earth Summit, June 1992), the Kyoto Protocol (COP3, December 1997), an extension of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that guides states' greenhouse gas emissions targets, and the Earth Summit II or Rio+10 (Johannesburg, September 2002) that provided a political framework to reaffirm commitments towards sustainability, and Rio+20 (Rio de Janeiro, June 2012) that focuses on reducing greenhouse gas.

Countries party to the UNFCCC, including Ghana, are enjoined to publish and update their national communication on climate (NCC), which includes emission inventories (Ministry of Environment & Environmental Protection Agency, 2015). Under Article 12 of the UNFCCC, Ghana submits its national communication every four years and a biennial update report to the COP (Ministry of Environment & Environmental Protection Agency, 2015). Ghana's National Inventory Report (NIR) which contains estimates for net greenhouse gas emissions for 1990–2012 was also submitted as part of the reporting regime. In 2008 and 2011, Ghana submitted its first and second national communications. The 2015 report is the third made to UNFCCC. Ghana's reports not only document efforts in meeting the convention, but also showcases the country's domestic policies that aimed at tackling climate change (Environmental Protection Agency, 2015). Whereas COP1 took place in March–April 1995 in Berlin, the 2015 COP21 (Paris Climate Agreement) was the landmark agreement that enjoined countries to limit hydrocarbon consumption and shift to renewable energies. Based on COP21, Ghana committed to building a climate-proof society to meet socio-economic needs, and contribute to global efforts in combating climate change (Environmental Protection Agency, 2015). These broad global climate landscapes have guided Ghana's energy regimes over the years, even though their impact of sustainable energy transition is a subject of debate.

In energy transition discourse, *regime* denotes the national policies, regulations, and agencies that guide energy production and use. There is no shortage of policies, agencies, and regulations nationally aimed at guiding the energy policies in Ghana (see Ministry of Energy, 2010; Ministry of Environment & Environmental Protection Agency, 2015; Environmental Protection Agency, 2015). Ghana's National Energy Policy was formulated in 2010 to guide the development of the energy sector, especially oil and gas, to create a conducive environment for investment, job creation, and industrial development (Ministry of Energy, 2010). The policy is aimed at securing long-term fuel supplies for the thermal power plants, reducing technical and commercial losses, increasing access to renewable energies, and diversifying the national energy mix. The vision was to develop an "energy economy" through oil and power exports by 2012 and 2015 respectively (Ministry of Energy, 2010). However, based on the experiences of Ghana since 2010, it is evident that there are limited guidelines on renewable energy development via niches with funding sources, timelines, and uptake channels. It is obvious from the vision that Ghana has been more concerned with increasing the quantity of energy regardless of the source.

Further to the 2010 energy policy, the Renewable Energy Act (2011) provides a framework for the development, investment, management, utilisation, sustainability, and supply of renewable energy (Renewable Energy Act, 2011). Some of the main renewable energy sources are wind, solar, hydro, biomass, biofuel, and geothermal. The policy envisages that the renewable energies will be integrated into the national energy grid system. Without any clear guidelines on financing, implementation, local technologies, and niche development, it is aimed at building indigenous and local capacities technologically in the renewable energies sector. This raises questions as to how the aims will be achieved over time in Ghana.

Moving beyond renewable energies, the Ghana Sustainable Energy for All (SE4ALL) Action Plan was developed in 2012 to ensure sufficient and sustainable energy provision in the country (Energy Commission et al., 2012). It aims at ensuring universal access to electricity, the promotion of liquified petroleum gas (LPG), and improved cooking stoves. The national electricity coverage in Ghana increased from 66% in 2008 to 72% in 2011 (Energy Commission et al., 2012). The electricity coverage in Ghana is about 85% currently with plans to have a universal coverage in the near future. Ghana has been concerned with increasing the electricity coverage but not the source of the power. Renewable energies currently contribute about 22 MW to Ghana's energy mix. Besides the broad policies, there are limited concrete changes of promoting energy transitions in Ghana through the development of niches.

At the *niches* level, sustainable energy transition is represented by technological development and research and development (R&D). Ghana policies consisted of sectorial performances, R&D, public funding, and scientific research and are less focused on policy objectives such as decarbonisation. The Ghana Energy Action Plan, however, recognises the need for partnerships between government, civil society organisations, the research community, and the private sector. Biomass as a source of over 60% of the total energy has seen limited financial and technological investment in Ghana. The vast arable lands are degraded due to wood fuel harvesting for domestic and commercial use. Support for decentralised off-grid technologies (such as solar PV and wind) as alternatives to the conventional electricity supply in Ghana is limited.

The most dominant local energy niche in Ghana is promoted through private sector investments in thermal energy generation. Over the years, the Ghana government guarantees power purchase to IPPs (Independent Power Producers). This led to the development of several thermal power plants such as the Kpone I & II, Sonon Asogli, and Takoradi Thermal 1 & 2 (T1&T2) by the private sector, sometimes in partnership with the state. The Africa & Middle East Resources Investment Group LLC (Ameri) and Karpower were built recently through partnerships with foreign investors. This highlights how Ghana's energy policies and niches are locked into existing hydrocarbon energy systems either through using crude or gas for power generation. Ghana's energy system entails transitioning within the hydrocarbon mix, with limited or no opportunities for local investment in renewable energy niches. The supposed establishment of a renewable energy fund to promote and finance sustainable transition energy niches never materialised.

Multi-level Perspective, Energy Transition, and Change

This paper provides critical insights on sustainable energy transitions in developing countries based on the experiences of Russia and Ghana under the methodological lenses of MLP. We examine to what extent a MLP is suitable for describing change in sustainable energy transition within landscape, regime, and niche concepts, and the potential challenges of mechanically transferring a one-fits-all approach to developing countries. It is obvious that given the different socio-economic and political economies across spaces, diverse conceptual tools are needed to better explain energy transition in developing countries.

In the Russian case, the findings reveal that SET is controversial because although the government is interested in modernisation and diversification of the economy, diversification of the markets for import is still highly dependent on the export of fossil fuels and the resource-based "regime" has led to lock-in in the "niches". The main challenge is in synchronising the changes to the values and practices of all the system's actors with the emerging risks and constant dynamic of the "landscape". Policy towards the sustainability transition lay in the rethinking of export policies both in the field of carbon raw materials and developing renewable energy capacities, and recognised such transition from a raw materials export model to a "stimulating infrastructure". Also, it is necessary to approach the Russian regions contextually, to provide subsidies for the renewable sources of energy, developing public-partnerships, establishing communication between the energy-saving programmes and private enterprises, and creating restrictions for the extraction of the resources. The growing structure of renewable energy will create a new "investment cycle" in the general energy balance, and competition in certain industrial sectors for jobs and finances will be expected (Romanov, 2022). On the one hand, the epistemological potential of the MLP approach for the Russian context is fruitful as a new research ground for describing the sustainability transition process among various stakeholders and levels (there is no literature that analyses energy transition in Russia from this perspective). In the Russian case, the MLP approach clearly presents the fundamental energy technologies, markets, institutions, consumption practices, and social policy that exist on different levels (common, regional, local), united by one centralised energy law and technical system (landscape); one institutional energy rule (meso) differs only by cost in economic regions. Niches including green and raw export stakeholders (governmental and business structure) represented their effectiveness previously by economic benefits in local internal energy using and export benefits. The raw materials export model of Russia raises issues for the green global economy and the political economy of socio-technical transitions is critical in energy transition discourse (Baker et al., 2014). On the other hand, rigid definitions of the concepts of "regime", "landscape", and "niche" do not describe organically and in full the nuances of the SET processes in the Russian context because of the interchange and interdependence of the niche and regime actors who are mainly driven by economic and political values under the resource-driven economy, the monopoly of big oil companies, great variability of sustainable energy transitions policy across regions in Russia, and low agency to regulate the temperature in homes independently. The centralisation and monopoly of the energy structure bears the advantages of continuity and reliability of the power supply utilities, but also raises barriers to developing a decentralised renewable energy system that tries to exist within the same unitary system. In this regard, the concepts of energy justice and energy poverty can provide better conceptual explanations of such processes.

The Ghana energy transition trajectory can be mirrored with the landscape, regime, and niche conceptually and theoretically; in practice, however, it is obvious that sustainable energy transitioning has been problematic since the country is locked into the existing hydrocarbon socio-technical system. As noted earlier, Ghana's energy transition lies within the landscape of international energy and sustainability conventions, frameworks, and socio-technology systems. The global landscape at the macro scale has informed the Ghana energy regime (meso) such as energy and renewable energy policies albeit with limited success in promoting sustainable energy transition. Theorising existing energy transition is Eurocentric (Power et al., 2016) based on assumptions of state capacity, markets, institutions, and infrastructure. But this does not represent the realities of some of the developing economies with a weak state and institutions and market systems (Berkhout et al., 2010; Bridge et al., 2013; Hansen & Coenen, 2015; Lawhon & Murphy, 2012) to generate funds for niche innovation. For example, in Ghana there is limited national or local investment, and the state has become deeply tied to existing hydrocarbon socio-technical and political systems (Unruh, 2000). In the past 50 years, Ghana has been committed to the hydropower system from Akosombo and Kpong, and since the late 1990s a thermal energy mix due to climate change and unreliable rainfall that affected energy produced by the hydro dams. Thus, Ghana has been technologically, structurally, and socially linked with two energy systems (hydro and thermal) with limited incentives to invest in alternative energy sources. Ghana is only circulating within the same hydrocarbon and hydro socio-technical system and cannot be said to be necessarily transitioning. A power purchase guarantee for IPPs irrespective of source does not encourage niche innovation in renewable energies. There is also the question as to whether local actors have the capabilities, be it financially and/or technologically to capitalise on the regime to invest in niches in Africa. Development of renewable energies is partly dependent on funding from governments, local investors or transnational FDIs. In Ghana, local actors do not appear to have the capacity for investments, and energy transition projects such as the biofuel from Jetropha are initiated by foreign entities

(Boamah, 2014). Some of Ghana's biofuel projects were financed by Canadian and Norwegian investors, fronted by local actors. This raises questions of the interests of the investors: sustainable energy or profit.

In this paper, we argue that even though Russia and Ghana strive for energy transition, the diversification of the markets for import are still highly depended on fossil fuels export and resource-based "regimes" which led to lock-in in the "niches". Both Ghana and Russia are commodity export models of energy policy development but they have a different base: in Ghana, more energy is produced on the basis of hydropower and thermal plants mostly power by natural gas. Russia's landscape perspective implies maintaining the status of an independent commodity-exporting power, which, however, retains its obligation to reduce emissions, while Ghana demonstrates a greater number of cases on reducing emissions within various intercountry agreements. Under the regime, both Russia and Ghana are showing a high commitment to the conventional energy market developing these technologies as part of energy efficiency and promoting jobs in this sector; however, Ghana seems more theoretically committed to diversifying with renewable energy sources. Also, due to climate complexity, renewable energy sources in Russia are currently expanding into the southern territories and Siberia. Niches for the development of technological innovation also differ across countries. Ghana is advancing private sector decarbonization innovation through private sector led solar equipment though still limited, and which is supposed to be more competitive, which is easier to implement given the greater focus on decentralized energy system and with investments in biomass and solar energies as the future to betting on. Despite these efforts, Ghana's energy architecture is still glued in thermal. The energy system of Russia is unified, centrally controlled, characterized by inertia, and the development of innovations in the field of renewable energy sources is mainly concentrated within the same structures and concerns that promote traditional hydrocarbon technologies, new technological niches will need to integrate into the existing system and select such economic instruments that will maintain a convenient tariff for the consumer. Russia is developing technologies in the field of all possible sources of renewable energy, with particular emphasis on hybrid solar and wind stations in the South and Siberia, biomass energy in the North but energy-efficient solutions in the field of traditional energy are developing the fastest than renewables.

With the MLP, there is a focus on niches and elite actors as deliberate leaders and promoters of innovative energy transition. Emphasis is placed on "bottom-up" niche innovations, even though where it fails to account adequately for entrenched landscape or regime stakeholders such as multinational firms whose behaviour is not easily altered by the state (Coenen & Truffer, 2012; Power et al., 2016; Truffer, 2012). But overly focused on elite and formal actors as drivers of niche innovation tends to de-emphasise informal networks of innovation and diffusion that characterise the development and uptake of technologies. It is also now clear that MLP need to adapt to different energy networks and flows in the geopolitical space beyond the macro-regime of the state. Transition concepts have been relatively diminutive about questions on geopolitics in shaping domestic and international energy policy choices and transition regimes

(McEwan, 2017; Power et al., 2016; Silver & Marvin, 2016). Politics partly drive niche innovation within the sustainability energy space. We argue the need to highlight the political economy of socio-technical energy literatures to allow for an understanding of how and why transnational actors, including "emerging powers" (such as China, Brazil, and India) play roles in shaping regimes, landscapes, and niches. There are a growing number of studies in the literature on energy geographies that raise queries about the energy infrastructures as sites of contestation, competition, and struggle over resources, technologies and social systems, ethics, energy poverty and justice, and socio-economic implications (Sovacool & Dworkin, 2015). Based on the concept of "energy landscapes", Frantál et al. (2014) observe that an energy system is not necessarily a physically delimited space, but instead dynamic entities constituted by complex local, national, and transnational flows of technologies, funding agencies and ideologies. Ramos-Mejía et al. (2018) highlight the challenges of socio-technical transformations amidst poverty and sustainability in energy transitions with dissimilar local dynamics. Countries exhibit a mix of well- and ill-functioning institutions, markets, and social systems, with each having implications for energy transitions. The developing countries are not homogenous, with differentiated structures, policies, and actors that either facilitate or inhibit effective energy transition. There is, therefore, the need for justice in energy transition discourse, while at the same time examining the historical trajectories of technologies. As Monagas & Corral (2022) recently note, it is obvious that given the different socio-economic and political economies across spaces, diverse conceptual tools are needed to better explain energy transition in developing countries.

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