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Original Research Paper

Assessing Energy Policies, Legislation and Socio-Economic Impacts in the Quest for Sustainable Development

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Abstract: The energy sector in Africa, particularly in countries like Uganda, plays a pivotal role in shaping economic development, social progress, and environmental sustainability. This study delves into the nuanced interplay between energy policies, legislation, and their real-world consequences in Uganda. By employing a case study approach, this research investigates the multifaceted impact of Uganda's energy policies and legislation on various stakeholders, including government institutions, businesses, and local communities. This study provides an overview of Uganda's energy landscape, highlighting the challenges faced by the nation in ensuring a stable and sustainable energy supply. It then meticulously examines the evolution of energy policies and legislation over the past few decades, analysing their formulation, implementation, and effectiveness. Through qualitative and quantitative analyses, this research assesses the socio-economic consequences of these policies and legislations. It explores how regulatory decisions have influenced energy accessibility, affordability, and reliability for urban and rural populations. Additionally, the environmental impact of energy policies is scrutinized, focusing on their contributions to climate change mitigation, natural resource conservation, and the promotion of sustainable practices. The study also evaluates the social repercussions, including the empowerment of local communities, employment generation, and overall improvements in the quality of life resulting from energy policy interventions. This research critically examines the challenges faced during policy implementation, such as bureaucratic hurdles, financial constraints, and political influences, which often hinder the desired outcomes. It identifies key lessons from Uganda's experiences, offering valuable insights for other African nations grappling with similar energy challenges.

Keywords: Audit and Energy Management, Climate Change, Energy Efficiency, Energy Labelling and Standards, GHG.

1. Introduction

Energy policy plays a pivotal role in shaping the energy landscape, with implications for economic growth, environmental sustainability, and national security. Energy policies were specifically designed to achieve multiple objectives such as ensuring energy security, promoting sustainability through the use of renewable sources, making energy affordable, and enhancing access to energy resources. The techniques and methods of balancing and prioritizing energy policy objectives vary with respect to country and region [1][2]. It is the responsibility of the government to enforce and encourage their citizens to adopt and embrace the energy policy. Governments employ a range of policy instruments to implement energy policies, such as taxation, subsidies, research and development incentives, and market-based mechanisms like cap-and-trade systems. The process of developing and implementing energy policies involves the collaboration of government agencies, regulatory bodies, and industry stakeholders. It is often influenced by political factors, economic considerations and public opinions [1][3].

Energy policies have substantial economic impacts such as industrial growth, job creation and energy prices which are solely dependent on the considerations of the policymakers. Energy policies have significant environmental and climate consequences which include reductions in greenhouse gas emissions, improvements in air quality, and the mitigation of environmental degradation. The formulation and implementation of energy policies are often subject to challenges, controversies, and debates associated with the aim of ensuring clean and safe energy for human consumption [4]. An effective energy policy should prioritize diversifying the energy mix, promoting energy efficiency, and ensuring affordability and reliability of energy supply by harnessing renewable sources like solar, wind, and hydroelectric power. The major challenges of partial or zero implementation of energy policy in various countries in Africa are as a result of political ideologies, vested interests and public perceptions.

2. Literature Review

2.1. Energy Policy

Energy policy refers to the set of principles, goals, and methods that guide a country or region's energy-related decisions. These energy-related decisions range from how to generate, distribute, transmit and consume energy resources, and regulate/incentivize their use. The primary goal of energy policy is to ensure a reliable, affordable, and sustainable energy supply while minimizing environmental impact. Energy policy is an essential aspect of any country's economic and environmental sustainability, as it directly affects the cost and availability of energy, its security and environmental impact [4]. The importance of energy policy stems from the fact that energy is a fundamental component of modern society. Energy helps boost a country's economy by acting as the only clean source at which many industries such as transportation (electric Vehicles), production (industries), Telecommunication, and household activities drive their energy. At the same time, the way we produce and consume energy also has significant environmental impacts, such as climate change, air pollution, and ozone layer depletion [5][6]. Therefore, effective energy policy seeks to balance these competing priorities by ensuring access to affordable, reliable, and clean energy sources that will reduce negative environmental impacts. Energy policies can be enacted in the form of (i) climate plans which aim to reduce greenhouse gas emissions, and (ii) regulations on energy efficiency which aim to subsidies the use of renewable energy sources. For a country to implement and encourage the use of clean energy, there must be energy policy implementation that encourages the use of renewable energy as a good alternative to conventional energy sources like coal and fossil fuel.

The Ugandan 2020 revised energy policy framework which was guided by the National Energy Policy focused on increasing the use of renewable energy, improving energy efficiency, and ensuring access to energy for all, particularly in rural areas. This policy aims to address energy poverty, reduce greenhouse gas emissions, and foster sustainable economic growth in Uganda [7][8]. Uganda aims to achieve universal access to electricity by 2030 and increase the use of renewable energy sources to a reasonable percentage. Uganda can reduce its reliance on fossil fuels, lower greenhouse gas emissions, and mitigate climate change impacts by embracing renewable sources of energy. Strong policy frameworks can attract private investments in clean energy projects, enhance energy security and create employment opportunities for Ugandans.

The successful implementation of the energy policy in Germany led to significant growth in renewable energy generation which accounts for 40% of Germany's electricity production as of today [9]. This implemented policy seeks to totally transform Germany's energy system from fossil fuels to renewable energy sources by 2050.

2.2. Energy Legislation

Energy legislation, on the other hand, refers to the laws and regulations that govern the energy sector including licensing, tariffs, safety standards, and environmental protection. Legislation mostly comprises energy policy that serves as government government-implemented framework that oversees the production, distribution, and use of energy to ensure safety, environmental protection, and the welfare of the citizens. Energy legislation provides a structured framework that governs energy resources and their activities, establishes the roles and responsibilities of governmental bodies, regulators, and industry stakeholders [10].

Impacts of Energy Legislation:

1) Governments and regulators often introduce incentives, subsidies, and feed-in tariffs to encourage investment in renewable energy technologies. These policy measures create a favorable environment for renewable energy development and help diversify the energy mix. Energy legislation also governs the liberalization and regulation of electricity markets. It establishes rules for market competition, pricing mechanisms, and access to the grid. Effective regulation ensures fair competition, prevents market manipulation, and fosters affordable electricity prices for consumers.
2) Energy legislation incorporates regulations to reduce emissions, promote clean technologies, and mitigate climate change. For example, the Paris Agreement on international treaty conference, aims to limit global warming by ensuring countries pursue the necessary policies and implement actions to curb greenhouse gas emissions [6]. This agreement drives national-level energy legislation to align with global climate goals
3) Energy legislation addresses safety concerns in energy operations to protect workers, the public, and the environment. It establishes guidelines for occupational health and safety, risk assessment, and emergency response planning. For instance, Nuclear energy regulations, impose strict safety measures to prevent accidents and protect against radiation hazards.
4) Energy legislation often emphasizes energy efficiency and conservation by setting mandatory standards and targets. These measures are crucial in reducing energy waste, minimizing environmental impacts, and enhancing resource sustainability. For instance, the European Union's Energy Efficiency Directive sets binding energy-saving targets for member states, promoting the use of renewable energy sources and improving energy performance in buildings [11].
5) Energy legislation serves as a crucial tool to regulate, guide, and promote sustainable energy practices. Its provisions encompass various aspects, including energy governance, efficiency, renewable energy promotion, market regulation, environmental protection, and safety. By adhering to energy legislation, countries can make informed decisions, achieve their energy goals, and contribute to a cleaner and more secure energy future.

Global energy demand is expected to grow up to 25% by 2040, primarily driven by developing African countries like Uganda. This surge in demand necessitates the development of effective energy policies and legislation to ensure a secure and sustainable energy supply [12] [13].

In Uganda, the government has developed several laws to promote sustainable energy development. The Renewable Energy Policy, for instance, aims to increase the share of renewable energy in the national energy mix to 61% by 2030 [12]. The Electricity Act provides the legal framework for the electricity sector which provides the legal foundation for the management and regulation of the energy sector. This law defines the roles of the Electricity Regulatory Authority (ERA) and highlights the importance of private sector participation in the energy industry whereas the National Environment Act sets standards for environmental protection [8].

The enforcement of these acts, coupled with innovative technologies and financing mechanisms, is crucial in driving the country's energy transition towards cleaner and more sustainable energy sources, reducing reliance on fossil fuels, and promoting energy efficiency. Energy legislation plays a crucial role in the development of new technologies and innovation. For instance, in the United States, the Energy Policy Act provided tax credits and financial incentives for research and development of advanced energy technologies [14][15]. This legislation has spurred innovation and the deployment of technologies such as solar power, energy storage systems, and electric vehicles.

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2.3. Energy Conservation Act

The Energy Conservation Act refers to a legislative framework designed to regulate and promote efficient energy utilization practices within a country or region. Its primary purpose is to mitigate energy wastage, reduce greenhouse gas emissions, ensure energy security, and foster sustainable economic growth. A conducted research highlights that the Energy Conservation Act assists in curtailing energy demand, thereby reducing dependence on fossil fuels and consequently limiting their adverse environmental impact [16][17]. This act establishes the Bureau of Energy Efficiency (BEE), which is responsible for implementing programs to promote energy-efficient technologies, devices, and equipment, as well as energy-efficient practices in industries and buildings. The BEE has developed a star rating system to measure the energy efficiency of products like refrigerators, air conditioners, and water heaters. This system helps consumers make informed decisions about energy-efficient products and incentivizes manufacturers to produce energy-efficient products. The Energy Conservation Act has led to significant reductions in energy intensity, increased implementation of energy-efficient practices in industries, and provided a framework for sustainable energy policies. The Energy Conservation Act in Japan encouraged energy-efficient practices, leading to a 20% reduction in energy consumption in the residential sector alone [18] and the Energy Conservation Act in the United Kingdom, aimed to promote energy efficiency in buildings which proposed to save about 300 TWh by 2050, demonstrating its long-term positive impact [19][20].

Energy Conversation Act encompasses various objectives that aim to promote energy efficiency across different sectors:

2.3.1. Energy Auditing and Management

The Act focuses on conducting energy audits to assess energy consumption patterns and identify potential areas for improvement. Energy audits aid in formulating strategies to conserve energy and reduce wastage. According to a case study, energy audits conducted through the Energy Conservation Act resulted in substantial energy savings in industries in India, leading to increased profitability and competitiveness [21].

a. Functions of Energy Auditing

   Energy auditors are professionals who specialize in examining the energy efficiency of buildings and industrial processes. They conduct detailed audits to identify energy wastages, develop energy conservation measures, and recommend cost-effective strategies to reduce energy consumption. energy auditors are able to identify energy losses, optimize process efficiency, and recommend energy-efficient technologies, resulting in significant energy savings. According to a study in [22], energy audits can result in energy savings of up to 30% annually. Energy Editor analyzes energy bills and energy consumption patterns, conducts interviews with facility managers, and perform on-site inspections to assess building energy performance, HVAC systems, lighting systems, and other equipment [23]. They also analyze historical data and use computer models to simulate energy-saving scenarios.

   A successful energy auditing is the case of the U.S. Department of Energy's Better Building Program. This program offers technical assistance to organizations that commit to reducing energy consumption by 20% over ten years and participating organizations have saved over $3 billion in energy costs [24].

b. Functions Energy Management

   Energy management is becoming increasingly crucial in today's world as it helps organizations reduce energy costs, improve energy efficiency, and minimize carbon footprint. An energy manager is a professional who oversees and controls the energy consumption of an organization, identifies and analyzes areas for improvement, identifies opportunities to reduce waste and increase efficiency, recommends energy-saving measures, and ensures that energy usage is optimized. They also facilitate the integration of energy-efficient technologies and practices in the organization's operations. Organizations with dedicated energy managers were more likely to implement energy-saving measures, leading to substantial reductions in energy consumption [25][26].

Roles of Energy Manager

- Monitoring of energy consumption
- analyzing energy data

- ensuring that an organization remains compliant with relevant regulations
- Helps in reducing carbon emissions to mitigate climate change

According to a study, energy managers can help organizations save up to 20% on their energy bills and reduce their carbon emissions by up to 50% [27]. These statistics highlight the importance of energy management and the impact energy manager can make in an organization. One of the main challenges faced by energy managers is the lack of awareness regarding energy consumption patterns and their impact on the environment. However, with the availability of technology, energy managers can utilize AI and big data analytics to monitor energy consumption patterns and make data-driven decisions. The use of technology can efficiently track energy usage and provide insights to optimize energy consumption. For instance, a case study of the University of California found that the university had saved up to $4 million in energy costs in the first year after implementing a comprehensive energy management program [28][29]. The university achieved energy savings through measures such as conserving energy during off-hours, retrofitting older buildings, and upgrading lighting systems. A large manufacturing plant in Kenya was struggling with high energy bills and inefficient operations and by adopting an energy management team, they were able to identify and implement several energy-saving measures, including upgrading lighting systems, optimizing HVAC systems, and implementing energy-efficient processes. As a result, the plant reduced its energy use by 20%, saving thousands of dollars in energy costs [30][31].

Table 1. The Difference between Energy Auditing and Energy Management

Energy Auditing	Energy Management
Energy auditing is the process of assessing, analyzing, and optimizing energy usage in a specific facility or organization. It involves identifying energy inefficiencies and recommending measures to improve energy performance.	Energy management refers to the strategic and systematic process of planning, organizing, and controlling energy-related activities within an organization to efficiently use and conserve energy resources
Focuses on analyzing existing energy usage patterns, identifying inefficiencies, and suggesting improvements to reduce energy consumption.	Focuses on planning, implementing, and monitoring strategies to optimize energy use, enhance energy efficiency, and reduce overall energy costs over the long term.
Aims to pinpoint areas of energy wastage and suggests energy-saving measures. Helps organizations understand their current energy consumption patterns.	Aims to create a sustainable energy management strategy, incorporating energy-efficient technologies, policies, and practices. Focuses on long-term planning and continuous improvement
Limited to a specific facility or organization. Involves detailed analysis of energy systems, equipment, and processes within that facility.	A broad and holistic approach that encompasses multiple facilities or even an entire organization. Considers not only technical aspects but also behavioral and managerial aspects of energy use
Involves energy audits, data collection, energy modelling, and analysis of energy usage patterns. Recommendations are made based on findings.	Involves strategic planning, goal setting, performance monitoring, implementation of energy-efficient technologies, employee training, and ongoing evaluation.
Generally, a short-term process, focusing on analyzing current energy usage and suggesting immediate improvements.	A long-term process that involves continuous monitoring, assessment, and improvement. Energy management practices are ongoing and evolve over time.
Helps organizations identify quick fixes and immediate energy-saving opportunities. This can lead to significant energy cost reductions in the short term.	Provides sustainable, long-term energy savings. Enhances operational efficiency, reduces environmental impact, and ensures compliance with regulations. Can also improve an organization's reputation and competitiveness.
Conducting an audit of lighting systems to identify and replace inefficient bulbs with energy-efficient LED lights.	Implementing an energy management system (EMS) that integrates smart sensors, automation, and real-time monitoring to optimize HVAC systems, lighting, and other energy-consuming devices.

From Table 1, It's important to note that both energy auditing and energy management are crucial for organizations looking to reduce their energy consumption, save costs, and contribute to environmental sustainability. Energy auditing helps identify specific areas for improvement, while energy management provides a comprehensive and ongoing approach to sustainable energy use.

In Uganda, where access to reliable and affordable energy is of utmost importance, the roles of energy managers and auditors hold great potential. Regards to the potential of these, the Ugandan government has set ambitious targets for increasing energy access and promoting sustainable energy practices [32][33]. Through their expertise, energy managers and auditors can bring about significant positive changes in Uganda's energy landscape and contribute to a more sustainable future.

2.3.2. Energy Standards and Labeling

The Act establishes energy standards for appliances, vehicles, and industrial equipment, and requires labeling to inform consumers about the energy efficiency of products. This incentivizes the adoption of energy-efficient technologies and encourages responsible energy consumption. A research study found that mandatory energy labelling policies, implemented under the Energy Conservation Act, significantly influenced consumer choice towards energy-efficient appliances [34][35][36].

a. Energy Standards

Energy standards refer to a set of mandatory regulations, guidelines, codes, or measures enforced by governments or other regulatory bodies, that define the minimum and optimal energy consumption levels and efficiency for buildings, appliances, equipment, and industrial processes. The primary aim of energy standards is to enhance energy efficiency, reduce greenhouse gas emissions, improve indoor air quality, and promote sustainability. It sets minimum energy efficiency requirements for various buildings, products and systems. Hence, setting minimum energy performance requirements, energy standards helps to eliminate highly inefficient products from the market while pushing manufacturers to enhance and embrace new technology. Researchers [16], opined that energy standards have a considerable impact on energy consumption and save about 18% of energy cost. Recent research in Uganda found that an energy-saving potential of about 310MW will be achieved by 2030 at a lower cost compared to the current supply of electricity when energy-efficient appliances and equipment are adopted [37]. A similar study by [32] showed that the use of efficient appliances and equipment could save 7% of the total consumed energy in Uganda.

Types of Energy Standards:

- Appliance and Equipment Standards: These standards specify the minimum energy efficiency levels that appliances and equipment (e.g., refrigerators, air conditioners, lighting) must meet to be sold in a particular market.
- Building Codes: Building energy codes set standards for the construction and renovation of buildings, including insulation, HVAC systems, and lighting, to ensure they are energy-efficient
- Industrial Standards: These standards apply to industrial processes and systems, encouraging companies to optimize their operations to reduce energy consumption.
- Vehicle Fuel Efficiency Standards: Governments set standards for the fuel efficiency of vehicles, such as Corporate Average Fuel Economy (CAFE) standards in the United States.
- Renewable Energy Standards: Some regions mandate a minimum percentage of electricity generation from renewable sources like wind or solar.

Challenges of Implementing Energy Standard:

- Higher upfront costs for products and buildings
- It may lead to some industries facing technical challenges in meeting energy standards, particularly if they involve radical changes in manufacturing processes.

b. Energy Labeling

Energy labeling refers to a system used to provide information about the energy efficiency of various products such as appliances, building materials, and vehicles aiming to help consumers make informed decisions that contribute to energy conservation and sustainability by encouraging the adoption of energy-efficient technologies [16][24]. Its main goal is to

create awareness of energy-efficient products, improve energy efficiency, and reduce environmental impact. This labelling typically includes a range of information, such as the product's annual energy consumption rate, energy efficiency rating, and comparison with similar products(benchmarking). These ratings are usually provided in the form of a rating system or label display, allowing consumers to compare the energy performance of similar products. For instance, appliances such as refrigerators, air conditioners, and washing machines are commonly labelled with energy efficiency ratings [32][34].

The significance of energy labelling lies in its ability to raise awareness among consumers about the environmental impact of their choices. By providing clear and standardized information, energy labels empower consumers to make environmentally conscious decisions. According to a study which highlights how energy labels play a significant role in promoting energy-efficient purchases and raising awareness among consumers [16]. Energy labelling helps consumers identify energy-saving products and positively influences consumers' purchase choices [35][36]. Energy labelling which is a factor for purchase choice helps in saving up to 30% of energy bills Likewise in the Energy Star program, Energy Star-rated appliances and electronics can reduce energy use by up to 50% compared to their conventional counterparts [32] [34] [36].

Challenges of Adopting Energy Labels:

- Label interpretation: Labels can be complex, making it challenging for consumers to interpret the information.
- Updating energy standards affects energy labels. As technology advances, energy standards may need to be updated to reflect the latest developments.

Energy labelling and energy standards are critical aspects of sustainable engineering and technology practices. They play a crucial role in reducing energy consumption, greenhouse gas emissions, and promoting energy-efficient products and systems. Through informative labels and mandatory performance requirements, these initiatives empower consumers, motivate manufacturers to improve product efficiency, and contribute to carbon emission reduction. They benefit consumers, businesses, and the environment by reducing energy costs and greenhouse gas emissions.

2.3.3. Energy Efficiency Measures

Energy efficiency refers to the ability to use energy in a more productive and efficient manner while maintaining the same level of output. This can be achieved by using advanced technology and equipment that are designed to consume less energy. Energy efficiency helps to reduce overall energy consumption, greenhouse gas emissions, and energy costs The Act compels industries, commercial buildings, and public institutions to implement energy-efficient practices, such as insulation, retrofitting, and use of energy-efficient equipment. This assists in reducing energy consumption and optimizing resource utilization [38][39]. A case study conducted in Australia reveals that the implementation of energy efficiency measures through the Energy Conservation Act in Australia resulted in notable reductions in electricity consumption and subsequently lowered carbon emissions [40].

According to research, energy efficiency is crucial for sustainable development, energy security, and economic growth. In fact, a recent study has shown that improving energy efficiency could reduce global energy consumption by 35%, and greenhouse gas emissions by 40% by 2050 [41][42]. Energy efficiency plays a vital role in combating climate change and promoting sustainable development.

Factors that Influence Energy Efficiency:

- Types of energy source
- Efficiency of technology and equipment
- User behavior

It is worth noting that energy efficiency is a complex issue that requires the involvement of many stakeholders, including governments, businesses, and individuals. Therefore, it is essential to work collaboratively to implement energy-efficient measures and technologies to promote sustainability and economic growth. It plays a vital role in promoting sustainable development, combating climate

change, and reducing energy costs [42][43]. By adopting energy-efficient technologies and changing behaviors, individuals, businesses, and governments can all work together towards achieving energy efficiency and contributing to global sustainability.

2.3.4. Awareness and Capacity Building

The Act focuses on creating awareness among the general public, industries, and professionals regarding energy conservation techniques. It facilitates capacity-building initiatives, training programs, and awareness campaigns that equip individuals with the skills and knowledge needed to adopt energy-efficient practices.

2.4. Advantages of Implementing Energy Policy and Its Consequences

2.4.1. Climate Change

Climate change refers to a long-term shift in global weather patterns, including temperature, precipitation, and wind patterns, as a result of human activities such as burning fossil fuels and deforestation. The scientific consensus is that climate change is happening and is primarily caused by human activities that emit toxic gases such as carbon dioxide (CO2), into the atmosphere. Global temperatures have increased by approximately 1.1°C since the pre-industrial era, and the Earth's temperature continues to rise at an alarming rate [44][45][46]. The Intergovernmental Panel on Climate Change (IPCC) warns that if we do not take immediate and drastic action to reduce our greenhouse gas emissions, we could face severe consequences, including rising sea levels, more frequent and severe weather events, and food and water shortages.

The major challenge that researchers face in addressing climate change is the fact that its effects are felt at different degrees in different parts of the world. Uganda as one of the developing and African countries is likely to be disproportionately affected by climate change, despite having contributed relatively little to global greenhouse gas emissions. This is because countries like Uganda are more vulnerable to droughts, floods, and other climate-related disasters, which can damage infrastructure and disrupt food supplies. Climate change results from the implications of greenhouse gases (GHGs) which act as the major catalyst for the rapid increase in climate change.

2.4.2. Consequences of Climatic Changes

Greenhouse gas refers to gases that trap heat in the earth's atmosphere, leading to global warming and climate change:

1. Global warming caused by GHG emissions is likely to lead to increased frequency and intensity of extreme heat, heavy precipitation, droughts, and hurricanes [44][46][10]. This could lead to consequences such as food and water insecurity, loss of biodiversity, soil degradation, and reduced agricultural yields.
2. GHG emissions also cause public health issues such as respiratory diseases and heat-related illnesses. The World Health Organization estimates that climate change will cause an additional 250,000 deaths per year between 2030 and 2050 [47]
3. The GHG affects the economy with estimates suggesting that global warming could have a devastating economic impact that will lead to losses of up to 23% of the global Gross domestic product (GDP) at the end of the century [33][42].
4. Climate change has already led to increased property and insurance claims due to more severe weather events, which will only get worse if action is not taken to reduce GHG emissions.

2.4.3. Ways to Control the Effects of Climatic Changes

In order to mitigate the effects of climate change, we need to take both adaptive, mitigative and policy measures:

1. Adaptive measures: This involves preparing for and responding to the impacts of climatic change, such as building sea walls to protect against rising sea levels or developing drought-resistant crops.
2. Mitigative measures: This involves reducing greenhouse gas emissions to slow the pace of climate change, such as transitioning to renewable energy sources like wind and solar power.
3. Implementation of Energy policies: this will help to reduce carbon emissions from transportation and industry, planting trees, and embrace energy-efficient products.

Climatic change effects can be curbed by countries adopting/implementing renewable energy policies and also encouraging the use of renewable energy sources such as wind and solar power to

replace traditional fossil fuels will help in reducing carbon emissions and slow global warming. Finally, embarking on energy-efficient buildings, Electric Vehicles (EVs), and industrial processes can reduce GHG emissions and create a more sustainable and clean energy that is in line with the African and Ugandan Sustainable Development Goals (SDGs). In general, energy policy and legislation are crucial aspect of any country's economic and environmental sustainability that provides a framework for sustainable energy development, environmental protection, and market operation.

3. Methodology

This research work was developed by reviewing various energy policies and management of various regions and countries. Data were obtained online and in the Ugandan Ministry of Energy and Mineral Development (UMEMD). Interviews were also granted to the Ugandans regards their consumption and their energy consumption awareness based on energy efficiency products and labelling.

4. Finding and Discussion

After carefully reviewing various energy policies of various regions/countries, one can conclude that energy policy has a pivotal role to play in the development of a country.

A successful case study demonstrating the impact of energy policy and legislation can be seen in Denmark. Through comprehensive energy policies and regulatory frameworks, Denmark has transformed its energy sector to heavily rely on renewable energy sources. For instance, the Danish government established feed-in tariffs, subsidies, and tax incentives for renewable energy projects, which led to a significant increase in wind power generation. Denmark now produces nearly 50% of its electricity from wind energy, making it a global leader in renewable energy integration [37].

It was observed that about 23% of Uganda's population has access to electricity of which 7% of the population comes from the rural area [48][49]. Energy has seriously taken another evolutional step to impact the lives of the citizens by countries adopting and implementing energy policies in their various capacities [51]. The establishment of the Bujagali Hydropower Dam in Uganda has increased the country's electricity production by 49%, thereby enhancing electricity access to both urban and rural dwellers [50]. The current population of Uganda is 49,010,292 as of Friday, October 27, 2023, based on Worldometer elaboration of the latest United Nations data and it was observed that only 14,016,944 (28.6%) of the population are residing in the urban area whereas 71.4% resides in the rural area [52]. These 71.4 % of rural residents share the 18% access to electricity which is not sufficient.

This simply shows that 18% of the 34,993,348 populaces of Ugandan citizens lack access to electricity and this may be as a result of the non-implementation of Uganda’s energy policy. When Uganda's energy policy is fully implemented, more renewable energy sources such as the Solar Home System project, which offers affordable solar panels to households, the Rural Electrification Strategy, which aims to increase the rate of electrification in rural areas, and the addition of hydropower to the energy mix will be adopted.

Despite these achievements, certain shortcomings in Uganda’s energy policy and its implementations still stand out such as; the lack of adequate financing, investment and incentive allocation, inadequate infrastructure, and heavy reliance on biomass (coal, wood) as the source of heat. Uganda's government should also endavour to develop supportive frameworks, such as financial support, subsidies, incentives and targeted programs to ensure that energy services are accessible to marginalized populations, rural communities and low-income households.

5. Conclusion

This study provides a comprehensive analysis of the consequences of energy policy and legislation in Uganda, offering a nuanced understanding of their impact on the nation's development trajectory. The findings not only contribute to the academic discourse on energy governance but also offer practical recommendations for policymakers, businesses, and civil society organizations striving to enhance energy access, promote sustainable development, and alleviate poverty in Africa. The Uganda energy policy, Energy SDGs adoption aims to drive sustainable development and propel Uganda towards a cleaner and more prosperous future come 2030.

References

[1] R. A. Atuguba, and F. X. D. Tuokuu, Ghana's renewable energy agenda: Legislative drafting in search of policy paralysis. Energy Research & Social Science, vol. 64, pp. 101453, 2020

[2] H. Othieno, J. Awange, H. Othieno, and J. Awange, Energy Resources in East Africa. Energy Resources in Africa: Distribution, Opportunities and Challenges, pp. 33-137, 2016
[3] A. C. Avci, O. Kaygusuz, and K. Kaygusuz, Renewable energy is capable of meeting our energy needs. Journal of Engineering Research and Applied Science, vol. 10, no. 1, pp. 1741-1756, 2021
[4] P. Zakkour, G. Cook, V. Kato, G. Bahati, I. Kihika, A. Baguma, and D. N. Kyazze, Formulating a geothermal energy policy, legal and regulatory framework for Uganda. In 6th African Rift Geothermal Conference, 2016
[5] V. H. U. Eze, K. C. A. Uche, W. O. Okafor, E. Edozie, C. N. Ugwu, and F. C. Ogenyi, "Renewable Energy Powered Water System in Uganda: A Critical Review," Newport International Journal of Scientific and Experimental Sciences (NIJSES), vol. 3, no. 3, pp. 140–147, 2023.
[6] U. Nations, United Nations Framework Convention on Climate Change Paris Agreement, 2016
[7] A. Bomuhangi, J. Namaalwa, G. Nabanoga, A. G. M. Russell, P. Byakagaba and A.Y. Banana, Natural resources policy environment in Uganda, implication for gendered adaptation to climate changes. Environ Sci Ind J, vol. 12, no. 10, pp. 117, 2016
[8] E. Ariwa, and I. W. Katono, Corporate Sustainability of Green Technology and Assessment of The Environment And Challenges Faced by Regulatory Authorities in Uganda: A Case of The Electricity Regulatory Authority (ERA). Journal of Internet Banking and Commerce, vol. 16, no. 2, pp. 1, 2011
[9] D. Tschopp, Z. Tian, M. Berberich, J. Fan, B. Perers, and S. Furbo, Large-scale solar thermal systems in leading countries: A review and comparative study of Denmark, China, Germany and Austria. Applied Energy, vol. 270, pp. 114997, 2020
[10] V. M. Tam, K. N. Le, C. N. Tran and I. C. S. Illankoon, A review on international ecological legislation on energy consumption: greenhouse gas emission management. International Journal of Construction Management, vol. 21, no. 6, pp. 631-647, 2021
[11] K. Grondys, A. Androniceanu, and Z. Dacko-Pikiewicz, Energy management in the operation of enterprises in the light of the applicable provisions of the energy efficiency directive (2012/27/EU). Energies, vol. 13, no. 17, pp. 4338, 2020
[12] S. D. L. R. du Can, D. Pudleiner, and K. Pielli, Energy efficiency as a means to expand energy access: A Uganda roadmap. Energy Policy, vol. 120, pp. 354-364, 2018
[13] V. H. U. Eze et al., "A Systematic Review of Renewable Energy Trend," Newport International Journal of Engineering and Physical Sciences, vol. 3, no. 2, pp. 93–99, 2023.
[14] J. P. Tomain, The dominant model of United States energy policy. U. colo. l. rev., vol. 61, pp. 355, 1990
[15] J. Stolte, The Energy Policy Act of 2005: The Path to Energy Autonomy. J. Legis., vol. 33, pp. 119, 2006
[16] S. Agarwal, V. Letschert, W. Y. Park, and U. Kaggwa, A review of the legislative landscape and refrigeration market for introducing an energy efficiency standards and labeling program for refrigeration appliances in Uganda. In 2021 Joint Conference-11th International Conference on Energy Efficiency in Domestic Appliances and Lighting & 17th International Symposium on the Science and Technology of Lighting (EEDAL/LS/IEEE: vol. 17, no. 01. pp. 1-7, 2022.
[17] V. H. U. Eze et al., "Renewable and Rechargeable Powered Air Purifier and Humidifier: A Review," INOSR Scientific Research, vol. 9, no. 3, pp. 56–63, 2023.
[18] K. I. Matsumoto, Y. Yamamoto, and N. Ohya, Effect of subsidies and tax deductions on promoting the construction of long-life quality houses in Japan. International journal of environmental research and public health, vol. 15, no. 11, pp. 2376, 2018
[19] P. J. Godwin, Building conservation and sustainability in the United Kingdom. Procedia Engineering, vol. 20, pp. 12-21, 2011.
[20] P. S. Mallaburn, and N. Eyre, Lessons from energy efficiency policy and programmesin the UK from 1973 to 2013. Energy Efficiency, vol. 7, pp. 23-41, 2014.
[21] R. Tilwani, and C. Sethuraman, Energy savings potentials in buildings through energy audit-a case study in an Indian building. In 2015 International Conference on Technological Advancements in Power and Energy (TAP Energy); IEEE, pp. 289-293, 2015.
[22] S. N. Chaphekar, R. A. Mohite, and A. A Dharme, Energy monitoring by energy audit and supply side management. In 2015 International Conference on Energy Systems and Applications; IEEE pp. 178-183, 2015

[23] P. Kumar, G.S. Brar, S. Singh, S. Nikolovski, H. R. Baghaee, and Z. Balkić, Perspectives and intensification of energy efficiency in commercial and residential buildings using strategic auditing and demand-side management. Energies, vol. 12, no. 23, pp. 4539, 2019

[24] O. I. Asensio, and M. A. Delmas, The effectiveness of US energy efficiency building labels. Nature Energy, vol. 2. No. 4, pp. 1-9, 2017

[25] E. L. Ratcliffe, I. Page, and A. Chami, U.S. Patent No. 5,682,949. Washington, DC: U.S. Patent and Trademark Office, 1997.

[26] V. H. U. Eze et al., "A Systematic Review of Renewable Energy Trend," Newport International Journal of Engineering and Physical Sciences, vol. 3, no. 2, pp. 93–99, 2023.

[27] M. Goulden, and A. Spence, Caught in the middle: The role of the Facilities Manager in organisational energy use. Energy Policy, vol. 85, no. 2015, pp. 280-287, 2015

[28] J. D. Eichman, Energy management challenges and opportunities with increased intermittent renewable generation on the California electrical grid. University of California, Irvine, 2013

[29] P. Petratos, and E. Damaskou, Management strategies for sustainability education, planning, design, energy conservation in California higher education. International Journal of Sustainability in Higher Education, vol. 16, no. 4, pp. 576-603, 2015

[30] C. Oludhe, A. Sankarasubramanian, T. Sinha, N. Devineni, and U. Lall, The role of multimodel climate forecasts in improving water and energy management over the Tana River Basin, Kenya. Journal of applied meteorology and climatology, vol. 52, no. 11, pp. 2460-2475, 2013

[31] K. H. Yatich, Realizing energy management practices as a competitive strategy among manufacturing firms in Kenya: An alternative outlook. African Journal of Business Management, vol. 12, no. 12, pp. 372-380, 2018

[32] S. Agarwal, V. Letschert, and U. Kaggwa, Implementation Strategy-Efficiency Standards And Labeling Programs in Uganda. Lawrence Berkeley National Lab. (LBNL), Berkeley, CA (United States), 2022. doi:10.2172/1868484

[33] D. Bamwesigye, Willingness to Pay for Alternative Energies in Uganda: Energy Needs and Policy Instruments towards Zero Deforestation 2030 and Climate Change. Energies, vol. 16, no. 2, pp. 980, 2023

[34] Z. Norzalina, C. Siwar, A. E. Choy, C. Norshamliza, Evaluating the Role of Energy Efficiency Label on Consumers' Purchasing Behaviour, 2014

[35] I. Lange, M. Moro and M. Rahman, Policy Labels and Investment Decision-making. Stirling Economics Discussion Paper, 2014.

[36] G. Si-Dai, L. Cheng-Peng, L. Hang, and Z. Ning, influence mechanism of energy efficiency label on consumers' purchasing behavior of energy-saving household appliances. Frontiers in Psychology, vol. 12, pp. 711854, 2021

[37] K. O. Adeyemi, and A. A. Asere, A review of the energy situation in Uganda, International Journal of Scientific and Research Publications, 2014, http://repository.elizadeuniversity.edu.ng/

[38] Y. Fernando, and W. L. Hor, Impacts of energy management practices on energy efficiency and carbon emissions reduction: A survey of Malaysian manufacturing firms. Resources, Conservation and Recycling, vol. 126, pp. 62-73, 2017

[39] S. Hayes, S. Nadel, C. Granda, and K. Hottel, what have we learned from energy efficiency financing programs. In American Council for an Energy-Efficient Economy, vol. 202, pp. 507-4000, 2011, www.aceee.org

[40] S. Byrom, G. D. Bongers, P. Dargusch, A. Garnett, and A. Boston, A case study of Australia's emissions reduction policies electricity planner's perspective. Journal of Environmental Management, vol. 276, no. 2020, pp. 111323, 2020.

[41] S. Nadel, and L. Ungar, Half Way There: Energy efficiency can cut energy use and greenhouse gas emissions in half by 2050. Report u1907 american council for an energy-efficient economy, 2019.

[42] S. Hatfield-Dodds, H. Schandl, D. Newth, M. Obersteiner, Y. Cai, T. Baynes, and P. Havlik, Assessing global resource use and greenhouse emissions to 2050, with ambitious resource efficiency and climate mitigation policies. Journal of Cleaner Production, vol. 144, pp. 403-414, 2017

[43] V. H. U. Eze, E. Edozie, K. Umaru, O. W. Okafor, C. N. Ugwu, and F. C. Ogenyi, "Overview of Renewable Energy Power Generation and Conversion (2015-2023)," Eurasian Experiment Journal of Engineering (EEJE), vol. 4, no. 1, pp. 105–113, 2023.

[44] S. M. Klara, R. D. Srivastava, and H. G. McIlvried, Integrated collaborative technology development program for CO2 sequestration in geologic formations—United States Department of Energy R&D. Energy Conversion and Management, vol. 44, no. 17, pp. 2699-2712, 2013

[45] G. Morelli, and M. Mele, Energy consumption, CO2 and economic growth nexus in Vietnam. International Journal of Energy Economics and Policy, vol. 10, no. 2, pp. 443-449, 2020

[46] V. H. U. Eze, M. C. Eze, C. C. Ogbonna, S. A. Ugwu, K. Emeka, and C. A. Onyeke, "Comprehensive Review of Recent Electric Vehicle Charging Stations," Global Journal of Scientific and Research Publications, vol. 1, no. 12, pp. 16–23, 2021.

[47] M. Romanello, C. Di Napoli, P. Drummond, C. Green, H. Kennard, P. Lampard, ... & A. Costello, The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. The Lancet, vol. 400, no. 10363, pp. 1619-1654, 2022

[48] P. Yaguma, P. Parikh, and Y. Mulugetta, Electricity access in Uganda's slums: multi-stakeholder perspectives from Kampala. Environmental Research Communications, vol. 4, no. 12, pp. 125008, 2022.

[49] C. K. A. Uche, V. H. U. Eze, A. Kisakye, K. Francis, and W. O. Okafor, "Design of a Solar Powered Water Supply System for Kagadi Model Primary School in Uganda," Journal of Engineering, Technology & Applied Science, vol. 5, no. 2, pp. 67–78, 2023, doi: 10.36079/lamintang.jetas-0502.548.

[50] G. Kimbowa, K. A. Mourad, Assessing the Bujagali Hydropower Project in Uganda. Mod App Ocean & Pet Sci, vol. 2, no. 4, 2019. MAOPS. MS.ID.000141.

[51] L. D. Peter, K. Paula, N. Lena, and M. Marie, Next steps in the energy transition—a high-impact forum, Oxford Open Energy, Vol. 2, 2023, oiad011, https://doi.org/10.1093/ooenergy/oiad011\

[52] Anonymous" [Online]. Available: https://www.worldometers.info/world-population/uganda-population/#:~:text=Uganda 2023 population is estimated, (and dependencies) by population, 2023. [Accessed: April 2023].