Achieving Just Energy Transition: Examining the Efficacy of Kenya's Policy and Regulatory Approaches

Kariuki Muigua

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Abstract

This paper discusses the progress made in achieving just energy transition by examining the policy and regulatory steps that Kenya has employed towards this. The author argues that while there is an urgent need to move towards cleaner energy sources in the country, the policy makers must also embrace the poor by putting in place measures that will ensure that they will not be left struggling with energy insecurity. The paper also makes a case for modernization of the use of biomass instead of getting rid of it completely as this may not be tenable due to other economic and social factors.

1. Introduction

One of the most important human endeavours that faces significant obstacles is producing the energy required for the world's expanding population, industrialization, and urbanization.[1] In underdeveloped nations, where there is currently insufficient and inadequate power supply, the issue is worse.[2] Unquestionably dependable economic boosters, fossil fuels (coal, natural gas, and oil) have detrimental effects on the environment and human health, including CO2 emissions and the degradation of natural resources.[3] A worldwide cry has been raised as a result for a sustainable energy system that is safe, sufficient, reasonably priced, and ecologically sound.[4]

Although one of the Sustainable Development Goals (SDG 7) is to achieve cheap and sustainable energy, the majority of developing economies continue to struggle with insufficient power supplies

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[1] Ebhota, W.S., 2021. Leveraging on sustainable energy transition to change the energy narrative of the dark continent. *International Journal of Energy Economics and Policy*, *11*(3), pp.409-416.

[2] Ibid.; Ibrahim, H.A. *et al.* (2023) 'Sustainability of power generation for developing economies: A systematic review of power sources mix', *Energy Strategy Reviews*, 47, p. 101085. Available at: https://doi.org/10.1016/j.esr.2023.101085.

[3] Ibid.

[4] Ibid.

and a significant reliance on fossil fuels.[5] The foundations of this societal threat include fast population expansion, industrialization, modernization, among others.[6] These power sources are known to contribute significantly to environmental pollution, global warming, and health hazards, even if they seem far from being adequate.[7]

While the global population without access to electricity decreased from 1.14 billion in 2010 to 675 million in 2021, primarily due to Asia, where the deficit decreased from 516 million in 2010 to 69 million in 2021, Africa only saw a slight decrease in its unelectrified population, from 591 million to 586 million during the same period, likely due to its rapidly growing population.[8]

The transition in energy sources from fossil fuels to renewables is only one aspect of the change. It must also cover the social, economic, and environmental aspects of producing energy sustainably.[9] The global energy industry's shift from fossil fuel-based to zero-carbon energy is hence referred to as the "energy transition."[10] As the energy sector increasingly concentrates on

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[5] Ibrahim, H.A. *et al.* (2023) 'Sustainability of power generation for developing economies: A systematic review of power sources mix', *op. cit.*

[6] Ibid.; see also Hafner, M., Tagliapietra, S. and de Strasser, L. (2018) 'The Challenge of Energy Access in Africa', in M. Hafner, S. Tagliapietra, and L. de Strasser (eds) *Energy in Africa: Challenges and Opportunities*. Cham: Springer International Publishing, pp. 1–21. Available at: https://doi.org/10.1007/978-3-319-92219-5_1; Ahuja, D. and Tatsutani, M. (2009) 'Sustainable energy for developing countries', *S.A.P.I.EN.S. Surveys and Perspectives Integrating Environment and Society* [Preprint], (2.1). Available at: https://journals.openedition.org/sapiens/823 (Accessed: 21 April 2024); *Improving energy access key to meeting development goals in Africa | UNCTAD* (2023). Available at: https://unctad.org/news/improving-energy-access-key-meeting-development-goals-africa (Accessed: 21 April 2024); Avtar, R. *et al.* (2019) 'Population–Urbanization–Energy Nexus: A Review', *Resources*, 8(3), p. 136. Available at: https://doi.org/10.3390/resources8030136; *Scaling Up Energy Access for Green, Resilient, and Inclusive Development in Western and Central Africa* (no date) *World Bank*. Available at: https://projects.worldbank.org/en/results/2023/11/17/scaling-up-energy-access-for-green-resilient-and-inclusive-development-in-western-and-central-africa (Accessed: 21 April 2024).

[7] Ibid.; see also Dida, G.O. *et al.* (2022) 'Factors predisposing women and children to indoor air pollution in rural villages, Western Kenya', *Archives of Public Health*, 80, p. 46. Available at: https://doi.org/10.1186/s13690-022-00791-9; Shilenje, Z.W., Maloba, S. and Ongoma, V. (2022) 'A review on household air pollution and biomass use over Kenya', *Frontiers in Environmental Science*, 10. Available at: https://doi.org/10.3389/fenvs.2022.996038.

[8] *Sustainable Development Goal 7 (SDG7)* (no date) *Sustainable Energy for All | SEforALL*. Available at: https://www.seforall.org/our-work/sustainable-development-goal-7-sdg7 (Accessed: 20 April 2024).

[9] Ali, K. *et al.* (2023) 'Testing the role of digital financial inclusion in energy transition and diversification towards COP26 targets and sustainable development goals', *Gondwana Research*, 121, pp. 293–306. Available at: https://doi.org/10.1016/j.gr.2023.05.006.

[10] Ibid.; *Energy transition: Connotations, mechanisms and effects - ScienceDirect* (no date). Available at: https://www.sciencedirect.com/science/article/pii/S2211467X24000270 (Accessed: 23 April 2024); *What is Energy Transition?* (no date). Available at: https://www.spglobal.com/en/research-insights/articles/what-is-energy-transition (Accessed: 23 April 2024); Arezki, R. and Matsumoto, A. (no date) 'Chapter 4. The Energy Transition in an Era of Low

the energy transition and the route to net zero, diversification into new markets and segments is also essential.[11] Many businesses understand the range of sectors in which their technology may be used.[12] Broadening the scope of oil and gas companies' primary fossil fuel business into new low-carbon energy markets and products is known as diversification in the context of the energy transition.[13]

Kenya and China signed a nuclear power cooperation agreement in 2015, allowing Kenya to receive technical assistance and expertise.[14] Kenya also signed cooperation agreements with Slovakia and Russia, as well as a collaboration arrangement with three South Korean nuclear power companies. Kenya and the US are both seeking a such cooperative pact.[15] All of this is in preparation for Kenya's goal of producing nuclear electricity by 2035. Kenya is collaborating with

Fossil Fuel Prices', in *Shifting Commodity Markets in a Globalized World*. International Monetary Fund. Available at: https://www.elibrary.imf.org/display/book/9781484310328/ch004.xml (Accessed: 23 April 2024); *Energy Transition - an overview | ScienceDirect Topics* (no date). Available at: https://www.sciencedirect.com/topics/engineering/energy-transition (Accessed: 23 April 2024).

[11] *World Energy Transitions Outlook 2023* (no date). Available at: https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2023 (Accessed: 21 April 2024).

[12] Ali, K. *et al.* (2023) 'Testing the role of digital financial inclusion in energy transition and diversification towards COP26 targets and sustainable development goals', *op.cit.*

[13] Ibid.; Cherepovitsyn, A., Kazanin, A. and Rutenko, E. (2023) 'Strategic Priorities for Green Diversification of Oil and Gas Companies', *Energies*, 16(13), p. 4985. Available at: https://doi.org/10.3390/en16134985; Herzog-Hawelka, J. and Gupta, J. (2023) 'The role of (multi)national oil and gas companies in leaving fossil fuels underground: A systematic literature review', *Energy Research & Social Science*, 103, p. 103194. Available at: https://doi.org/10.1016/j.erss.2023.103194; *The Oil and Gas Industry in Energy Transitions – Analysis* (2020) *IEA*. Available at: https://www.iea.org/reports/the-oil-and-gas-industry-in-energy-transitions (Accessed: 23 April 2024); Hunziker, B. (2020) 'The role of oil and gas companies in the energy transition', *Atlantic Council*, 9 January. Available at: https://www.atlanticcouncil.org/in-depth-research-reports/report/the-role-of-oil-and-gas-companies-in-the-energy-transition/ (Accessed: 23 April 2024); Kim, J., Panton, A.J. and Schwerhoff, G. (2024) 'Energy Security and The Green Transition', *IMF Working Papers*, 2024(006). Available at: https://doi.org/10.5089/9798400263743.001.A001; Gitelman, L., Kozhevnikov, M. and Visotskaya, Y. (2023) 'Diversification as a Method of Ensuring the Sustainability of Energy Supply within the Energy Transition', *Resources*, 12(2), p. 19. Available at: https://doi.org/10.3390/resources12020019; Morgunova, M. and Shaton, K. (2022) 'The role of incumbents in energy transitions: Investigating the perceptions and strategies of the oil and gas industry', *Energy Research & Social Science*, 89, p. 102573. Available at: https://doi.org/10.1016/j.erss.2022.102573.

[14] 75 (2022) *Kenya - Energy-Electrical Power Systems*. Available at: https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems (Accessed: 21 April 2024).

[15] Ibid.

the International Atomic Energy Agency(IAEA) to increase its capabilities in order to achieve this.[16]

The majority of Kenya's energy needs, particularly those of rural households, are met by an excessive reliance on the ever-diminishing biomass energy resource, despite the country's resources also including petroleum, geothermal power, small hydropower, solar, wind, and biomass residue from the country's agricultural sector.[17] This high level of reliance is explained by the abundance of biomass found in forests, woods, and industrial and agricultural wastes. Sub-Saharan Africa's high reliance on biomass energy, however, is unlikely to change anytime soon due to the region's growing population, the scarcity of reasonably priced modern energy sources like electricity, kerosene, and LPG, and the growing trend towards bioeconomies as a means of addressing climate change in line with the objectives of the Paris Agreement.[18] In addition to being the primary fuel for cooking in most sub-Saharan homes, biomass is a vital source of energy for small- and medium-sized rural businesses and establishments, including bakeries, restaurants, hospitals, prisons, tea shops, tobacco curing, brick-making, and fish smoking.[19]

This paper critically appraises Kenya's journey towards achieving energy transition for sustainability. It discusses the current global status, challenges and prospects of Kenya in realising this dream into a reality for its people.

2. Access to Energy and Sustainable Development

Increased energy consumption and CO2 emission restrictions are two of the world's main energy transitioning problems.[20] The energy sector plays a crucial role in accomplishing the Sustainable Development Goals and yet, among the infrastructure sectors, energy generation and distribution

[16] 75 (2022) *Kenya - Energy-Electrical Power Systems*. Available at: https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems (Accessed: 21 April 2024).

[17] Kennedy S Muzee, "Low-carbon Africa: Kenya". *This report is one of six African country case studies commissioned by Christian Aid to support the report Low-Carbon Africa: Leapfrogging to a Green Future*. Available at: https://www.christianaid.org.uk/sites/default/files/2022-07/low-carbon-africa-kenya-november-2011.pdf (Accessed: 20 April 2024).

[18] *Kenya's charcoal bans have fuelled a smuggling problem | ISS Africa* (no date). Available at: https://issafrica.org/ (Accessed: 21 April 2024).

[19] Ibid.

[20] Ali, K. *et al.* (2023) 'Testing the role of digital financial inclusion in energy transition and diversification towards COP26 targets and sustainable development goals', *op.cit.*

is also the largest emitter of greenhouse gas emissions, accounting for 37% of global emissions overall.[21] The Sustainable Development Goal 7 (SDG 7) aims to provide "affordable, reliable, sustainable, and modern energy for all" by 2030.[22] Its three main objectives are to guarantee that everyone has access to affordable, dependable, and modern energy services; significantly increase the proportion of renewable energy in the world's energy mix; and double the rate at which energy efficiency is improving globally.[23]

Similarly, SDG 12 requires countries to ensure sustainable consumption and production patterns. Target 12.c thereof requires countries to rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.[24] Reconciling environmental deterioration with economic progress, and accomplishing more with less, is one of the world's biggest difficulties in integrating environmental sustainability with welfare and growth.[25] The shift to a greener and more socially inclusive global economy requires resource and impact decoupling in order to support sustainable patterns of production and consumption.[26]

The Sustainable Development Goal (SDG) number seven (SDG 7), which calls for universal access to affordable, modern, sustainable, and clean energy, is linked to a number of other objectives, including: ending world hunger, promoting economic growth and decent work;

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[21] Wernersson, L. *et al.* (2024) 'Mainstreaming systematic climate action in energy infrastructure to support the sustainable development goals', *npj Climate Action*, 3(1), pp. 1–12. Available at: https://doi.org/10.1038/s44168-024-00108-2.

[22] *Sustainable Development Goal 7 (SDG7)* (no date) *Sustainable Energy for All | SEforALL*. Available at: https://www.seforall.org/our-work/sustainable-development-goal-7-sdg7 (Accessed: 20 April 2024).

[23] Ibid.

[24] Ibid.; Martin (no date) 'Sustainable consumption and production', *United Nations Sustainable Development*. Available at: https://www.un.org/sustainabledevelopment/sustainable-consumption-production/ (Accessed: 21 April 2024).

[25] Environment, U.N. (2021) *GOAL 12: Sustainable consumption and production*, *UNEP - UN Environment Programme*. Available at: http://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-12 (Accessed: 21 April 2024).

[26] Ibid.

eliminating poverty; promoting health and well-being; providing clean water and sanitation; taking action against climate change; and encouraging responsible consumption and production.[27] Therefore, it may be argued that many of the SDGs' goals would be challenging to achieve for poor nations who are having trouble with access to energy.[28] A major component of the social, environmental, and developmental difficulties facing the globe today is the search for adequate energy to meet the growing demand.[29]

In order to achieve the goal of the SDGs and COP26 aims (direction towards energy transition and diversification) to obtain net zero emissions by 2050 and the (SDGs 7, 12, 11 and 13) by 2030, energy transition and diversification with policy frameworks are thus essential components.[30] Thus, in compliance with UN guidelines, contemporary energy systems should generate low to zero carbon dioxide emissions; balance capital-intensive investments for network expansions; influence local energy security and self-sufficiency; and promote social investment and inclusivity.[31]

3. Energy Transition: Examining Kenya's Policies and Energy Landscape

To build a more inclusive and clean energy economy, significant economic, political, and social connectivity across economies as well as an efficient domestic governance structure is essential.[32] In poor nations, an over dependence on biomass and other polluting fuels for cooking has added to the problem of global climate change.[33] One of the main issues with the energy access situation in underdeveloped nations has been the availability of clean cooking energy. Modern energy accessibility promotes clean energy development.[34]

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[27] Ebhota, W.S., 2021. Leveraging on sustainable energy transition to change the energy narrative of the dark continent. Op. cit.
[28] Ibid., p.409.
[29] Ibid., p.409.
[30] Ali, K. *et al.* (2023) 'Testing the role of digital financial inclusion in energy transition and diversification towards COP26 targets and sustainable development goals', *op. cit.*

[31] Ibid., p.409.
[32] Acheampong, A.O., Opoku, E.E.O. and Dogah, K.E., 2023. The political economy of energy transition: the role of globalization and governance in the adoption of clean cooking fuels and technologies. *Technological Forecasting and Social Change*, *186*, p.122156.
[33] Ibid.; see also Namaswa, T. *et al.* (2022) 'Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya', *Journal of Horticulture and Forestry*, 14(4), pp. 56–67. Available at: https://doi.org/10.5897/JHF2022.0689.

[34] Ibid.

According to the broad definition, a home is considered energy poor if it relies on traditional energy sources like biomass or cannot access contemporary energy sources like electricity and clean cooking fuels or technology for basic energy needs.[35] Indeed, research has shown that energy poverty is a precursor to other environmental and social issues, such as socioeconomic development and human health.[36] Kenya is one of the countries that have been suffering from this inadequate access to clean energy sources and over-reliance on biomass.[37] Biomass fuel sources include agricultural and industrial wastes, such as wood fuel (firewood and charcoal) and crop residues, as well as habitat systems such as enclosed forests, woods, bushlands, grasslands, farmlands, and plantations.[38] Charcoal is still a valuable resource, especially for people living in cities, nevertheless. On the other hand, increased rates of deforestation are associated with its expansion.[39] A little over 47% of Kenyan homes utilise charcoal as a fuel source; 82% of urban

[35] Ang'u, C. *et al.* (2023) 'Analysis of energy poverty in Kenya and its implications for human health', *Energy Policy*, 176, p. 113506. Available at: https://doi.org/10.1016/j.enpol.2023.113506.

[36] Ibid.; Jessel, S., Sawyer, S. and Hernández, D. (2019) 'Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature', *Frontiers in Public Health*, 7. Available at: https://doi.org/10.3389/fpubh.2019.00357; Xiao, Y. *et al.* (2021) 'The Relationship between Energy Poverty and Individual Development: Exploring the Serial Mediating Effects of Learning Behavior and Health Condition', *International Journal of Environmental Research and Public Health*, 18(16), p. 8888. Available at: https://doi.org/10.3390/ijerph18168888; Pan, L., Biru, A. and Lettu, S. (2021) 'Energy poverty and public health: Global evidence', *Energy Economics*, 101, p. 105423. Available at: https://doi.org/10.1016/j.eneco.2021.105423; Li, J. (2023) 'Policies to Alleviate Energy Poverty: From Fundamental Concepts to a Practical Framework in the New Era', in F. Taghizadeh-Hesary and D. Zhang (eds) *The Handbook of Energy Policy*. Singapore: Springer Nature, pp. 195–225. Available at: https://doi.org/10.1007/978-981-19-6778-8_8; Katoch, O.R. *et al.* (2023) 'Energy poverty and its impacts on health and education: a systematic review', *International Journal of Energy Sector Management*, 18. Available at: https://doi.org/10.1108/IJESM-10-2022-0007; Guzowski, C., Martin, M.M.I. and Zabaloy, M.F. (2021) 'Energy poverty: conceptualization and its link to exclusion. Brief review for Latin America', *Ambiente & Sociedade*, 24, p. e00272. Available at: https://doi.org/10.1590/1809-4422asoc20200027r2vu2021L2DE.

[37] Ibid.; *Health and forests suffer as East Africa continues to rely on biomass fuels* (no date) *Alliance for Science*. Available at: https://allianceforscience.org/blog/2020/11/health-and-forests-suffer-as-east-africa-continues-to-rely-on-biomass-fuels/ (Accessed: 23 April 2024); *Boosting Access to Renewable Energy across East Africa* (no date). Available at: https://www.afd.fr/en/actualites/boosting-access-renewable-energy-across-east-africa (Accessed: 23 April 2024); Shilenje, Z.W., Maloba, S. and Ongoma, V. (2022) 'A review on household air pollution and biomass use over Kenya', *Frontiers in Environmental Science*, 10. Available at: https://doi.org/10.3389/fenvs.2022.996038.

[38] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *Fuel Communications*, 7, p. 100015. Available at: https://doi.org/10.1016/j.jfueco.2021.100015.

[39] *Charcoal value chains in Africa and their role for sustainable development* (2021) *SweDev*. Available at: https://www.swedev.dev/charcoal-value-chains-in-africa-and-their-role-for-sustainable-development/ (Accessed: 21 April 2024); Zorrilla-Miras, P. *et al.* (2018) 'Environmental Conservation and Social Benefits of Charcoal Production in Mozambique', *Ecological Economics*, 144, pp. 100–111. Available at: https://doi.org/10.1016/j.ecolecon.2017.07.028; Tassie, K. *et al.* (2021) 'Socioeconomic and Environmental Impacts of Charcoal Production Activities of Rural Households in Mecha District, Ethiopia', *Advances in Agriculture*, 2021, p. e6612720. Available at: https://doi.org/10.1155/2021/6612720;

dwellings and 34% of rural homes do the same.[40] Currently Kenya is among the countries in the Sub-Saharan Africa (SSA) that are still in energy crisis and socio-economic deficit that cannot be disputed. Accessibility to modern and renewable energy for a long time has been considered to be a privileged in Kenya.[41] Despite Kenya's 75% power penetration rate, many individuals still find the cost of connection to be prohibitive.[42] Kerosene is now used by 92% of all homes, of which 94% are in rural regions and 89% are in urban areas.[43] It is mostly used for lighting, and the majority of urban families use it to prepare food, which explains why urban use of kerosene is larger than that of rural households.[44]

Although 75% of Kenyans have access to electricity and the country is Africa's largest generator of geothermal energy, many still find the expense of access to be prohibitive.[45] Although the government has a plan to use subsidies and other measures to make liquefied petroleum gas the main fuel for cooking, the plan is not being implemented quickly enough.[46] Giving access to these substitutes priority would lessen reliance on charcoal.[47]

The primary obstacle to mitigating the uncontrolled utilisation of biomass has been the absence of efficacious policies and tactics to tackle the escalating difficulties in its cultivation and use. For

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Igini, M. (2022) *Deforestation in Africa: Causes, Effects, and Solutions*, *Earth.Org*. Available at: https://earth.org/deforestation-in-africa/ (Accessed: 21 April 2024); Chidumayo, E. and Gumbo, D. (2013) 'The environmental impacts of charcoal production in tropical ecosystems of the world: A synthesis', *Energy for Sustainable Development*, 17, pp. 86–94. Available at: https://doi.org/10.1016/j.esd.2012.07.004; Wekesa, C. *et al.* (2023) 'Effects of charcoal ban on value chains and livelihoods in Kenyan coast – Stakeholders' perceptions', *Environmental Development*, 45, p. 100809. Available at: https://doi.org/10.1016/j.envdev.2023.100809.

[40] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[41] Ibid.; Agoundedemba, M., Kim, C.K. and Kim, H.-G. (2023) 'Energy Status in Africa: Challenges, Progress and Sustainable Pathways', *Energies*, 16(23), p. 7708. Available at: https://doi.org/10.3390/en16237708.

[42] *Kenya's charcoal bans have fuelled a smuggling problem | ISS Africa* (no date). Available at: https://issafrica.org/ (Accessed: 21 April 2024).

[43] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[44] Ibid.

[45] *Kenya's charcoal bans have fuelled a smuggling problem | ISS Africa* (no date). Available at: https://issafrica.org/ (Accessed: 21 April 2024).

[46] Ibid.

[47] Ibid.

example, Kenya passed Acts and policies such as the Energy Act 2019[48] that face a number of obstacles, such as stakeholders such as charcoal producer association organisations not cooperating with one another and a lack of persistent political will.[49] For instance, the government's 2018 ban on the production of charcoal is a poor policy strategy for ensuring sustainability because it encourages overexploitation in private companies, increases illegal tree harvesting and charcoal production, demoralizes the community from engaging in sustainable forest and tree management, and increases corruption as producers bribe law enforcement and the police.[50] The biomass energy industry has not received much investment due to inadequate legislation in Sub-Saharan Africa, as the majority of investments are in commercial energy sources, namely electricity and petroleum-based fuels.[51] Some authors have however observed that wood fuels have received little attention in global policy discussions on energy supply; instead, the emphasis has been on the need for the impoverished to have access to "modern" energy sources like kerosene, liquefied petroleum gas (LPG), and electricity.[52]

Kenya's commitment to reducing over-reliance on fossil fuels and non-sustainable biomass fuels may be met by implementing and promoting clean, efficient, and sustainable energy technology.[53] The country has selected major priority mitigation actions to achieve this goal. In order to achieve this, there has been a consistent shift towards clean cooking using liquefied petroleum gas (LPG), with a current penetration rate of around 19% (2.4 million) and a projected 100% changeover by 2028.[54] LPG costs have increased quickly in spite of government attempts to promote LPG use through tax incentives. With LPG at zero rating, costs were steady from 2016 to 2021 before sharply rising in July 2021 as a result of the reinstatement of VAT.[55] There was however a reversal

[48] Energy Act, No. 1 of 2019, Laws of Kenya.

[49] Namaswa, T. *et al.* (2022) 'Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya', *Journal of Horticulture and Forestry*, 14(4), pp. 56–67. Available at: https://doi.org/10.5897/JHF2022.0689.

[50] Ibid; see also *Kenya's charcoal bans have fuelled a smuggling problem | ISS Africa* (no date). Available at: https://issafrica.org/ (Accessed: 21 April 2024).

[51] Ibid.

[52] Namaswa, T. *et al.* (2022) 'Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya', *op. cit.*

[53] 'Promoting Clean Cooking in Kenya – KIPPRA' (no date). Available at: https://kippra.or.ke/promoting-clean-cooking-in-kenya/ (Accessed: 21 April 2024).

[54] Ibid.

[55] 'Promoting Clean Cooking in Kenya – KIPPRA' (no date). Available at: https://kippra.or.ke/promoting-clean-cooking-in-kenya/ (Accessed: 21 April 2024).

of this in 2023 where there was removal of VAT on liquefied petroleum gas (LPG) – zero rated for VAT.[56] Thus, in reality, and with such uncertainties, most of the impoverished communities in Sub-Saharan Africa are unlikely to obtain their primary household energy needs from modern energy sources for several years to come.[57] This is because the number of rural poor populations that are unable to buy modern energy sources is growing, which causes the usage of biomass energy to rise.[58] Research and development of more advanced and effective technologies for producing and using biomass energy are required.[59] To ensure that the developed technologies are effective, inexpensive, straightforward, and easy to use, as well as to take into account user needs like cooking comfort, health concerns, and safety, this can be accomplished by strengthening research and development institutions and promoting multidisciplinary and multi-institutional research through bio-energy innovation platforms.[60] The Kenya Bioenergy Strategy 2020–2027 states that policies pertaining to biomass energy should be focused on guaranteeing the sustainable, adequate, competitive, secure, and consistent supply of biomass energy to fulfil current demand while preserving and safeguarding the environment.[61]

Kenya's population is expanding, the economy is expanding, and energy demand is outpacing supply.[62] In an attempt to make Kenya's economy middle-income by 2030, the Kenyan

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[56] *Key Highlights of the Finance Act 2023 - KRA* (no date). Available at: https://www.kra.go.ke/popular-links/key-highlights-of-the-finance-act-2023 (Accessed: 21 April 2024).

[57] Namaswa, T. *et al.* (2022) 'Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya', *op. cit.*

[58] Ibid; see also *Why Kenya cannot do away with charcoal* (no date). Available at: https://www.the-star.co.ke/sasa/lifestyle/2023-11-03-why-kenya-cannot-do-away-with-charcoal/ (Accessed: 21 April 2024).

[59] Ibid.

[60] Namaswa, T. *et al.* (2022) 'Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya', *op. cit.*

[61] Ibid; see also now, business (2023) *Kenya fast tracking shift to clean energy*, *Business Now*. Available at: https://businessnow.co.ke/kenya-fast-tracking-shift-to-clean-energy/ (Accessed: 21 April 2024); *Fast and fair renewable energy for Africa: Lessons from Kenya* (no date) *Business & Human Rights Resource Centre*. Available at: https://www.business-humanrights.org/en/from-us/briefings/fast-and-fair-renewable-energy-for-africa-lessons-from-kenya/ (Accessed: 21 April 2024); User, S. (no date) *A Just Energy Transition for Africa*. Available at: https://www.acts-net.org/2018/index.php/blogs/foresight-africa-blog/a-just-energy-transition-for-africa (Accessed: 21 April 2024); *What does justice mean for the energy transition and how do we achieve it?* (2023). Available at: https://www.iied.org/what-does-justice-mean-for-energy-transition-how-do-we-achieve-it (Accessed: 21 April 2024).

[62] *Kenya Energy Outlook – Analysis* (no date) *IEA*. Available at: https://www.iea.org/articles/kenya-energy-outlook (Accessed: 21 April 2024); week, S. up to date on the editors' picks of the (2024) *Power demand could overtake generation by 2027*, *Business Daily*. Available at: https://www.businessdailyafrica.com/bd/economy/power-demand-could-overtake-generation-by-2027--4515164 (Accessed: 21 April 2024); Maket, I. (2021) 'Population dynamics and economic growth in

Government's Vision 2030 programme has proposed aggressive goals for future economic growth.[63] The main issue the nation faces is its dependency on hydroelectric electricity and the lack of investment in power generation.[64] Companies in Kenya experience power interruptions, costing them an average of 6.3 million Kenyan shillings every month.[65]

In order to close the energy supply and demand imbalance, the Kenyan government launched an ambitious plan in 2013 to increase productive power output from 1664 MW to more than 5000 MW by the end of 2017.[66] The aim has not yet been fully attained. When completely implemented, the percentage of power generated by renewable energy sources was predicted to drop from 66% in 2017 to less than 50%.[67] The remaining energy will be generated mostly by thermal, nuclear, and natural gas power plants.[68] Kenya's National Climate Action Strategy and its Plan of National

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Kenya', *Hungarian Statistical Review*, 4, pp. 18–33. Available at: https://doi.org/10.35618/hsr2021.02.en018; Baskaran, G. and Coste, S. (2024) 'Achieving Universal Energy Access in Africa amid Global Decarbonization'. Available at: https://www.csis.org/analysis/achieving-universal-energy-access-africa-amid-global-decarbonization (Accessed: 21 April 2024).

[63] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[64] Ibid.; *The Seven Major Threats to Kenya's Power Sector* (no date) *Energy for Growth Hub*. Available at: https://energyforgrowth.org/article/the-seven-major-threats-to-kenyas-power-sector/ (Accessed: 21 April 2024); Sai, R. and Lin, B. (2022) 'Productivity assessment of power generation in Kenya: What are the impacts?', *Energy*, 254, p. 124200. Available at: https://doi.org/10.1016/j.energy.2022.124200.

[65] Ibid.; 'Promoting the Use of Solar Energy in the Manufacturing Sector in Kenya – KIPPRA' (no date). Available at: https://kippra.or.ke/promoting-the-use-of-solar-energy-in-the-manufacturing-sector-in-kenya/ (Accessed: 23 April 2024); week, S. up to date on the editors' picks of the (2023) *Cost of power outage on Kenyan economy*, *Business Daily*. Available at: https://www.businessdailyafrica.com/bd/economy/cost-of-power-outage-on-kenyan-economy--4463688 (Accessed: 23 April 2024).

[66] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*; 75 (2022) *Kenya - Energy-Electrical Power Systems*. Available at: https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems (Accessed: 23 April 2024); Kiprop, E., Matsui, K. and Maundu, N. (2018) 'Can Kenya Supply Energy With 100% Renewable Sources?', in; *The Design and Sustainability of Renewable Energy Incentives by World Bank Publications - Issuu* (2014). Available at: https://issuu.com/world.bank.publications/docs/9781464803147 (Accessed: 23 April 2024).

[67] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[68] Ibid.; see also 75 (2022) *Kenya - Energy-Electrical Power Systems*. Available at: https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems (Accessed: 21 April 2024); admin (2023) 'Kenya's Renewable Power Generation Hits 86pct Of Total Output', *Kenya Investment Authority (KenInvest)*, 11 January. Available at: https://www.invest.go.ke/2023/01/11/kenyas-renewable-power-generation-hits-86pct-total-output/ (Accessed: 21 April 2024); *Kenya - Electrical Power Systems | Privacy Shield* (no date). Available at: https://www.privacyshield.gov/ps/article?id=Kenya-electrical-power-systems (Accessed: 21 April 2024); Kihara, M. *et al.*

Agreed Commitments (INDCs) were both in conflict with the programme. The program's objective was to enhance Kenya's power generation from wind, solar, and geothermal sources.[69]

Kenya Energy Transition & Investment Plan 2023-2050

Kenya's Ministry of Energy is in charge of developing and executing energy policies that regulate industry participants and guarantee efficiency and safety while conserving and using energy.[70] Kenya's Ministry of Energy and Petroleum launched the Kenya Energy Transition & Investment Plan 2023-2050 in 2023 whose main objectives are: to build an Energy Transition and Investment Plan (ETIP); help Kenya frame an energy transition agenda that will attract investment, while at the same time ensuring a just transition and fully supporting Kenya's rapid economic growth trajectory; and to help Kenya engage the global investment and climate finance community.[71]

The Kenya Energy Transition and Investment Plan outlines Kenya's commitment to combat climate change and achieve net-zero emissions by 2050.[72] With assistance from Sustainable Energy For All (SEforALL) and the UN, the Kenya Ministry of Energy and Petroleum developed the strategy, which intends to put Kenya in a position to attract investment, spur new business ventures, and seize chances for green growth in the rapidly changing global environment.[73] The plan highlights the potential for investment opportunities and economic growth through the transition to clean energy.[74]

(2024) 'Mid- to long-term capacity planning for a reliable power system in Kenya', *Energy Strategy Reviews*, 52, p. 101312. Available at: https://doi.org/10.1016/j.esr.2024.101312.

[69] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[70] Ibid.

[71] Republic of Kenya, *Kenya Energy Transition & Investment Plan 2023 – 2050*, P. 1. Available at https://energy.go.ke/sites/default/files/KAWI/Kenya-ETIP-2050%202.pdf [Accessed on 19 April 2024]; See also *Sustainable Energy for All* (2024) *Sustainable Energy for All | SEforALL*. Available at: https://www.seforall.org/taxonomy/term/46 (Accessed: 21 April 2024).

[72] 'Kenya energy transition faces infrastructure, funding challenges' (no date) *Gas Outlook*. Available at: https://gasoutlook.com/analysis/kenya-energy-transition-faces-infrastructure-funding-challenges/ (Accessed: 20 April 2024).

[73] Ibid.
[74] Ibid.

It identifies key technologies for decarbonization, such as renewable energy, green hydrogen, e-mobility, energy storage, and clean cooking.[75] The plan also emphasizes the importance of strong governance, supportive policies, and stakeholder collaboration.[76] It estimates that around $600 billion in capital investment is needed, with a focus on the power and transport sectors.[77] The plan envisions job creation, reduced fossil fuel consumption, and a transition to cleaner and more sustainable energy sources.[78]

Kenya intends to electrify its country in order to replace fossil fuels. According to the Plan, this will reduce overall CO2 emissions (a net zero scenario) and be powered by solar, wind, geothermal, and maybe nuclear energy in addition to energy storage and energy efficiency.[79]

4. Fast-tracking Just Energy Transition in Kenya for Sustainability

Reducing energy poverty and providing access to modern energy sources are top priorities for several governments throughout the globe.[80] The Sustainable Development Goals (SDGs) of the United Nations, among which Goal 7 is to "ensure access to affordable, reliable, sustainable and modern energy for all," are another important source of inspiration for them. In order to promote economic growth, enhance health, ensure food security, and strive towards the accomplishment of nearly all of the SDGs, access to modern energy is crucial.[81] Even though access to modern energy is crucial, many people in poor nations still view it as a privilege rather than a right.[82]

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[75] Republic of Kenya, *Kenya Energy Transition & Investment Plan 2023 – 2050*, P. 1. Available at https://energy.go.ke/sites/default/files/KAWI/Kenya-ETIP-2050%202.pdf [Accessed on 19 April 2024].

[76] Ibid., p.1.

[77] Ibid., p.1.

[78] Ibid., p.1.

[79] 'Kenya energy transition faces infrastructure, funding challenges' (no date) *Gas Outlook*. Available at: https://gasoutlook.com/analysis/kenya-energy-transition-faces-infrastructure-funding-challenges/ (Accessed: 21 April 2024).

[80] Acheampong, A.O., Opoku, E.E.O. and Dogah, K.E., 2023. The political economy of energy transition: the role of globalization and governance in the adoption of clean cooking fuels and technologies. *Op. cit.*

[81] Ibid.; *Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all — SDG Indicators* (no date). Available at: https://unstats.un.org/sdgs/report/2016/goal-07/ (Accessed: 23 April 2024).

[82] Ibid.; Nations, U. (no date) *Goal 7—Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All*, *United Nations*. United Nations. Available at: https://www.un.org/en/chronicle/article/goal-7-ensure-access-affordable-reliable-sustainable-and-modern-energy-all (Accessed: 23 April 2024); *LDC - Progress in least developed countries hinges on access to modern energy, new United Nations report says | UNCTAD* (2017). Available at: https://unctad.org/press-material/ldc-progress-least-developed-countries-hinges-access-modern-energy-new-united (Accessed: 23 April 2024); *What you need to know about energy and poverty* (no date) *World Bank Blogs*. Available at: https://blogs.worldbank.org/en/voices/what-you-need-know-about-energy-and-poverty (Accessed: 23 April 2024); Hesselman, M. *et al.* (2021) 'Energy poverty in the COVID-19 era: Mapping global responses in light of momentum for the right to energy', *Energy Research & Social Science*, 81, p. 102246. Available at:

According to the national energy review, there is a significant reliance on biomass and wood as fuel, with wood accounting for 68% of total energy use (oil accounting for 22%, electricity for 9%, and others for 1%).[83] Considering the government's ambitious target of raising the number of power connections from 15% to at least 65% by 2022, Kenya's penetration of electricity remains low.[84]

Kenya is equipped with a 2.3 GW capacity. About 32% is thermal power, about 57% is hydropower, and the remainder is made up of geothermal and emergency thermal power.[85] The combined effect of wind and solar photovoltaic (PV) electricity is minimal, at most 1%.[86] Nevertheless, due to insufficient precipitation, the percentage of hydropower generated in the generating mix fluctuated from 38% to 76%.[87] To make up the difference, which varies from 16 to 33% of the mix, thermal energy sources are used. At the moment, Kenya is using 1429 MW of grid-connected energy. Fossil fuel and hydropower are the principal energy sources.[88]

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https://doi.org/10.1016/j.erss.2021.102246; *The Ethics of energy: a framework for action - UNESCO Digital Library* (no date). Available at: https://unesdoc.unesco.org/ark:/48223/pf0000123511 (Accessed: 23 April 2024); Pachauri, S. (2011) 'Reaching an international consensus on defining modern energy access', *Current Opinion in Environmental Sustainability*, 3. Available at: https://doi.org/10.1016/j.cosust.2011.07.005; Jiglau, G. *et al.* (2024) 'Energy and the social contract: From "energy consumers" to "people with a right to energy"', *Sustainable Development*, 32(1), pp. 1321–1336. Available at: https://doi.org/10.1002/sd.2727.

[83] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[84] Ibid.

[85] Ibid.; *Kenya steps up as global geothermal powerhouse | Reuters* (no date). Available at: https://www.reuters.com/markets/commodities/kenya-steps-up-global-geothermal-powerhouse-2023-10-05/ (Accessed: 21 April 2024); Gavin, J. (2022) *Kenya bets on renewables in hydro and geothermal push*, *African Business*. Available at: https://african.business/2022/07/energy-resources/kenya-seeks-to-maximise-benefits-from-baseload-renewables (Accessed: 21 April 2024).

[86] Ibid.

[87] Ibid.

[88] Ibid; moulo (2021) *Kenya's path towards sustainable electricity for all*, *Our Africa, Our Thoughts*. Available at: https://blogs.afdb.org/fr/climate-change-africa/kenya%E2%80%99s-path-towards-sustainable-electricity-all-312 (Accessed: 23 April 2024); AfricaNews (2023) *Kenya championing greater use of renewable energy in Africa*, *Africanews*. Available at: https://www.africanews.com/2023/09/05/kenya-championing-greater-use-of-renewable-energy-in-africa/ (Accessed: 23 April 2024); Mwiti, L. (no date) *Confusion reigns over Kenya's actual electricity generation capacity*, *The Standard*. Available at: https://www.standardmedia.co.ke/article/2001290115/fact-checker-just-how-much-is-kenyas-electricity-capacity (Accessed: 23 April 2024); Chege, K. (2021) *Africa's Energy Future May Be Mixed*, *Engineering For Change*. Available at: https://www.engineeringforchange.org/news/africas-energy-future/ (Accessed: 23 April 2024).

By tackling climate change and environmental issues, renewable energy makes a beneficial contribution to society.[89] As an illustration, biodiesel has the ability to lower the quantity of greenhouse gases released into the environment.[90] This is as a result of greenhouse gas emissions being far lower than those of fossil fuels.[91] Additionally, the commercialization of some energy sources, like biodiesel, can help women become financially independent by releasing them from burdensome labour and economic obligations.[92] With technology for irrigation and water pumping, as well as for agricultural processing like milling and canning, energy can also significantly improve food security for the underprivileged.[93] There is a good chance that some of the low-income households' appropriate water pumping and irrigation technology will not only guarantee a year-round supply of food but will also generate additional income.[94]

Several factors have hindered the growth of renewable energy in the nation and the sub-Saharan region as a whole. These factors include high initial capital costs, a shortage of skilled labour, inadequate policy and legal frameworks, poor planning, a lack of coordination and linkages in renewable energy programmes, pricing distortions that disadvantage renewable energy, weak dissemination strategies, poor baseline information, and low maintenance capacity.[95] Policy and regulatory frameworks must seek to adequately address these challenges if renewable energy sector is to contribute more towards the transition to cleaner sources of energy for the Kenyan people. Research indicates that the adoption of clean fuels and cooking technologies is influenced

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[89] Ibid.

[90] Hanaki, K. and Portugal-Pereira, J. (2018) 'The Effect of Biofuel Production on Greenhouse Gas Emission Reductions', in K. Takeuchi et al. (eds) *Biofuels and Sustainability: Holistic Perspectives for Policy-making*. Tokyo: Springer Japan, pp. 53–71. Available at: https://doi.org/10.1007/978-4-431-54895-9_6; *Emissions from Biofuels - an overview | ScienceDirect Topics* (no date). Available at: https://www.sciencedirect.com/topics/engineering/emissions-from-biofuels (Accessed: 21 April 2024); Khanna, M., Crago, C.L. and Black, M. (2011) 'Can biofuels be a solution to climate change? The implications of land use change-related emissions for policy', *Interface Focus*, 1(2), pp. 233–247. Available at: https://doi.org/10.1098/rsfs.2010.0016.

[91] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya' op.cit.

[92] Ibid.

[93] Kennedy S Muzee, "Low-carbon Africa: Kenya". *This report is one of six African country case studies commissioned by Christian Aid to support the report Low-Carbon Africa: Leapfrogging to a Green Future*. Available at: https://www.christianaid.org.uk/sites/default/files/2022-07/low-carbon-africa-kenya-november-2011.pdf (Accessed: 20 April 2024).

[94] Ibid.

[95] Ibid.

by globalization (economic, social, and political) and governance (efficiency of government, prevention of corruption, political stability, and rule of law).[96]

The inability to obtain advanced energy, the pressure on biomass supplies to increase, rising energy prices, the fact that the demand for electricity is greater than the capacity of new generation, and the dispersion of Kenya Power and Lighting Company (KPLC) make it difficult to connect all customers who would like to purchase a significant amount of rural electrification through grid development are some of the current challenges and weaknesses affecting Kenya's energy supply.[97] As the state and its allies recognise the need to protect and sustain the environment, they must work together to find solutions to these issues in order to ensure an adequate and affordable energy supply for economic development, which includes improving people's quality of life.[98]

Other factors that need to be taken into account include the costs of producing energy, capacity/availability issues, environmental effects, and choices made about the purchase of power.[99] The ability to create jobs for the expanding population and sustainability are two more

[96] Acheampong, A.O., Opoku, E.E.O. and Dogah, K.E., 2023. The political economy of energy transition: the role of globalization and governance in the adoption of clean cooking fuels and technologies. Op.cit.s

[97] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya',*op. cit.*; Berg, L. (no date) *Powering Kenya's Progress: Support to GoK on the Energy Sector White Paper*, *Dalberg*. Available at: https://dalberg.com/our-ideas/powering-kenyas-progress-support-to-gok-on-the-energy-sector-white-paper/ (Accessed: 21 April 2024).

[98] Ibid.; Jaiswal, K.K. *et al.* (2022) 'Renewable and sustainable clean energy development and impact on social, economic, and environmental health', *Energy Nexus*, 7, p. 100118. Available at: https://doi.org/10.1016/j.nexus.2022.100118; *World Energy Transitions Outlook 2022* (no date). Available at: https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022 (Accessed: 23 April 2024).

[99] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*; Dragasevic, Z. *et al.* (2021) 'Analyzing the factors influencing the formation of the price of electricity in the deregulated markets of developing countries', *Energy Reports*, 7, pp. 937–949. Available at: https://doi.org/10.1016/j.egyr.2021.07.046; *Read 'The Power of Renewables: Opportunities and Challenges for China and the United States' at NAP.edu* (no date). Available at: https://doi.org/10.17226/12987; PricewaterhouseCoopers (no date) *The energy-demand opportunity: How companies can thrive in the energy transition*, *PwC*. Available at: https://www.pwc.com/gx/en/issues/esg/the-energy-transition/energy-demand-opportunity.html (Accessed: 23 April 2024); Pan, A., Xu, S. and Zaidi, S.A.H. (2024) 'Environmental impact of energy imports: Natural resources income and natural gas production profitability in the Asia-Pacific Economic Cooperation Countries', *Geoscience Frontiers*, 15(2), p. 101756. Available at: https://doi.org/10.1016/j.gsf.2023.101756; *Factors affecting natural gas prices - U.S. Energy Information Administration (EIA)* (no date). Available at: https://www.eia.gov/energyexplained/natural-gas/factors-affecting-natural-gas-prices.php (Accessed: 23 April 2024); Strielkowski, W. *et al.* (2021) 'Renewable Energy in the Sustainable Development of Electrical Power Sector: A Review', *Energies*, 14(24), p. 8240. Available at: https://doi.org/10.3390/en14248240.

important factors.[100] Given Kenya's abundance of geothermal resources, geothermal energy is anticipated to be the preferred source of contribution to the main load capacity. It is advantageous in terms of cost, high capacity/accessibility characteristics, and nearly zero emissions—primarily if traditional closed cycles are employed to re-inject water into the crust of the earth.[101]

In terms of hydroelectric resources, the competition for water supply from horticulture and other irrigation-dependent agricultural operations is growing exponentially, while population growth drives up the demand for water for residential and commercial applications.[102] Utilising river flows as the main source of energy generation is risky since it essentially depends on unpredictable and often unexpected variations in the environment and weather.[103] For instance, it has been observed that the unchecked expansion of commercial and agricultural endeavours into the water catchment areas, such as the Cherangani Hills, Mount Kenya, Mount Elgon, and Mau Forest, seems to be increasing the susceptibility of hydropower development to the effects of drought and the unpredictable weather patterns common in Kenya and the Horn of Africa.[104] Therefore, it is necessary to protect the river water supplies, which includes keeping enough forests to safeguard runoff and installing soil erosion control technologies in catchment regions to lower the chance of dam siltation.[105]

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[100] Ibid.

[101] Ibid.

[102] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[103] Ibid.; Farghali, M. *et al.* (2023) 'Social, environmental, and economic consequences of integrating renewable energies in the electricity sector: a review', *Environmental Chemistry Letters*, 21(3), pp. 1381–1418. Available at: https://doi.org/10.1007/s10311-023-01587-1; Lai, O. (2023) *Examining the Pros and Cons of Hydroelectric Energy*, *Earth.Org*. Available at: https://earth.org/pros-and-cons-of-hydroelectric-energy/ (Accessed: 23 April 2024); *How does climate change affect river flow and impact of climate change on water resources?* (no date) *ResearchGate*. Available at: https://www.researchgate.net/post/How_does_climate_change_affect_river_flow_and_impact_of_climate_change_on_water_resources (Accessed: 23 April 2024).

[104] Kennedy S Muzee, "Low-carbon Africa: Kenya". *op cit.*; Dept, I.M.F.A. (2024) 'Kenya: Staff Report for the 2023 Article IV Consultation, Sixth Reviews Under the Extended Fund Facility and Extended Credit Facility Arrangements, Requests for Augmentations of Access, Modification of Performance Criteria, Waiver of Nonobservance of Performance Criteria, Waiver of Applicability of Performance Criteria, and First Review Under the Resilience and Sustainability Facility Arrangement', *IMF Staff Country Reports*, 2024(013). Available at: https://doi.org/10.5089/9798400264177.002.A004.

[105] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op cit.*

In order to improve performance and lower indoor air pollution, additional funding must be allocated to the research and development of advanced biomass stoves.[106] Alternatively, by enacting strong anti-poor policies, it is crucial to increase accessibility to LPG as a substitute for biomass notwithstanding Kenya's significant lack of biomass.[107] Rather than imposing prohibitions, county governments should think about providing alternate means of subsistence to rural populations that produce charcoal.[108] Their reliance on charcoal as a source of revenue would decrease if agriculture-related activities were given more of a priority.[109]

Environmental deterioration and climate change are significant worldwide issues that demand immediate attention from decision-makers, scholars, and other stakeholders.[110] Petroleum fuel remains the primary non-renewable source of energy use in Kenya. The usage of petroleum fuel raises greenhouse gas emissions, which contribute to climate change and global warming.[111] With the rate at which fossil fuels are being used up worldwide and the detrimental effects of greenhouse

[106] Ibid.; Thomas, E. *et al.* (2015) 'Improved stove interventions to reduce household air pollution in low and middle income countries: a descriptive systematic review', *BMC Public Health*, 15(1), p. 650. Available at: https://doi.org/10.1186/s12889-015-2024-7; Thomas, E. *et al.* (2015) 'Improved stove interventions to reduce household air pollution in low and middle income countries: A descriptive systematic review Environmental health', *BMC public health*, 15, p. 650. Available at: https://doi.org/10.1186/s12889-015-2024-7; Carvalho, R.L. *et al.* (2019) 'Household air pollution mitigation with integrated biomass/cookstove strategies in Western Kenya', *Energy Policy*, 131, pp. 168–186. Available at: https://doi.org/10.1016/j.enpol.2019.04.026; Grieshop, A.P., Marshall, J.D. and Kandlikar, M. (2011) 'Health and climate benefits of cookstove replacement options', *Energy Policy*, 39(12), pp. 7530–7542. Available at: https://doi.org/10.1016/j.enpol.2011.03.024; Ahmad, R. *et al.* (2022) 'Current challenges and future prospect of biomass cooking and heating stoves in Asian Countries', *Frontiers in Energy Research*, 10. Available at: https://doi.org/10.3389/fenrg.2022.880064; Sutar, K.B. (2022) 'Energy Efficiency, Emissions and Adoption of Biomass Cookstoves', in *Alternative Energies and Efficiency Evaluation*. IntechOpen. Available at: https://doi.org/10.5772/intechopen.101886.

[107] Ibid.; 'Promoting Clean Cooking in Kenya – KIPPRA' (no date). Available at: https://kippra.or.ke/promoting-clean-cooking-in-kenya/ (Accessed: 23 April 2024).

[108] *Kenya's charcoal bans have fuelled a smuggling problem | ISS Africa* (no date). Available at: https://issafrica.org/ (Accessed: 21 April 2024).

[109] Ibid; Owino, B., D.Asher and Mulwa, M. (2018) *Barriers to Uptake of Clean and Renewable Energy: Case of Bomet and Homa-Bay County*. Cuts Nairobi.

[110] Ali, K. *et al.* (2023) 'Testing the role of digital financial inclusion in energy transition and diversification towards COP26 targets and sustainable development goals',*op.cit*.

[111] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya',*op. cit.*

gas emissions, using sustainable and renewable energy sources is becoming more and more necessary.[112]

Kenya is endowed with the potential for renewable energy sources, such as geothermal, solar, biomass, wind, and hydropower, given its natural environment and geographical peculiarities.[113] To achieve sustainable development, all public sector players, non-governmental organisations, and citizens should make a concerted effort to support and encourage the use of renewable energy sources.[114] The encouragement of investments in renewable energy at the lowest level is not supported by a decentralised coordinating structure, which causes isolated initiatives in rural regions to lag behind.[115] The creation of this framework may serve as a significant platform for encouraging local communities to get involved in renewable energy technology initiatives including cogeneration, small hydro, and wind power for water pumping.[116] There is need for more efforts coupled with real financial investment in initiatives as the Ministry of Energy and Petroleum's Strategy Paper dubbed "*Behaviour Change and Communication Strategy for Promoting Clean Cooking in Kenya 2022: Towards Ensuring Access to Affordable, Reliable, Sustainable and Modern Energy for All Kenyans*" which seeks to promote the following seven strategies: (1) Ideation, branding and rallying call[117], (2) Execution of an awareness and behaviour change strategy, (3) Focus on elements of behaviour change, (4) Media advocacy to enhance public awareness and understanding of clean cooking, (5) Partnerships and coalitions, (6) Special events

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[112] Ibid.; *Fossil fuels and climate change: the facts* (no date). Available at: https://www.clientearth.org/latest/news/fossil-fuels-and-climate-change-the-facts/ (Accessed: 23 April 2024); US EPA, O. (2016) *Global Greenhouse Gas Overview*. Available at: https://www.epa.gov/ghgemissions/global-greenhouse-gas-overview (Accessed: 23 April 2024); Perera, F. (2018) 'Pollution from Fossil-Fuel Combustion is the Leading Environmental Threat to Global Pediatric Health and Equity: Solutions Exist', *International Journal of Environmental Research and Public Health*, 15(1), p. 16. Available at: https://doi.org/10.3390/ijerph15010016; Gielen, D. *et al.* (2019) 'The role of renewable energy in the global energy transformation', *Energy Strategy Reviews*, 24, pp. 38–50. Available at: https://doi.org/10.1016/j.esr.2019.01.006.

[113] Ibid.; See also Kennedy S Muzee, "Low-carbon Africa: Kenya". *Op. cit.*

[114] Takase, M., Kipkoech, R. and Essandoh, P.K. (2021) 'A comprehensive review of energy scenario and sustainable energy in Kenya', *op. cit.*

[115] Kennedy S Muzee, "Low-carbon Africa: Kenya". *Op.cit.*

[116] Ibid.

[117] This is meant to coalesce all the relevant stakeholders around a common rallying call, "Upishi Bora, Afya Bora." (Republic of Kenya, 'Behaviour Change and Communication Strategy for Promoting Clean Cooking in Kenya 2022: Towards Ensuring Access to Affordable, Reliable, Sustainable and Modern Energy for All Kenyans' (Ministry of Energy, 2022). Available at: https://energy.go.ke/sites/default/files/KAWI/Other%20Downloads/BCC%20Strategy%20for%20Promoting%20Clean%20Cooking%20%20Kenya(1).pdf (Accessed: 21 April 2024), p. 21).

to promote clean cooking, and (7) Engaging the private sector/ industry players in promoting clean cooking.[118] The Strategy Paper seeks to achieve this by focusing on the benefits of using improved cooking solutions, such as saving money and time, improving health, and positive environmental impacts especially targeting women living in rural, peri-urban, and informal settlements of Kenya as well as men, community networks, and private sector players, among others.[119] There is a need to actively employ these strategies especially in rural areas and urban areas as a way of changing the attitudes of people while also empowering them economically in order to promote a sustainable transition to cleaner energy sources in Kenya.

Kenya's green transformation programme can also be accelerated by innovative climate financing solutions that mobilise green investment, foster locally-led and domestically financed climate and economic resilience, and place the nation in a position to gain from sustainable economic growth.[120] The expansion of clean power capacity necessitates constant investment in order to scale up renewable energy in line with demand growth. The grid must be strengthened in tandem with the growth of renewable energy sources to prevent transmission and distribution lines from filling up to capacity.[121]

It has been correctly asserted that the majority of barriers to the spread and uptake of sustainable energy technology originate at the government level.[122] These are matters of government intervention and policy. This means that when it comes to energy investment, development, and

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[118] Republic of Kenya, 'Behaviour Change and Communication Strategy for Promoting Clean Cooking in Kenya 2022: Towards Ensuring Access to Affordable, Reliable, Sustainable and Modern Energy for All Kenyans' (Ministry of Energy, 2022). Available at: https://energy.go.ke/sites/default/files/KAWI/Other%20Downloads/BCC%20Strategy%20for%20Promoting%20Clean%20Cooking%20%20Kenya(1).pdf (Accessed: 21 April 2024).

[119] Ibid.

[120] 5iveafrica (2023) 'Kenya should stay the low carbon course for green economy growth', *FSD Africa*, 6 September. Available at: https://fsdafrica.org/news/kenya-should-stay-the-low-carbon-course-for-green-economy-growth/ (Accessed: 21 April 2024); *Climate Investment Funds Endorses Kenya's $70 million Plan for 100 percent Clean Energy | Climate Investment Funds* (no date). Available at: https://www.cif.org/news/climate-investment-funds-endorses-kenyas-70-million-plan-100-percent-clean-energy (Accessed: 21 April 2024).

[121] *Kenya Power's Decarbonising the Energy Mix Initiative | NewClimate Institute* (no date). Available at: https://newclimate.org/resources/publications/kenya-powers-decarbonising-the-energy-mix-initiative (Accessed: 21 April 2024).

[122] Acheampong, A.O., Opoku, E.E.O. and Dogah, K.E. (2023) 'The political economy of energy transition: The role of globalization and governance in the adoption of clean cooking fuels and technologies', *op. cit.*

distribution, a nation's institutional structure and governance are crucial.[123] Some people argue that government participation is necessary due to the significant financial investment needed for energy infrastructure.[124] Governments in many developing (African) nations subsidize the cost of electricity so that it is affordable for everyone.[125] Since state-owned businesses make up a large portion of the energy industry in many of these nations, the efficiency of governance in general and government in particular are crucial to the smooth operation of these businesses.[126]

5. Conclusion

It has been noted correctly that the cost, dependability, and efficiency of renewable energy solutions are increasing daily. We must alter how we create and use energy because our present reliance on fossil fuels is unsustainable and hazardous for the environment. To combat climate change, one of the greatest risks to human existence, it is imperative that these new energy alternatives be put into practice as soon as possible.[127]

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[123] Ibid.

[124] Ibid; *Chapter 4. Government's Role in the Electricity Sector* (no date). Available at: https://www.oas.org/dsd/publications/unit/oea79e/ch08.htm (Accessed: 21 April 2024); Hall, S., Foxon, T.J. and Bolton, R. (2016) 'Financing the civic energy sector: How financial institutions affect ownership models in Germany and the United Kingdom', *Energy Research & Social Science*, 12, pp. 5–15. Available at: https://doi.org/10.1016/j.erss.2015.11.004; SITNFlash (2012) 'Beyond the Debate: The role of government in renewable energy finance', *Science in the News*, 15 December. Available at: https://sitn.hms.harvard.edu/flash/2012/energy-finance/ (Accessed: 21 April 2024); *Public Sector Must Play Major Role in Catalyzing Private Climate Finance* (2022) *IMF*. Available at: https://www.imf.org/en/Blogs/Articles/2022/08/18/public-sector-must-play-major-role-in-catalyzing-private-climate-finance (Accessed: 21 April 2024); Bridge, G., Özkaynak, B. and Turhan, E. (2018) 'Energy infrastructure and the fate of the nation: Introduction to special issue', *Energy Research & Social Science*, 41, pp. 1–11. Available at: https://doi.org/10.1016/j.erss.2018.04.029; Song, Y., Shahzad, U. and Paramati, S.R. (2023) 'Impact of energy infrastructure investments on renewable electricity generation in major Asian developing economies', *Australian Economic Papers*, 62(1), pp. 1–23. Available at: https://doi.org/10.1111/1467-8454.12282; *Why Public Financing Needs to Be Centre Stage for Universal Energy Access* (2023). Available at: https://www.irena.org/News/expertinsights/2023/Sep/Why-Public-Financing-Needs-to-Be-Centre-Stage-for-Universal-Energy-Access (Accessed: 21 April 2024).

[125] Acheampong, A.O., Opoku, E.E.O. and Dogah, K.E. (2023) 'The political economy of energy transition: The role of globalization and governance in the adoption of clean cooking fuels and technologies', *op cit.*

[126] Ibid.

[127] *Goal 7: Affordable and clean energy* (no date) *The Global Goals*. Available at: https://globalgoals.org/goals/7-affordable-and-clean-energy/ (Accessed: 20 April 2024); African Development Bank (2021), *Energy, Climate and Green Growth*, *African Development Bank Group*. African Development Bank Group. Available at: https://www.afdb.org/en/private-sector/what-we-invest/energy-climate-and-green-growth (Accessed: 21 April 2024).

The development of alternate energy sources to fossil fuels is now imperative, as energy is the driving force behind economic progress.[128] For the purpose of providing a sufficient, clean, and reasonably priced power supply, a change from the fossil fuel economy paradigm to a sustainable alternative energy idea has long been underway.[129] The success of this transition depends on a number of factors as discussed in this paper. There is a need to strike a balance between the competing factors of ensuring that both the poor communities' needs and interests as well as climate change mitigation are taken care of.[130] In order to expedite the advancement of sustainable energy solutions, it will be necessary to forge deeper political commitments, implement long-term energy planning strategies, and provide sufficient regulatory and scale incentives.[131] Controlling these intricate global energy dynamics is important and difficult for reducing energy poverty, ensuring energy security, and slowing down climate change.[132] Thus, managing this change together with contemporary power sector trends like decentralisation, digitalization, and decarbonisation is part of Sustainable Energy Transition (SET).[133]

Achieving just energy transition is possible. There must however be in place an efficacious policy and regulatory framework.

[128] Ebhota, W.S., 2021. Leveraging on sustainable energy transition to change the energy narrative of the dark continent. *International Journal of Energy Economics and Policy*, *11*(3), pp.409-416.

[129] Ibid.

[130] week, S. up to date on the editors' picks of the (2023) *People, planet and profit: Striking the right balance in energy transition*, *Business Daily*. Available at: https://www.businessdailyafrica.com/bd/opinion-analysis/columnists/people-planet-and-profit-striking-the-right-balance-in-energy-transition-4452854 (Accessed: 21 April 2024).

[131] *Report: Universal Access to Sustainable Energy Will Remain Elusive Without Addressing Inequalities* (no date) *World Bank*. Available at: https://www.worldbank.org/en/news/press-release/2021/06/07/report-universal-access-to-sustainable-energy-will-remain-elusive-without-addressing-inequalities (Accessed: 21 April 2024).

[132] Ebhota, W.S., 2021. Leveraging on sustainable energy transition to change the energy narrative of the dark continent. *International Journal of Energy Economics and Policy*, *11*(3), pp.409-416.

[133] Ibid.

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