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Unbending the Winding Path of a Low-Income Country's Energy Sector amid the COVID-19 Pandemic: Perspectives from Malawi

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Abstract: This paper discusses the impact of COVID-19's vulnerability context on Malawi's Energy Sector and outlines mechanisms for enhancing Malawi's energy-sector resilience based on experiences from a range of stakeholders. The investigation was conducted online by inviting purposively selected stakeholders to create presentations responding to thematic questions. The final sample had 19 stakeholders with representation from policy-makers, regulatory bodies, national grid supply players, off-grid players, development agencies, bankers, professional bodies, civil society, and women's rights bodies. The presentations from the stakeholders highlighted how COVID-19 affects the operation costs of energy systems and implementation of energy systems projects in areas that require stimulus packages to contain energy system delivery costs and prevent disruption of essential services amid the COVID-19 pandemic. These services include stakeholder responses to COVID-19 in the energy sector, the role of digital payments particularly when purchasing electricity units, and the state of third-party service providers such as banks and mobile network operators to enhance preparedness and continuity of operations for the energy sector. Based on the findings in these thematic areas and an application of systems thinking in the analysis, the paper finally makes recommendations on how Malawi and similar low-income countries can strategise to enhance energy systems resilience.

Keywords: energy-sector resilience; Malawi; COVID-19; vulnerability context; low-income countries

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1. Introduction

1.1. Background

The coronavirus disease 2019 (COVID-19) was classified and declared as a global pandemic by the World Health Organisation (WHO) in February 2020 [1]. COVID-19 is associated with common cold symptoms and severe acute respiratory syndrome [2] and was first diagnosed in Wuhan, China, in December 2019 [3–5]. By the time of this study in June 2020, COVID-19 had spread to 216 countries and territories, infecting approximately 10 million and killing about 500,000 people worldwide [1]. Malawi had recorded about 1200 cases and 13 deaths during the same period [6].

Globally, governments have adopted COVID-19 containment and preventive measures to inhibit infections of the disease. The containment measures included travel restrictions, self-quarantine or self-isolation for fourteen days for those suspected to have been in contact with an infected person or were travelling from countries or regions with a high risk of COVID-19 cases; social distancing, working from home, frequent washing of hands with soap or use of alcohol-based hand sanitiser, and investment in personal protective equipment (PPE) for workers [1,7–10]. In addition, some governments have implemented partial or strict total lockdowns to stop the spreading of the disease [11,12]. Some states have invested in expanding the capacity of health facilities, including the construction of new hospitals, the establishment of isolation centres, increasing the number of beds and equipment such as ventilators, and the capacity of oxygen production facilities [1,7].

Although COVID-19 containment and preventive measures have proven to be effective in inhibiting the spread of COVID-19, these measures have led to a reduced workforce across all sectors of the economy [13]. As a result, many jobs have been lost, supply chains of most commodities for trade have been reduced, and schools have been closed down [5]. The supply chain of basic amenities and services at national and international levels such as food supplies, energy and water have been significantly affected [14]. For instance, oil prices declined between March and June 2020 as a result of reduced demand caused by the decrease in both local and international travel [15]. The containment and preventive measures for the COVID-19 pandemic have necessitated strict behavioural changes and skewed demand, supply and consumption patterns, including energy. In general, the resilience of the supply chains has been tested by the COVID-19 outbreak [13].

Energy is also central to the containment, management, and mitigation against COVID-19 [16,17]. Energy in the form of electricity is needed for, among others, the production of oxygen for aiding breathing and oxygen supply to COVID-19 patients, ventilator operation and other medical equipment in health facilities treating COVID-19 patients [18,19]. Energy also powers electronic equipment to facilitate electronic transactions, promoting social distancing measures in banking halls, shopping malls and other service centres; powering information technologies for communication between governments and citizens and between doctors and patients, and households, especially considering that employees and the general public at large have been encouraged to stay or work from home during the pandemic [20–24]. However, COVID-19 preventive measures present significant challenges to energy supply chain management [25].

COVID-19 preventive measures have the potential to increase operational costs in the supply chain of energy services and affect future capital structure [26]. At the household level, staying and working from home has significant implications on increasing household energy demand and consumption, thereby increasing energy bills against dwindling household income due to scaled-down business operations and loss of employment in some sectors of the economy [27–29].

The COVID-19 pandemic has increased the energy demand in old and new hospitals specifically constructed for the treatment of COVID-19 patients. For example, the utilisation of radiologic examinations, which became vital in the early diagnosis of COVID-19, as most patients infected with the disease have pneumonia characteristics visible in computed tomography (CT) imaging patterns [30]; require a reliable and constant supply of energy. Personal hygiene, including the frequent washing of hands as a containment measure against the spread of COVID-19, requires the provision of energy for treatment and pumping of water from water sources to points of use [31].

Paradoxically, operations in the energy sector and delivery of reliable and quality energy services have become increasingly difficult and complex following the outbreak of the COVID-19 pandemic [32,33]. In context, in Malawi, preventive measures for the COVID-19 pandemic called for strict behavioural changes, which created difficult working conditions, and social interactions in a work environment very challenging to manage. At the time of this study, people whose professional fields were not considered essential were required to manage their work from home while observing social distance and strict hygiene measures. Those allowed to go to work could only do so in limited groups in the light of social distancing and strict hygiene. Shutdowns were also induced, voluntary and imposed, including travel restrictions. Therefore, the study intended to assess the impact of the disease on Malawi's energy sector in light of resilience. While systems and infrastructure are expected to be resilient, the COVID-19 pandemic has been a test of resilience for systems worldwide.

1.2. The Concept of Resilience in the Context of Energy Systems

Resilience is the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions [34–36]. Furthermore, a resilient system can absorb disturbances and reorganize while undergoing change to retain more or less the same function, structure, identity, and feedbacks it possessed before the disturbances were introduced [34–36]. A resilient system has the potential to be sustainable over time [37] and serve continuously with minimum interruptions [38].

The complexity of energy systems, which consist of interconnected technical, social, economic, and environmental components that interact as a unit [39], necessitates that energy systems possess adaptability and transformability attributes to withstand and recover rapidly from disruptions caused by the COVID-19 global pandemic [40–42].

1.3. Objective of the Paper

This study investigated the impact of COVID-19 on the energy sector in Malawi. The aim was to identify the impacts of the COVID-19 pandemic on Malawi's energy sector and outline appropriate coping mechanisms to enhance resilience in the energy sector. Recognising the challenges that COVID-19 has presented in work practices and travel logistics, it is important to devise approaches for enhancing energy systems' resilience based on empirical evidence. Specifically, the present paper intends to: (i) analyse the impacts of COVID-19 on the energy sector in Malawi, (ii) examine the options for meeting energy needs in the light of the dictates for preventing COVID-19, and (iii) draw lessons for enhancing energy systems resilience.

Qualitative system dynamics modelling was used in this study to reveal the cause–effect relationships at play amongst variables in the energy sector components in Malawi as a result of the impacts of the COVID-19 global pandemic. The interconnectedness and interactions among key variables were presented using causal loop diagrams to gain insights into leverage points of the energy sector that required policy interventions promoting resilience during the COVID-19 global pandemic.

2. Materials and Methods

The research was exploratory and qualitative in nature. The restrictions on travel, public gathering, and the need for social distancing as a result of the COVID-19 pandemic, led to the adoption of alternative video conferencing methods for qualitative data collection [43]. Traditional methods of communication, including in-person interviews and focus group discussions, were disrupted by the pandemic; hence video conferencing for data collection was safer, less time consuming, and economical in this case. The COVID-19 preventive measures provide a new perspective, where internet costs for interaction and conferencing are compared with costs of travelling to hold interviews and focus group discussions [44–46].

Therefore, data was collected through two online workshop sessions via Zoom where key stakeholders in the energy sector conducted presentations guided by the following questions:

- How has COVID-19 affected operations costs for energy systems?
- How has COVID-19 impacted the early-stage development of energy projects, construction and the implications for the Malawi's energy outlook?
- Which areas require a stimulus package to contain the delivery costs of energy and prevent disruption of essential services during the COVID-19 pandemic?
- What are the stakeholders' responses to COVID-19 in the energy sector?
- Are onsite/backup (decentralised) energy systems for medical care facilities helpful in managing the impacts of COVID-19 in the energy sector?
- What are the challenges and solutions on digital payments? Particularly when purchasing electricity units?

- What is the state of third-party service providers such as banks and mobile network operators? How can they enhance preparedness and continuity of operations for the energy sector?
- What are the implications of the COVID-19 on energy policy and legal framework?
- What lessons can we implement from COVID-19 in order to enhance the resilience of energy systems?

A total of 24 stakeholders were identified purposively based on their roles in the energy sector in Malawi to ensure representation of all the key players. The health sector was also targeted owing to the key role in the fight against the COVID-19 pandemic, which requires energy. Five participants, representing 20.8% of the total participants targeted for data collection, did not attend the video conferences. Thus, data was collected from 79.2% of the sample targeted for this research. The final sample had 19 stakeholders with the following representation: policy-makers, regulatory bodies, national grid supply players (generation and distribution), off-grid players, development agencies, bankers, professional bodies, civil society, and women's rights bodies.

The presentations from stakeholders were followed by plenary discussions from all the participants highlighting individual experiences and lessons learnt along the lines of the research questions. The workshops and plenary discussion methods provide the opportunity of engaging participants in more in-depth research than closed structured questionnaires online [47,48].

The approach to data collection used in this study provided a platform for participants to describe their empirical experiences and viewpoints on the impacts of the COVID-19 pandemic on the energy services supply chain under consideration. In addition, the approach used for data collection revealed underlying structures that may cause variations over time in the energy services supply chain; this is presented qualitatively using causal loop diagrams in Figure 2. Data were analysed qualitatively by grouping ideas and information obtained from participants' presentations and plenary discussions into broad thematic areas of concern using the methods presented by Vanderstoep and Johnston [49].

The discussion of the findings is complemented by a system dynamics qualitative modelling [50–53], based on the cognitive map shown in Figure 1, in light of the variables collected from online workshops.

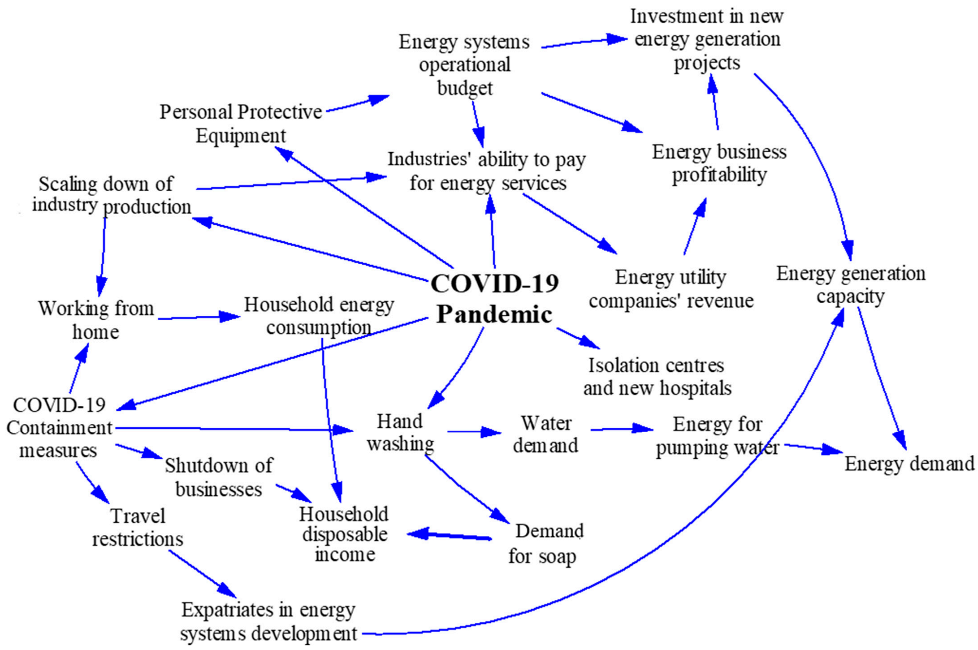

Figure 1. Cognitive map of energy sector variables in Malawi as a result of the COVID-19 pandemic.

3. Findings and Discussions

3.1. Impacts of COVID-19 on the Energy Sector in Malawi

The impacts of the COVID-19 pandemic on the energy sector in Malawi are categorised by the following components of the energy value chain: (i) development of energy projects, (ii) energy utility companies, (iii) operational costs of utility companies, and (iv) energy demand and consumption in selected sectors. Figure 1 demonstrates the links between components and interconnectedness of factors at play in the energy sector. The energy sector variables are factors liable to change over time as a result of either external or internal shocks. The variables in this research were grouped into four components of the energy supply value chain.

3.1.1. Impacts on Early-Stage Energy Projects Development, Construction and Implications in the Country's Energy Outlook

The level of impact of the COVID-19 pandemic on projects is demonstrated in the causal loop diagram in Figure 2. The arrowheads in Figure 2 indicate the direction of influence (causality) by the variable at the tail of the arrow. The positive or negative sign shows the type of influence, whether the variable (at the arrow's tail) has an increasing or decreasing effect on the subsequent variable (at the arrow's head). The loops presented as R1, R2, R3, B1, B2, and B3 show the recurrence of a cause–effect relationship among the variables interconnected in the loop.

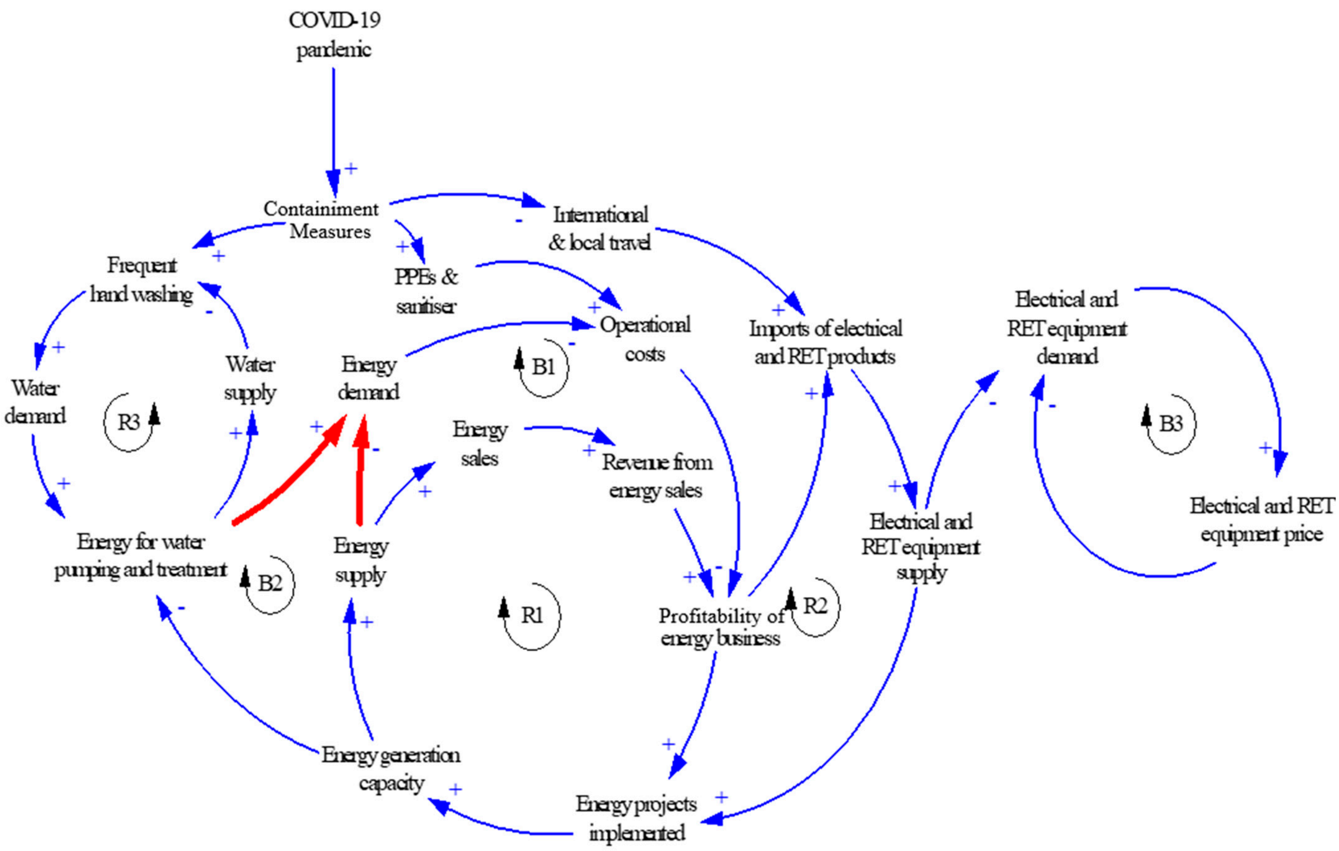

Figure 2. Causal loop diagram of the impacts of COVID-19 pandemic on the energy sector in Malawi. The interconnectedness of the variables is shown, including how they influenced other variables at the arrowhead.

Firstly, travel restrictions instituted globally by governments and the World Health Organisation (WHO), as a COVID-19 pandemic containment measure, decreased and eventually halted imports of energy equipment and components into Malawi. The disruption in the supply chain of electrical supplies, renewable energy equipment, and products resulted in a scarcity of these products on the market in Malawi. Supply disruption affects both upstream and downstream movement, rendering the balance of supply and demand challenging [54,55].

The reinforcing loop R1 in Figure 2 shows that the decrease in international and local travel due to the COVID-19 pandemic decreased imports of electrical and renewable energy products into Malawi. The decrease in imports of electrical and renewable energy equipment decreased the availability of the equipment on the market, decreasing the implementation of energy projects. The decrease in energy projects included the maintenance of existing power generation plants and installing new power stations, resulting in a decrease in energy generation capacity by the energy utility companies. In turn, energy supply decreased in all the sectors of the economy.

Furthermore, the decrease in energy supply decreased energy sales, which decreased revenue from the energy sales, resulting in a decrease in profits from the energy sales. The overall effect of reduced revenue from energy investments has been declining investment in energy projects and the development of new power generation plants [55,56].

Loop R2 shows the reinforcing effects of the COVID-19 pandemic in the supply chain of energy equipment. It is evident from loop R2 in Figure 2 that the decrease in profits from energy sales reinforced the decrease in imported electrical and renewable energy equipment into Malawi, which further decreased the availability of equipment on the market, thereby creating a circus cycle of impacts from the COVID-19 pandemic on the energy supply system in Malawi.

Additionally, the balancing loop B3 shows that the decrease in supply and availability of electrical and renewable energy equipment on the market increased the demand for the products, which resulted in an increase in prices by traders who had stocks of the products imported before the travel restrictions were instituted. Suppliers with the products in stock benefitted from the high demand and low supply, thereby significantly increasing the product prices.

The scarcity of equipment for the implementation of energy projects resulted in the following:

(i) Maintenance works on the grid distribution network, and connections for new energy customers in Malawi were affected due to the lack of essential materials, such as conductors for medium voltage (MV) and low voltage (LV) installations. Furthermore, the response to rectifying faults by the power utility companies had dwindled due to fault-clearing staff teams working in shifts of limited staff numbers per grouping to comply with restrictions.
(ii) The construction of a hydro-based mini-grid (300 kW installed capacity) at Usingini was delayed. The project developer was unable to import goods and services for the project. Later the project was suspended due to the delays.
(iii) Maintenance works of two turbines at Kapichira hydropower plant, with a total generation capacity of 64 MW, were delayed as spare parts could not be imported, and expatriate engineers contracted to conduct the maintenance works could not travel due to travel restrictions from COVID-19. Delayed maintenance of the hydropower plant led to the loss of 64 MW on the national grid.
(iv) The development of a 300 MW hydropower project at Mpatamanga, which is under the planning stage, has also been delayed.
(v) Construction works of 120 MW solicited grid-connected solar PV projects at Golomoti, Nanjoka in Salima and Nkhotakota were suspended as the equipment could not be shipped into Malawi. For instance, equipment such as solar panels, batteries, and invertors for both the Nanjoka and Nkhotakota solar farms were imported from China and scheduled for commissioning in July and December 2020, respectively. However, the equipment could not be shipped as China was affected by the coronavirus.
(vi) Developers of energy projects, such as Independent Power Producers (IPPs) in Malawi, could not comply with deadlines for equipment installation; this delayed the commissioning of projects.

(vii) Energy projects funded by supporting partners, for instance, the World Bank Malawi Electricity Access Project (MEAP), were delayed as the officers responsible for the project could not travel to Malawi. If implemented on time, this project may have increased access to modern energy for most households, health facilities, schools, water pumping stations and enterprises in Malawi.

(viii) The development, commencement, assessment, and implementation of increasing energy access projects supported by the United Nations Development Programme (UNDP) in partnership with the Department of Energy Affairs of the Malawi Government were delayed.

(ix) For liquid fuels and gas (LFG), it was discovered that the volume of fuels imported into Malawi by the National Oil Company (NOCMA) and Petroleum Importers Limited (PIL) reduced due to the decline in oil demand largely caused by travel restrictions and less production from manufacturing companies. The reduced volumes imported and sold in the country negatively impacted fuel levies collected and used for the Malawi Rural Electrification Program (MAREP) and Roads Administration Fund (RAF). The impact on funding for MAREP, a program extending the electricity grid to rural trading centres and/or marketplaces in a phased manner, affected energy access in Malawi.

Given the delays in implementing and commissioning energy projects, it may be difficult for Malawi to achieve its energy mix targets to ensure energy security and reliable supply if a similar situation or vulnerability context continues. The Government of Malawi intends to reduce biomass energy consumption to approximately 44% by 2025, increase electricity consumption from renewable energy sources such as solar to about 23% by 2025, and increase grid access to 30% by 2030 [57,58].

3.1.2. Impact on Operational Costs for Energy Systems

Increased operational costs of energy systems in Malawi during the COVID-19 pandemic were attributed to the following reasons:

(i) Provision of personal protective equipment (PPE) and other COVID-19 containment measures such as masks, hand sanitisers, regular disinfecting of staff-shared machines such as cars and office computers. These were not planned or budgeted for by the power utility companies and mini-grid operators in their annual operational and maintenance (O&M) budgets.

(ii) Demand for risk allowance by employees for working in an environment that exposed them to risks of COVID-19 such as fault-clearing in household premises, offices, and the distribution network. Employees of power utility companies and mini-grid operators organised sit-in demonstrations and a strike to demand improvements in service conditions reflecting the risks emanating from COVID-19, which affected company revenue.

(iii) Reduced numbers of employees travelling in one vehicle while undertaking routine work-related activities to observe social distancing led to an increase in the number of vehicles used per activity, such as fault-clearing. The increase in the number of vehicles used per activity resulted in more fuel consumption and therefore cost for the faults and maintenance activities budget lines. In terms of vulnerability context, Sadati et al. [59], Wilder–Smith and Freedman [60] argued that the COVID-19 containment measures might not be effective in curbing the spread of coronavirus and could lead to inadvertent consequences. In the case of the power utility companies in Malawi, the increase in O&M costs, which reduced the profitability of the power utility companies, may affect energy service delivery in the long run and compromise the fight against the pandemic, which requires energy input.

(iv) The double hiring of consultants: Local consultants were hired later to install energy system components due to travel restrictions imposed on expatriate consultants who were initially contracted to perform installations of an integrated system for user interface.

(v) Employing alternative measures to conduct community sensitisation, training, and civic education activities to raise awareness for the mini-grid project and safety issues in place of in-person meetings. For instance, United Purpose, a mini-grid developer, resorted to using a public address system at night instead of in-person daytime workshops. To ensure the security of staff operating the public address system at night, the mini-grid developer hired police services to provide security for the staff, which increased the project cost.

Though the findings above are qualitative, they demonstrate that the ripple effects of the COVID-19 pandemic on business and government operating costs cannot be understated, as observed by some authors, notably Elavarasana [61], Eroğlu [62], and Kanitkar [63]. The diversity of the participants ensured that the qualitative study captured different perspectives of different stakeholder groups.

3.1.3. Areas That Require a Stimulus Package to Meet the Costs of Delivering Energy Systems and Prevent Disruption of Essential Services during the COVID-19 Pandemic

In light of this impact, data collected from the stakeholders showed that the electricity supply companies, including off-grid players, needed financial support due to the following reasons:

(i) Electricity demand declining due to the confinement measures, as most sectors of the economy operated skeleton crews and customer liquidity went down. The pandemic caused electricity demand to fall as industrial electricity consumption holds the largest share in Malawi electricity consumption. Public institutions, such as boarding schools, also shut down, resulting in reduced demand for electricity. Similar reductions in electricity demand were observed in several regions of the world [64–67], and a notable decline in energy consumption reached 20% in France, 25% in Italy, and 12% in the United Kingdom [68].

(ii) Retailing of electricity units went down as most families with informal income sources did not have the resources to buy electricity units while staying at home, forcing most post-paid families to opt for defaulting on electricity bills.

(iii) Businesses operations scaled down such that productive use of energy from mini-grids, notably welding and carpentry businesses, consumed less energy. This reduced energy consumption from anchor customers of mini-grids is a threat to the sustainability of mini-grids. This reduction in business operation among small and medium enterprises (SMEs) has also been noted in sub-Saharan Africa, accounting for 38% of the regional GDP [69].

(iv) The COVID-19 pandemic affected revenue for the Electricity Supply Corporation of Malawi (ESCOM). The pandemic compelled manufacturing companies to request ESCOM to reduce its maximum demand (MD) charges because of scaled-down production and operations. The industry or commercial base of ESCOM customers account for 80% of ESCOM revenue, while domestic customers account for only 20% of the revenue.

It was also observed that frequent washing of hands as a measure of preventing the spread of COVID-19 increased water bills for the households. Therefore, the power utility companies needed to consider reducing tariffs for water supply companies, which could be passed on to households as a way to reduce water bills. Stakeholders also expressed the need to support the off-grid sector due to the following:

(i) Demand for off-grid systems increased. Notable examples included basic electricity for remote COVID-19 quarantine and treatment centres, demand for refrigeration of medication in rural healthcare facilities that lack the power and subsequent equipment to provide cold storage, and an increased need for communication and information on COVID-19, which led to the increase in electricity demand for charging appliances used for communication.

(ii) Demand for fuelwood in the form of firewood and charcoal increased in the household sector as most people were staying and working from home. This demand accelerated the rate of deforestation. For example, it was reported that the catchment area for Lichenya River in Mulanje Mountain, which supplies water for the 220 kW micro-hydropower mini-grid system for Mulanje Energy Generation Company, suffered extensive deforestation during the coronavirus period. Law enforcement agencies were working below capacity, following orders to work from home at times when there was an increased demand for fuelwood. It was also reported that staying in homes presented a burden on women to cook and increased the rate of obtaining fuelwood.

Specific financial support as suggested by stakeholders were as follows:

(i) A financial package to reduce the retail price of Liquefied Petroleum Gas (LPG), which has the potential to substitute biomass as energy for cooking at the household level in Malawi. This package should also have health benefits as it has the potential to reduce exposure to smoke from biomass fuel and indoor air pollution, which cause respiratory diseases and can exacerbate respiratory problems caused by COVID-19.
(ii) Financial package to reduce electricity tariffs. With people confined to their homes and resorting to teleworking and e-payment for shopping, families need support to buy electricity.
(iii) Financial package for tax and duty waivers on electrical supplies to energy sector players.

However, it was observed that financial support, especially on tax waivers, is a hard decision for the government, given that the tax base was already reduced due to lean industrial operations and reduced international trading.

3.2. Options for Meeting Energy Needs in Light of COVID-19

In order to ensure that the energy needs of different consumers are still met, the energy sector players in Malawi highlighted a number of adaptation mechanisms discussed in the following sections.

3.2.1. Stakeholder Responses to COVID-19 in the Energy Sector

The stakeholders' response to adaptation during the COVID-19 pandemic was as follows:

(i) Provision of sanitation supplies such as hand sanitisers and regular disinfection of staff-shared machines such as cars and office computers;
(ii) Changing the mode of working from full-time to working in shifts per day or week in order to comply with social distancing measures;
(iii) Reducing the number of officers travelling in cars to observe social distancing;
(iv) Suspension of new electricity connection;
(v) Suspension of all power distribution network projects. For example, installation of transformers and distribution lines as the equipment is held at the border due to travel restrictions, and following the skyrocketing prices of the equipment by suppliers amid the pandemic;
(vi) Intensification of awareness campaigns for households on the benefits of purchasing electricity units using digital payments rather than queuing at electricity utility offices;
(vii) Promotion of the use of energy-efficient technologies such as LEDs to help households reduce energy costs and reduce pressure on the grid to prevent load shedding, which can impact essential services.

3.2.2. The Role of Onsite/Backup (Decentralised) Energy Systems for Medical Care Facilities in Managing the Impacts of COVID-19 on the Energy Sector

COVID-19 underscores the need for a reliable electricity supply in health care facilities. As highlighted in Section 3.1.3, demand for off-grid systems increased in basic electricity for remote COVID-19 quarantine and treatment centres, among other electricity needs. Highly notable was that reliable and uninterrupted power was required in COVID-19 testing sites because whenever an interruption in the power supply occurred at the testing facility, all the samples collected from suspects of COVID-19 infection were disposed of, and the sample collection process had to be repeated, which was a very painful process for the individuals being tested. Therefore, to ensure reliable power supply to healthcare facilities, the Ministry of Health initiated procurement of power backup generators and solar systems for distributing treatment, isolation, screening, and testing centres.

It was also observed that there are three categories in which the Malawi health sector is categorised: community hospital level, district hospital level, central or tertiary hospital level, and community hospitals that rely mainly on solar off-grid energy systems. District and tertiary hospitals rely on grid electricity as their main power supply, with some hospitals having a solar backup or diesel generators. However, some COVID-19 isolation sites did not have any power supply source. At the time of this study, there were seven COVID-19 isolations centres in Malawi, namely: Karonga District Hospital, Mchinji District Hospital, Kameza, Mwanza District Hospital, Mzimba South, Mangochi District Hospital, and Chitipa District Hospital. There were also three treatment sites: Kamuzu Central Hospital, Zomba Central Hospital, and Mzuzu Central Hospital. All these sites required an uninterrupted power supply to manage the COVID-19 pandemic in Malawi.

3.2.3. Electronic Payments as a Means of Observing Social Distance in Payments for Energy

Stakeholders observed that electronic payments could play a role in avoiding queues when purchasing electricity units. However, it was also observed that third-party service providers such as banks and mobile network operators had several challenges, which demonstrates a lack of preparedness to ensure continuity of energy sector operations. Specifically, stakeholders observed that:

(i) Challenges with electronic payments systems in Malawi deterred people from using the electronic platforms for paying energy services;
(ii) Mobile networks and banks are slow to resolve and process refunds on failed transactions towards bill payments and prepayment of electricity units;
(iii) Electronic payment platforms were also unavailable when needed due to mobile and internet network challenges;
(iv) Power outages also rendered third-party vending of electricity units unreliable or unavailable as mobile network providers, and banks rely on their power availability for efficient digital payments and transactions.

3.3. Lessons for Enhancing the Resilience of Energy Systems

According to Chinazzi [70], early detection and isolation measures were highlighted as effective approaches to enhance resilience and reduce coronavirus transmissibility. In line with the research questions and the discussions by the stakeholders, the following lessons were drawn.

3.3.1. Implications of the COVID-19 to Energy Policy and Legal Framework

It was observed that policy and legal frameworks have inadequate provisions for electricity tariff restructuring amid a vulnerability context that affects revenue streams of both consumers and electricity suppliers. The liquid fuels and gas subsector benefited from the automatic fuel pricing mechanisms in which the reduction of crude oil prices was passed on to consumers in Malawi. The challenge with the electricity tariff structure during COVID-19 is that electricity suppliers are confronted with increasing operational costs, which need to be passed on to consumers. Also, electricity consumers confront reduced revenue streams and increased household expenses, including energy, which need social net relief. This research found that the energy policy and legal framework need to be reviewed to provide cushioning to electricity suppliers and consumers amid vulnerability contexts similar to COVID-19.

3.3.2. Lessons from the COVID-19 to Enhance the Resilience of Energy Systems

The following lessons were learned by the energy sector stakeholders from their experiences with COVID-19:

(i) Electronic transactions are essential for enhancing payments and therefore revenue collection in vulnerability contexts such as of COVID-19;
(ii) Bulk ordering and warehousing of essential materials and equipment to last for several months is crucial for reducing the vulnerability of the energy sector to natural events such as COVID-19;
(iii) Local capacity for both human resources and the production of essential materials is crucial to enhancing the resilience of the energy sector. The lockdown and travel restrictions rendered it impossible for expatriate professionals to travel to Malawi. There are also the presented challenges of importing essential goods for energy projects. This pandemic is a wake-up call for different professionals, including energy sector practitioners, to fast-track local capacity building;
(iv) Preparedness based on quick information collection and responsiveness is essential. Apparently, no institution in Malawi appeared to be enforcing measures when the COVID-19 was announced in China.

4. Conclusions and Recommendations

The COVID-19 pandemic has significantly and negatively affected the energy sector in Malawi. The development and implementation of energy projects for all categories and magnitudes of grid connection, mini-grids, and standalone renewable systems have been delayed or suspended. The suspension of implementation for these energy projects signifies a significant vulnerability context for Malawi. There is great uncertainty in the supply chain of materials and energy service delivery owing to the implementation of travel restrictions, social distancing, and sanitisation as mitigation measures supressing the spread of COVID-19. Revenue from energy sales has decreased while operating costs have increased. Promotion to increase access to clean, affordable and sustainable energy is hindered, which negatively impacts the attainment of Sustainable Development Goal number seven and hence Sustainable Energy for All by 2030. COVID-19 has also underscored the importance of reliable energy supplies to support healthcare facilities in the country.

It was observed that the Malawi energy sector was not prepared for the vulnerability context requiring actions and solutions. The coping mechanisms implemented were short term. Therefore, long term strategies for the enhancement of Malawi's energy sector are required. The COVID-19 pandemic has adversely impacted the energy sectors of many countries across the globe. However, preparedness for coping with the pandemic has varied between countries [56]. The findings in this study compare well with other sub-Saharan African countries [56]. A systems approach for modelling the energy sector to gain insights into the key variables can have adverse impacts on the energy supply chain and promote the development of coping mechanisms during pandemics.

Given the findings and the discussion, the following recommendations are made:

(i) The Ministry of Energy should start energy scenario planning for 5 or 10 years, including other hazards such as drought, and suggest solutions in advance. For instance, in a scenario where a pandemic lasts 5 years or more, or the country faces drought for many years considering that Malawi relies heavily on hydropower plants and many more scenarios. This will help the country to devise solutions in advance and boost preparedness.
(ii) The Ministry of Energy should liaise with the Ministry of Trade and Industry to support local companies manufacturing essential electrical supplies to ensure an uninterrupted supply chain. For example, companies and organization that are producing PPE locally.
(iii) Ministry of Energy should liaise with the Ministry of Labour and Manpower Development, and Professional Bodies such as the Malawi Institution of Engineers and Renewable Energy Industry Association and implement local skills development programmes for the energy sector.

(iv) Reserve Bank should enforce strict compliance with customer complaint resolutions for electronic payments.
(v) The government should construct more fuel reserves, thereby increasing storage capacity and avoiding a standstill in the future if such situations constraining travel and importation recur.
(vi) Policy-makers must devise recovery measures that are forward-and-outward, looking beyond the market-driven approach. Innovative approaches are needed to secure financing amid crisis at foreseeable scales and reasonable speed; this can be achieved through a coherent design approach that ensures inclusiveness, evidence from past situations, and secure political buy-in.

Although this study originated from a case study on the Malawi energy sector, the findings and coping mechanisms recommended in this paper to increase the resilience of energy sectors in times of pandemics can be applied to low-income countries with conditions similar to Malawi.

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