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Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Name</th>
</tr>
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<tbody>
<tr>
<td>BAU</td>
<td>Business-as-Usual</td>
</tr>
<tr>
<td>BESS</td>
<td>Battery Energy Storage System</td>
</tr>
<tr>
<td>CCDR</td>
<td>Country Climate and Development Report</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon Dioxide (Scientific Symbol)</td>
</tr>
<tr>
<td>CSO</td>
<td>Civil Society Organization</td>
</tr>
<tr>
<td>DSM</td>
<td>Demand Side Management</td>
</tr>
<tr>
<td>EGENCO</td>
<td>Electricity Generation Company</td>
</tr>
<tr>
<td>ESCOM</td>
<td>Electricity Supply Corporation of Malawi</td>
</tr>
<tr>
<td>FOLU</td>
<td>Food and Land Use Coalition</td>
</tr>
<tr>
<td>GEAPP</td>
<td>Global Energy Alliance for People and Planet</td>
</tr>
<tr>
<td>GHG</td>
<td>Green House Gases</td>
</tr>
<tr>
<td>HAP</td>
<td>Household Air Pollution</td>
</tr>
<tr>
<td>HH</td>
<td>Household</td>
</tr>
<tr>
<td>HYDRO</td>
<td>Hydropower</td>
</tr>
<tr>
<td>ICC</td>
<td>Improved Charcoal Cookstoves</td>
</tr>
<tr>
<td>IDA</td>
<td>International Development Association</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>IHS5</td>
<td>Fifth Integrated Household Survey</td>
</tr>
<tr>
<td>IPP</td>
<td>Independent Power Producer</td>
</tr>
<tr>
<td>IRP</td>
<td>Integrated Resource Plan</td>
</tr>
<tr>
<td>JCM</td>
<td>JCM Matswani Solar Group Corp Limited</td>
</tr>
<tr>
<td>LPG</td>
<td>Liquid Petroleum Gas</td>
</tr>
<tr>
<td>MAED</td>
<td>Malawi Energy Demand Assessment</td>
</tr>
<tr>
<td>MBS</td>
<td>Malawi Bureau of Standards</td>
</tr>
<tr>
<td>MCC</td>
<td>Millennium Challenge Corporation</td>
</tr>
<tr>
<td>MEAP</td>
<td>Malawi Electricity Access Project</td>
</tr>
<tr>
<td>MEPS</td>
<td>Minimum Energy Performance Standards</td>
</tr>
<tr>
<td>MERA</td>
<td>Malawi Energy Regulatory Authority</td>
</tr>
<tr>
<td>MGDS</td>
<td>Malawi Growth and Development Strategy</td>
</tr>
<tr>
<td>MIGA</td>
<td>Multilateral Investment Guarantee Agency</td>
</tr>
<tr>
<td>MITC</td>
<td>Malawi Investment and Trade Centre</td>
</tr>
<tr>
<td>MK</td>
<td>Malawi Kwacha</td>
</tr>
<tr>
<td>MRES</td>
<td>Malawi Renewable Energy Strategy</td>
</tr>
<tr>
<td>MW</td>
<td>Mega Watt</td>
</tr>
<tr>
<td>MW2063</td>
<td>Malawi Vision 2063</td>
</tr>
<tr>
<td>NCIC</td>
<td>National Construction Industry Council</td>
</tr>
<tr>
<td>NDC</td>
<td>Nationally Determined Contributions</td>
</tr>
<tr>
<td>NES</td>
<td>National Electrification Strategy</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>PML</td>
<td>Power Market Limited</td>
</tr>
<tr>
<td>PPA</td>
<td>Power Purchase Agreement</td>
</tr>
</tbody>
</table>
PPP       Public Private Partnership
PV        Photovoltaic
RMI       Rocky Mountain Institute
SADC      Southern African Development Community
SAPP      Southern African Power Pool
SB        Single Buyer
SDG       Sustainable Development Goals
SE4A      Sustainable Energy for Africa
SMO       System and Market Operator
SOE       State Owned Enterprise
SWECO     Swedish Consultants
UN        United Nations
US        United States
USD       United States Dollar
WBG       World Bank Group

All dollar amounts are US dollars unless otherwise indicated.
1. Background – Energy Sector Review

a. Country Context/National Energy Resources

The energy sector in Malawi encompasses five major subsectors, as follows: Hydropower based electricity, Biomass energy, Petroleum, Coal, and Renewable energy (solar, wind and geothermal).

Regarding carbon emissions, biomass, coal and petroleum products are the major contributors. Regarding biomass, this is largely due to overdependence on biomass energy for cooking and heating. In 2020, 98.8 percent of the households were using biomass energy - charcoal and wood fuel - as their primary energy for cooking and heating. A higher proportion (79.1 percent) of households was using firewood, followed by 18.5 percent that were using charcoal and 1.2 percent using electricity.

There are also emissions from the transport sector and the electricity subsector, mainly through diesel generation. The electricity subsector currently consists of predominantly renewable energy sources - about 75 percent, with hydro generation as the bigger part and solar generation as the smaller part. The remaining part comes from the diesel power plants whose primary role is for peak demand covering. Meanwhile, these diesel peaking power plants have high costs (0.42US$/kWh, as compared to the average electricity tariff of 0.12US$/kWh), and adverse environmental impacts.

Malawi has one of the lowest electricity access rates in the world. The electrification rate is standing at 14 percent with severe disparities between urban and rural areas (54 percent in the urban areas and 7 percent in the rural areas). The inequality between the rich and the poor is stark; the poorest 20 percent reports 1 percent and the richest 20 percent reports 31 percent electrification rate. There is almost no coverage in the bottom 40 percent of the population, and this has serious implications for human development and economic transformation outcomes.

The progress on electricity access has been much slower as compared to other countries in Sub-Saharan Africa (see Annex 1). Between 2010 and 2019, Malawi’s annualized average change in electrification has been less than 0.5 percent, as compared to other countries such as Madagascar, Ethiopia, Sudan, Tanzania, Uganda, and Kenya that are all above 1.5 percent, with Kenya being the highest at 5.5 percent. Malawi’s Integrated Resource Plan of 2017 and the Sustainable Energy Agenda set the objective of 30 percent access by 2030, the Malawi Vision 2063 sets a 50 percent access target by 2030 and 100 percent by 2063, and the Malawi Renewable Energy Strategy (MRES) targets universal access by 2030.

In 2016, the electricity subsector in Malawi went through a number of reforms that were largely supported by the Millennium Challenge Corporation (MCC). The Electricity Act of 2004 was amended to allow for the unbundling of the electricity subsector into: (i) generation segment; and (ii) transmission and distribution segment. This allowed for the participation of the private sector in the generation segment. Under the unbundling, the generation segment of the Electricity Supply Corporation of Malawi (ESCOM) was carved out of the utility to create a separate state-owned enterprise (SOE) known as Electricity Generation Company (EGENCO). Because of these reforms, ESCOM assumed the role of the Single Buyer; the System and Market Operator for the transmission network; and the operator of the distribution network and retail services. In June 2018, the Government of Malawi further carved out the Single Buyer function from ESCOM and created another SOE, Power Market Limited (PML) that received a license from the Malawi Energy Regulatory Authority (MERA) in December 2020 to be the new Single Buyer.

The Government of Malawi in 2018 developed a National Electrification Strategy (NES) for enabling efficient electricity access scale-up. The NES presents a series of electrification-specific recommendations that focus on strengthening existing distribution networks and distribution licensees to support expansion of grid infrastructure and connectivity; promoting restructuring of rural electrification/renewable energy program management; and scaling-up of off-grid renewable initiatives through establishing quality standards, providing fiscal incentives for solar devices, and supporting
local manufacturing of renewable, off-grid devices. The NES also provides guidance on the fiscal framework that is required to create the enabling environment for investment in renewable energy-based mini grids for outlying communities identified under a comprehensive geospatial least cost grid electrification and off-grid complement plan, along with an off-grid market assessment for Malawi. The NES is organized into four thematic pillars, namely: (i) institutional elements; (ii) policy and regulatory elements; (iii) technical and planning elements; and (iv) financial elements. Key recommendations under the NES are implemented through the Malawi Electricity Access Project (MEAP) that is being implemented by the Ministry of Energy and ESCOM with funding from the World Bank, which has provided IDA funding of US$150 million. Under this financing, US$110 million is for grid access, and US$40 million for off-grid access scale-up. It is expected that the scale-up activities will increase the off-grid rate from the current very low levels of about 6 percent to 20 percent by 2030, and on-grid access to 30 percent by the same target year.\(^4\)

The electricity subsector, which is key to accelerating economic growth, is facing several constraints, with the sector financial context being by far the most important constraint. This has led to infrastructure deficits across the entire value chain, and weak performance of SOEs responsible for service delivery. ESCOM’s financial position has weakened over the last three financial years; the utility is running an operating loss leading to its inability to meet its financial obligations without sovereign funding support. Tariff increases have been approved only recently, after a long gap despite which tariffs (currently at US$0.05/kWh during off peak to US$0.14/kWh during peak demand and the average tariff is US$0.1210/kWh) remain below cost recovery levels. ESCOM’s total financial shortfall, including net financial debt and investments is estimated to weigh around 8-10 percent on the total public domestic debt for Malawi. ESCOM is also faced with payment arrears from Government agencies, which has further weakened its financial position. The situation has been exacerbated by the recent devaluation of the Malawian Kwacha (MK) against the United States Dollar (USD) by 25 percent; it is further compounded by a very high debt service ratio and staffing levels. Due to this weak financial position, ESCOM is in turn incurring payment arrears with EGENCO, its primary source of electricity generation. The financial position of the sector has also been burdened by the overreliance on expensive emergency diesel generation that is being used to address the power supply deficit being faced by the country. As of December 2021, the installed capacity of base power was about 444 MW against a demand of 719 MW. However, by April 2022, available capacity changed to 267.14 MW against the same demand of 719 MW projected in the Integrated Resource Plan (IRP). Before April 2022, peaking, emergency diesel generators were supplementing the installed capacity with a total installed capacity of 129.33 MW of which 78 MW was by an Independent Power Producer (IPP), and the rest was by EGENCO. Nevertheless, in April 2022, the Government of Malawi made a bold decision to discontinue (by not renewing) the leasing of the 78 MW of diesel generators from the IPP due to high operation costs (which contributed to high tariffs). This decision, coupled with environmental issues that adversely affected the operation of the existing hydropower stations, leading to output being below the projected optimal output, led to the exacerbation of the power supply deficit.

b. Balance of Energy/Power Demand and Supply Situation

In terms of power demand, the 2017 IRP electricity demand forecast for the base forecast estimates that maximum demand will reach 719 MW by 2020, 1,873 MW by 2030 and 4,620 MW by 2040 (see Table 1 below). The annual average growth rates are 17.5 percent through to 2020 (reflecting suppressed demand in its various forms) and 10 percent per annum from 2020 to 2030 (including the elimination of suppressed demand). This compares with annual average growth rates of maximum demand over a period from 2010 to 2015 of 4.2 percent per annum. However, between 2015 and 2016, there was heavy load shedding due to low water levels in the Shire River, from which Malawi generates about 98 percent of its hydroelectricity.

Regarding domestic power demand, ESCOM reports that it serves 423,455 consumers, resulting in an electrification index of 10.3 percent. The National Energy Policy of 2018 aligns Malawi with a full
access agenda, setting an ambitious target of 80 percent coverage by 2035 (approximately 60 percent by 2030) that will require providing, on average, over 250,000 households with electricity service each year, using a combination of grid and off-grid resources. Achieving this rate of electrification growth will require mobilizing significant technical, financial, and program management resources in a well-coordinated manner from all sector stakeholders.

The key demand drivers in Malawi include domestic cement and sugar manufacturing, mining, irrigation agriculture, and processing of agricultural products such as tobacco and tea and small-scale industries. In order to manage demand, ESCOM has a time of use tariff for industries, that encourages consumers to use electricity during off-peak periods.

Regarding power supply, the total installed hydropower generation capacity operated by EGENCO is 390.15 MW mainly on the Shire River, which is draining Lake Malawi. A small mini hydropower plant located on Wovwe River in Northern Malawi has a generation capacity of 4.5 MW (see Table 2 below).

<table>
<thead>
<tr>
<th>Year</th>
<th>Low Case Scenario (MW)</th>
<th>Base Case Scenario (MW)</th>
<th>High Case Scenario (MW)</th>
</tr>
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<tbody>
<tr>
<td>2020</td>
<td>567</td>
<td>719</td>
<td>982</td>
</tr>
<tr>
<td>2030</td>
<td>1,235</td>
<td>1,873</td>
<td>2,591</td>
</tr>
<tr>
<td>2037</td>
<td>2,236</td>
<td>3,566</td>
<td>5,217</td>
</tr>
<tr>
<td>2040</td>
<td>2,841</td>
<td>4,620</td>
<td>6,945</td>
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Table 1. Electricity Demand Forecasts (Maximum Demand, MW Sent Out)

<table>
<thead>
<tr>
<th>Year</th>
<th>Low Case Scenario (MW)</th>
<th>Base Case Scenario (MW)</th>
<th>High Case Scenario (MW)</th>
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<tr>
<td>2020</td>
<td>567</td>
<td>719</td>
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<td>1,235</td>
<td>1,873</td>
<td>2,591</td>
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<td>2037</td>
<td>2,236</td>
<td>3,566</td>
<td>5,217</td>
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<tr>
<td>2040</td>
<td>2,841</td>
<td>4,620</td>
<td>6,945</td>
</tr>
</tbody>
</table>

Source: Government of Malawi (Malawi Economic Annual Report, 2021)

Table 2. EGENCO Power Generation Capacity in Malawi

<table>
<thead>
<tr>
<th>Station – Hydro</th>
<th>Installed Units</th>
<th>Available Units</th>
<th>Installed Capacity (MW)</th>
<th>Available Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nkula “A”</td>
<td>3</td>
<td>3</td>
<td>35.10</td>
<td>35.10</td>
</tr>
<tr>
<td>Nkula “B”</td>
<td>5</td>
<td>5</td>
<td>100.00</td>
<td>100.00</td>
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<tr>
<td>Tedzani I&amp;II</td>
<td>4</td>
<td>4</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Tedzani III</td>
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<td>2</td>
<td>62.00</td>
<td>55.00</td>
</tr>
<tr>
<td>Tedzani IV</td>
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<td>1</td>
<td>19.10</td>
<td>19.10</td>
</tr>
<tr>
<td>Kapichira I&amp;II</td>
<td>4</td>
<td>0</td>
<td>129.60</td>
<td>0.00</td>
</tr>
<tr>
<td>Wovwe</td>
<td>3</td>
<td>2</td>
<td>4.35</td>
<td>2.90</td>
</tr>
<tr>
<td><strong>SUB TOTAL</strong></td>
<td><strong>22</strong></td>
<td><strong>17</strong></td>
<td><strong>390.15</strong></td>
<td><strong>249.10</strong></td>
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<table>
<thead>
<tr>
<th>Station – Thermal</th>
<th>Installed Units</th>
<th>Available Units</th>
<th>Installed Capacity (MW)</th>
<th>Available Capacity (MW)</th>
</tr>
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<tr>
<td>Lilongwe “A” (Diesels)</td>
<td>3</td>
<td>3</td>
<td>5.40</td>
<td>0.00</td>
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<tr>
<td>Kanengo Phase 1 (Diesels)</td>
<td>5</td>
<td>1</td>
<td>10.00</td>
<td>0.00</td>
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<td>Kanengo Phase 2 (Diesels)</td>
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<td>10.00</td>
<td>1.60</td>
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<tr>
<td>Luwinga (Diesels)</td>
<td>3</td>
<td>0</td>
<td>6.00</td>
<td>0.00</td>
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<tr>
<td>Mapanga (Diesels)</td>
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<td>6</td>
<td>20.00</td>
<td>9.60</td>
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<tr>
<td>Likoma (Diesels)</td>
<td>2</td>
<td>2</td>
<td>1.17</td>
<td>1.17</td>
</tr>
<tr>
<td>Chizumulu (Diesels)</td>
<td>2</td>
<td>2</td>
<td>0.66</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>SUB TOTAL</strong></td>
<td><strong>30</strong></td>
<td><strong>11</strong></td>
<td><strong>53.22</strong></td>
<td><strong>13.02</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Station – Solar</th>
<th>Installed Units</th>
<th>Available Units</th>
<th>Installed Capacity (MW)</th>
<th>Available Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likoma</td>
<td>1</td>
<td>1</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Chizumulu</td>
<td>1</td>
<td>1</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>SUB TOTAL</strong></td>
<td><strong>2</strong></td>
<td><strong>2</strong></td>
<td><strong>1.30</strong></td>
<td><strong>1.30</strong></td>
</tr>
</tbody>
</table>

TOTAL 54 30 444.67 263.42

Source: Government of Malawi (Malawi Economic Annual Report, 2021)
Before April 2022, the country had hired some diesel-operated generators located in the major cities of Blantyre, Lilongwe, and Mzuzu, which had a total installed capacity of 78 MW, that were supposed to be used during peak demand periods to avoid load shedding. However, sometimes these were used continuously during periods of outages of the hydropower generation plants. These diesel generators, which were hired from Aggreko, have been decommissioned because of high operating costs.

EGENCO is operating a total of 1.3 MW solar generated power plants at Likoma and Chizumulu Islands on Lake Malawi. These solar power plants are operated as hybrids, as they are also connected with 1.83 MW diesel back up, and are operated as mini grids on each island.

The country has three Independent Power Producers (IPP) operating mini hydropower and Solar Power Plants. There are two mini-hydropower plants in Mulanje District, one constructed and operated by Mulanje Hydro Limited with an installed capacity of 8.2 MW, and the other by Cedar Energy Limited with an installed capacity of 3.2 MW. The IPPs have Power Purchase Agreements with the Single Buyer company. The power station by Mulanje Hydro Limited is located across the confluence of the Ruo River and its tributary, the Ndiza River; hence, the power station is known as “Ruo–Ndiza Hydroelectric Power Station”.

The other operational IPP is JCM, which is operating the 60 MW Salima Solar Power Plant and 20 MW Golomoti Solar Power Plant. Serengeti Energy is another IPP that is constructing a 20 MW Solar Power Plant in Nkhotakota that may be operational before the end of 2022. Serengeti Energy has also been given a greenlight by Power Market Limited (PML) to develop a 16.9 MW phase 2 Solar Power Plant in Nkhotakota, which will include battery storage for grid stability purposes.

With the power supply and demand gap growing, the Integrated Resource Plan (IRP) has listed priority projects that need to be implemented quickly if this gap is to be bridged. Mpatamanga Hydropower (350 MW) and solar power generation (about 40 MW) have been listed as priority projects.

c. Current State of Non-Power Energy (Cooking)

Malawi’s terrestrial ecosystems comprise forests, mountains, and grasslands. The country has eighty-seven forest reserves, five national parks, four wildlife reserves, and three nature sanctuaries that were established to protect important wildlife populations, major water catchment areas, and landscapes of high aesthetic value and to preserve them for scientific and recreational uses. The greatest threat to biodiversity in Malawi is the unprecedented loss of habitats, fragmentation of species habitats, and isolation of remaining communities due to unsustainable land use practices. Agriculture, urbanization, infrastructure development, and human settlements are the major drivers of habitat loss and fragmentation in Malawi. The agriculture sector has been embroiled in the continuous cultivation of land in wetlands and riverbanks, encroachment into protected areas, and cultivation on mountain slopes.

In Malawi, according to the Malawi Fifth Integrated Household Survey (IHS5) 2019-2020, 98.8 percent of households were using solid fuels as the main fuel for cooking. The use of charcoal multiplies by seven times the number of trees required to produce 1 tonne of charcoal. This process has resulted in wanton tree cutting, resulting in deforestation and forest degradation. Further, deforestation has negatively influenced land degradation due to soil erosion. Annually, an estimated 0.6 to 1 percent of forest cover is lost, largely due to tree cutting to provide charcoal and firewood. This is directly undermining agricultural productivity, food and water security, and is negatively impacting hydropower generation capacity, while making the country vulnerable to climate shocks, and limiting its social, economic, and industrial development. The loss of forest cover also induces prolonged droughts and enhances the processes of climate change. Over the years, it has also led to a significant increase in ambient temperature, resulting in making conditions uncomfortable for human habitation.

Similarly, the overdependence on traditional biomass (wood and charcoal) as fuels to meet the
country’s growing energy needs are threatening Malawi’s climate as forest resources, which act as carbon sinks, are being depleted. These important concerns are reflected in the choice of mitigation measures outlined in Malawi’s Nationally Determined Contributions (NDCs).

In order to reduce deforestation and forest degradation, the Government of Malawi Energy Compact, several non-governmental organizations (NGO), and the private sector have proposed the use of electricity, liquefied petroleum gas (LPG), biogas, briquettes and pellets among others, as alternative sources of energy for cooking, along with the adoption of energy-efficient cookstoves. This is a decarbonization process, whereby the use of charcoal and firewood is being reduced. The climate impacts of cutting down trees for charcoal making has been flooding of rivers, siltation of the hydropower ponds, and extended dry spells which, in turn, have reduced water flow out of Lake Malawi into the Shire River for hydropower generation, as well as water supply to Blantyre City.

d. Current State of Power Sector and Impact/Relevance of Issues to Climate

The Government of Malawi has taken important steps in recent years to open its generation sector to private sector participation as IPPs. This is part of its decarbonization agenda as outlined in the IRP 2017 - particularly in solar and hydro power. To date, there are signed Power Purchase Agreement (PPAs) with IPPs for solar generation amounting to 216 MW. The World Bank is supporting the Government of Malawi to develop the 350 MW Mpatamanga Hydropower plant. This project is being developed as a Public Private Partnership (PPP) with International Finance Corporation (IFC) as a co-developer in the project. The project is estimated to cost approximately US$1.1 billion, with the World Bank contributing US$300 million in concessional funding and US$200 million as IDA guarantee to leverage the US$600 million private finance. In addition, IPPs for three grid-connected solar PV projects are underway with participation by IFC and MIGA, of which the 60 MW Salima power project has been commissioned, and the 20 MW Golomoti solar power project with 5 MW of battery energy storage has also been commissioned.

Due to the limited availability of financing and the challenges in securing financing for capital projects for developing countries, Malawi’s energy sector development has been largely driven for years by least cost considerations. In this regard, the plans and policies that have been implemented in the past have largely been meant to see the energy sector develop on a trajectory that was mainly based on affordability, above all other considerations. Development of the sector has, therefore, tended to be concentrated within the tried, tested, and traditional forms of power generation, with hydropower taking center stage as the main power generation source for the country’s power system development trajectory. Hydropower today represents 75 percent of the generation mix.

Despite the outlined initiatives above and interventions to improve and grow Malawi’s electricity sector, the sector has been and continues to be highly impacted by climate change. Malawi has experienced an increase in the frequency, intensity, and magnitude of extreme weather events over the past two decades. The country is particularly vulnerable to floods, droughts, and strong winds associated with tropical cyclones. The country has experienced more than 19 major flooding events and 7 droughts over the past five decades. In 2015, the country was affected by the worst floods in 50 years; affecting over 1 million people, displacing 230,000 people, and killing 106 people, with another 172 people reported missing. In January 2022, the country lost 129.60 MW of base power due to damage caused to the Kapichira Hydropower Plant by Tropical Storm Ana.

Environmental degradation and climate change have emerged as major development issues that have adversely affected food security, water quality and energy security, thereby frustrating government efforts to improve the general livelihoods of both urban and rural communities. This impact is especially significant on the country’s existing hydropower stations, the majority of which are located in a cascade on the Shire River, which sits in a watershed that is increasingly under pressure from deforestation and forest degradation. In 2010, Malawi had 1.39 Mha of natural forest, extending
over 12 percent of its land area. In 2021, it lost 14.7 Kha of natural forest, equivalent to 5.21 Mt of CO₂ emissions. Both climate and human activity pressures have resulted in the performance of the run-of-river hydropower plants, which make up 75 percent of the country’s grid capacity, being greatly reduced over the years. The climate change impacts include some major climate-related flood events that have, on more than one occasion, extensively damaged the hydropower plants. The floods rendered the power plants inoperable for considerable lengths of time whilst repairs were underway, at a high direct and indirect cost to the economy (loss of revenue by the utilities, and loss of production by the industry and other consumers due to reduced power production).

e. Power Shortfall makes Electric/Clean Cooking a Challenge

The current power demand and supply deficit, which is resulting in prolonged load shedding of up to eight to ten hours a day, is posing a big challenge for clean cooking initiatives that are targeting to reduce the use of electricity in Malawi.

Prolonged droughts due to the effect of climate change have also negatively affected hydropower production in the country. The water flow out of Lake Malawi into the Shire River reduces to low levels, that are inadequate to generate enough power from the installed power generation facilities. The impact of these climate change induced droughts means that the power utility has to load shed a significant number of both industrial customers and households. In 2017/2018, hydropower generation dropped by about 28 percent due to low water levels in Lake Malawi, and subsequent reduced water flows in Shire River resulting in frequent and extended load shedding programs that lasted more around ten hours. During this period, the peak supply shortfall was estimated at 135 MW – approximately 40 percent of peak demand. Despite the high precipitation rate over the lake, water evaporation is also contributing to low lake levels during years of drought caused by deforestation of the catchment areas. In 2022, Tropical Storm Ana had destroyed the intake dam structure of Kapichira power plant, removing 129.60 MW from the grid. This is hampering efforts focused on clean cooking initiatives – meaning that a lot of domestic users are resorting again to firewood and charcoal for their daily thermal energy requirements.
2. Adaptation, Mitigation and Resilience Measures

a. Institutional, Regulatory and Policy framework

The constraints and challenges forced upon the energy sector by climate change have, in recent years, forced the Government of Malawi to rethink its approach to both power sector development and the building back better measures of existing power infrastructure for climate change adaptation and resilience.

This change in thinking – to make the sector more adaptive and resilient to climate change - has resulted in the promulgation of four strategic interventions. First was the formulation of new policies and strategies as contained in the revised National Energy Policy (2018), which is the main guiding document for the sector. The revised Energy Policy has included policy interventions to not only encourage preservation of the environment and thus reduce climate impacts on the energy sector infrastructure, but also focus attention on the development of renewable energy and cutting down on fossil fuels’ usage for energy production. Such policy interventions include accelerating the transition to clean cooking solutions and reducing pressure on fast depleting biomass-based fuel sources - whose depletion was linked to degradation in land conditions, thereby increasing the risk of flash floods and sediment transport that was adversely affecting the operation costs and efficiency of hydropower plants.

Second was the development of other strategies such as the Integrated Resource Plan (IRP), National Electrification Strategy (NES), Malawi Renewable Energy Strategy (MRES) 2017, the National Charcoal Strategy (2017 – 2027) and Sustainable Energy for All (SEforALL) Action Agenda 2017 - all of which have already been formulated and adopted by the Government.

Third was the revision and complete overhaul of the energy sector building standards for both existing and future energy development, with the intention of building back better existing energy infrastructure that would better withstand climate impacts, as well as building future infrastructure to much higher standards than before. For example, transmission lines have migrated from the use of wooden poles to lattice steel pylon and recently to round concrete structures that can withstand the wind speeds and storms generated by tropical cyclones.

Fourth was the promulgation of the Malawi Vision 2063 document. In January 2022, Malawi launched the Vision 2063 (MW2063) that aims at transforming the country into a wealthy and self-reliant industrialized ‘upper middle-income country’ by the year 2063. MW2063 is anchored on three key pillars, namely: Agriculture Productivity and Commercialization; Industrialization; and Urbanization. Energy development has been identified as one of the key elements required to support all the three key pillars of MW2063; without adequate and affordable energy, mainly in the form of electricity, achievement of Vision 2063 through the identified three key pillars would not be possible. Development of climate adaptive and resilient electricity infrastructure is thus a critical factor in Vision 2063 (developed economic infrastructure), that needs a special focus in order for it to be realized.

The first and second strategies were to be supported by changes in policy, moving away from the business-as-usual approach and paying attention to the key and pivotal role that climate change was playing and was expected to continue to play in the growth of the energy sector moving forward.

b. Government Commitments – NDCs, SEforALL Action Agenda

The Government of Malawi has formulated and made very clear commitments on programs to combat climate change through the NDC, which has clear strategies on adaptation and mitigation measures to climate change. The commitment has also stipulated unconditional as well as conditional financing of
the laid down strategies, including the listing of interventions and stakeholders of each intervention. The Government has further committed that future sector annual budgets should include strategies laid down in the NDC for implementation.

For the energy sector, it is clear that the use of renewable energy as part of the decarbonization process should be promoted. This will have a very positive impact - from the current 2.34MtCO2e contribution from the energy sector out of the national total for Malawi of 9.33MtCO2e, in 2040 the sector’s contribution will only increase to 6.9MtCO2e out of the total of 17.7MtCO2e for Malawi. Nationally, the reduction will be 51 percent. If it were not for the NDC commitments, nationally the country was to produce 34.6MtCO2e of GHG emissions (see Table 3 below). From the table, it can be seen that, with only domestic contributions, the emission reduction is 6 percent, while with NDCs the emission reduction is 51 percent.

### Table 3. NDC Emission Reduction Scenarios Against BAU (excl. FOLU)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2017 MtCO2e</th>
<th>2020 MtCO2e</th>
<th>2030 MtCO2e</th>
<th>2040 MtCO2e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business-as-Usual (BAU)</td>
<td>9.33</td>
<td>10.71</td>
<td>19.25</td>
<td>34.61</td>
</tr>
<tr>
<td>Domestic Contributions</td>
<td>9.33</td>
<td>10.70</td>
<td>18.07</td>
<td>32.56</td>
</tr>
<tr>
<td>All Nationally Determined Contributions (NDC)</td>
<td>9.33</td>
<td>10.68</td>
<td>12.78</td>
<td>16.92</td>
</tr>
</tbody>
</table>

Source: Malawi Government (Updated National Determined Contribution Report) 2020

In addition to NDC commitments, the Government of Malawi has also committed to implement the SEforALL Agenda. Under the program, the Government had planned to distribute 2 million energy-efficient stoves by 2020 supported by the Irish Government, and this was achieved by October 2020. The Government also planned a national stoves program to promote energy-efficient stoves in order to reduce the impact of the use of firewood and charcoal, which is contributing to the deforestation of natural forests, which significantly contributes to the effect of climate change. To this end, Malawi has developed the SDG 7 Cleaner Cooking Energy Compact under the SEforALL Agenda under which, among other things, the country intends to roll out 5 million efficient cookstoves, 135,000 electric cookers, and 54,000 LPG stoves by 2030. Malawi was selected as a Global Theme Champion on Energy Access for the high-level Dialogue on Energy, following the achievement of rolling out 2 million energy-efficient cookstoves by 2020.

c. Adaptation Measures

i. Adaptation of Energy Assets and Infrastructure

The policy and strategic interventions that have been undertaken in the energy sector for it to be better adaptive and resilient to the impacts of climate change have been anchored in the main energy assets and infrastructure strategies, as follows:

1. Energy Mix diversification: Exploitation of alternative sources of renewable energy other than hydro, which has been and continues to be very negatively impacted by climate change. Such diversification includes the fuel source: (i) solar (already under use and under development by the private sector); (ii) wind (under planning for private sector development); (iii) biomass from agriculture waste (under planning for private sector development, for example, power generation from bagasse by Illovo Sugar); (iv) natural gas (under planning by both the State and the private sectors); and (v) geothermal (under planning by the Government in partnership with the private sector).
2. Location diversification: Spread development of hydropower by moving away from focus on one river cascade to reduce negative impacts. Plans were underway to diversify hydropower away from the Shire River cascade to other sites in the center and north of Malawi (Bua, Rukuru, or Songwe).

3. Design changes for both existing and future infrastructure: Mainly focused on hydropower and power transmission and distribution infrastructure. For hydropower - machines would be designed to withstand low water quality; for transmission and distribution lines - the strategy would be shifting lines away from known and future projected flood plains, change in foundation design, and change in the design of the line structures to better withstand adverse weather conditions brought about by climate change.

4. Technology changes: Produce or adopt and adapt to new technologies for utilizing renewable sources of fuel that include the use of solar, wind, ethanol, biogas, natural gas, geothermal and other renewable types of fuel. The new technologies are likely to make redundant some of the older energy assets and infrastructure. The cost of these new technologies must be factored in as part of the climate change adaptation measures.

5. Power trading with other Southern African countries such as Mozambique with large hydropower generation plants will enable Malawi to not only increase variable renewable energy in the generation mix but also assist the country to decarbonize quickly.

ii. Adaptation of Households and Commercial Enterprises

The Malawi Government through the NDCs has made a strategic Climate Change Adaptation decision to switch fuels used by households for thermal requirements to cleaner and environmentally friendly fuels. According to the SEforALL, the country can use a number of fuel types that are available. As part of the strategic adaptation measures, Malawi has proposed the use of electricity, LPG, biogas, briquettes, and pellets as alternatives to firewood and charcoal. At the same time, the government also recognizes that biomass will remain the primary source of energy for the foreseeable future - hence, it promotes its sustainable production and efficient use. This strategic adaptation measure requires the creation of a policy and regulatory framework that provides an enabling environment for the adoption of these clean cooking solutions. These new household fuels require the development of new promotional strategies, propelled by commercial enterprises creating a critical mass of consumers in densely populated townships and villages, along with the appropriate household cooking technologies.

Malawi’s commercial enterprises must employ adaptation measures in support of these strategic decisions by the Government. Those that are using greenhouse gas emitting fuels need to switch to cleaner alternatives. For example, a number of commercial enterprises are using diesel generators to run their businesses, when grid electricity is not available. As a part of technological adaptation requirements, the country must explore ways of bringing in ethanol generators for use when grid electricity has problems. Renewable energy-powered solutions through programs that are supporting adaptation measures for climate change deliberately should be promoted, as stipulated in the NDC action programs.

iii. Cost of Transition to Households and Commercial Entities

The adaptation measures presented in this report will require initial capitalization on concessional terms. This will require the use of both unconditional and conditional financing, as defined in the NDC (page 27). The financing arrangements will be part of the environmental protection costs to promote fuel switching from biomass-based and fossil fuels to renewable energy fuel sources such as solar, wind, fuel ethanol, biogas, and natural gas. The cost of transition to environmentally friendly fuels for household use, as well as the commercialization process of stocking the fuels and the new technologies to use the fuels, should employ special financing arrangements.
As part of implementing the NDCs, the Government should identify commercial enterprises through a transparent process based on their potential to stock and market both the fuel and the new environmentally friendly technologies. For households, this will be in strategic locations, both rural and densely populated townships in urban centers, while for commercial enterprises, a targeted approach will be employed. The identified entrepreneurs shall undergo commercialization training. Old assets, which commercial enterprises are using, will transition out as new environmentally friendly technologies are used. Training of operators of commercial enterprises will be conducted on both fuel switching and technology usage. This arrangement would ensure that enterprise owners are not continuing to use old assets instead of new and green technologies.

d. Mitigation Measures

i. Decarbonization of the Sector

It is obvious that, as the country continues to develop, electricity demand will also continue to grow. According to the demand forecast in the IRP report and as reported in Section 1 of this report, the annual average growth rates were 17.5 percent from 2017 to 2020 (reflecting suppressed demand in its various forms) and 10 percent per annum from 2020 to 2030 (including the elimination of suppressed demand). This compares with annual average growth rates of maximum demand over a period from 2010 to 2015 of 4.2 percent per annum. Currently, ESCOM is load shedding due to inadequate electricity supply. The government, the Single Buyer Company and private investors are considering run-of-river hydro, hydro reservoir, solar, wind, coal, and gas as generation expansion options, as well as interconnection with neighboring countries including Mozambique, Tanzania, and Zambia. Scenario projections of the energy mix are pointing to the fact that coal for base power generation need to be introduced for Malawi’s grid expansion; hence, the inclusion of coal in the supply options. However, there is a need for the country to consider that building coal plants is risky, as most coal plants globally are likely going to be affected by early retirement within the next 20 years due to falling renewable costs, decarbonization requirements, and carbon pricing. Further, Malawi will need to import coal for electricity generation since the country has lignite coal, which is not an optimal fuel due to its low energy content that causes inefficient burning. Of course, there are plans to use both local lignite and to import higher quality coal, varying between IPPs and EGENC0.

In view of the impact that the use of coal for power generation could have on carbon emissions, the first part of the analysis on decarbonization of the power sector in Malawi will focus on power generation mix available to the country, based on the Government of Malawi’s planning process that was done with technical support from the Rocky Mountain Institute (RMI). The second part of the analysis has also considered the impact of interconnecting the Malawi power system with that of the Southern African Power Pool (SAPP). This is so because the use of coal is predominant in SAPP, especially in South Africa, Botswana, and Zimbabwe.

Malawi produced the IRP 2017 in which various energy resources were assessed, demand projections made, as well as supply options assessed. In this section of the report, the analysis has focused on the generation mix from the IRP as presented in the draft Malawi Integrated Generation Model of January 2022, done with technical support from RMI.

The modeling comes up with three scenarios as follows: Generation Mix 1, Generation Mix 2 and ESCOM Generation Mix. Results of the analysis of the three-generation mixtures are presented in Figure 1 below. Here, it is shown that Generation Mix 1 scenario has maintained diesel generators and has introduced solar and the power Interconnector to SAPP in 2022 and progresses to introduce wind energy in 2023, as well as hydro storage in 2023. These are the dominant technologies up to 2030 to meet the projected energy demand growth for Malawi.
Figure 1. Generation Mix Scenarios

Generation Mix 1 Installed Capacity (MW)

Generation Mix 2 Installed Capacity (MW)
Generation Mix 2 scenario has introduced coal power generation in 2023, and the hydro storage is dominant in the generation mix. Generation Mix 2 scenario has removed the SAPP Interconnector, solar and wind. Demand has been dwarfed to 2,500MW-installed capacity compared to 3500MW-installed capacity for Generation Mix 1.

On the other hand, ESCOM Generation Mix has also maintained diesel generation, and has introduced coal power generation, solar, Interconnector and geothermal in 2023. This scenario has eliminated wind in the generation mix.

These three generation mixtures have implications on both carbon emissions and capital cost, as is elaborated in the sections ahead.

In terms of annual carbon emission in billion tonnes of CO₂ eq, Generation Mix 1 has the lowest while the ESCOM Generation Mix has the highest and Generation Mix 2 is in the middle (see Figure 2). From Figure 2, it is very clear that the dominance of renewable energy in Generation Mix 1 means less carbon emissions compared to the introduction of coal fired power generation in Generation Mix 2 and ESCOM Generation Mix. The results of the IRP modelling have major implications in terms of decarbonization policies in Malawi.

In terms of Capital Expenditures and Operating Expenditures, the trend is maintained for Generation Mix 1, which has the lowest (US$3.5 billion Capex and US$4 billion Opex) while ESCOM Generation Mix has the highest capital expenditure (over US$8 billion) as well as operating expenses (US$9 billion). This wide disparity can be attributed to the dominance of the use of imported coal in both Generation Mix 2 and ESCOM Generation Mix.
Figure 2. Power Generation in 2030 Vs Annual Carbon Emissions

Source: GoM (IRP Modelling) 2022
To demonstrate whether a renewable-heavy grid could meet demand requirements at cost-competitive levels, or if coal is indeed the least cost option over a 25- to 30-year period, the modeling of generation expansion options further looked at output estimates cost, grid reliability impacts, and the resilience of various grid mixes to changing river levels and different demand projections. The modeling highlighted that generation mix with hydro and renewables - solar, wind and storage - offers a similar net present value to a grid with hydro, natural gas, and coal up to 2030 as shown in Figure 3 below.

**Figure 3. Power Generation Installed Capacity in 2030**

Further, the modeling showed that a renewable-heavy grid in Malawi can reliably meet peak demand and overall energy needs, and that supply can be balanced by having hydro reservoirs in the system, as reservoirs can be flexibly operated. However, solar and wind should be built incrementally to allow adaptability to changing scenarios. Interconnections with neighboring countries will play a critical role through electricity imports to mitigate seasonality effects, or climate impacts due to decreased water levels.

The Malawi Energy Generation mix analysis notwithstanding, the second part of the analysis has looked at the impact of power interconnection with SAPP in order to assess the impact that the use of coal in SADC countries would have on the carbon footprint in Malawi.

According to the SAPP scenario projections that were done in January 2022, an annual demand growth rate of 2017 estimated at 3 percent was used and the peak demand was projected to continue the growth trajectory. To meet the forecasted demand growth for Malawi and make the country a strong participant in the decarbonization pathways in the SAPP region, a number of scenario projections were made as shown in Figure 4 below. Three scenarios were presented: Generation Scenario S1 ET0, S1 ET4 and S2 ET4.

For each scenario, emission projections were calculated and presented for purposes of comparison. Capital requirements were also presented both at the SAPP level and for Malawi. The analysis in this report has concentrated on the generation mix that would contribute to the decarbonization process in Malawi as a SAPP participant.
Figure 5 presents the evolution of the generation mix in Malawi when the country is connected to the SAPP under a SAPP decarbonization pathway, envisaging a generation mix comprising of coal, fuel oil, water (hydro), solar (PV), and onshore wind. In the generation mix of S1 ET0, hydropower dominates and coal has to be introduced to meet the demand growth. The same trend is seen in the capacity requirements. However, in the decarbonization scenario S1 ET4, coal is expected to diminish, Solar PV is introduced and becomes a dominant energy source, and onshore wind power is also introduced to meet the demand growth up to 2040.

In terms of capacity, Solar PV and, to some extent, onshore wind is expected to increase significantly as can be seen in Figure 5 below. In the decarbonization scenario S2 ET4, however, wind does not feature, and hydropower is significantly increased, thereby reducing coal usage. Solar PV remains a significant source of power for Malawi in terms of both generation and capacity requirements. This will reduce the carbon footprint for the country.
It is clear from Figure 5 that, for Malawi to meet its projected power demand, coal power generation was supposed to be introduced in 2022 in all scenarios that have been assessed. In the analysis, the SAPP decarbonization pathway of Scenario S1 ET4 and S2 ET4, coal power plants would be completely decommissioned in the country by 2036. This means that, by 2040, the dominant sources of power generation will be renewable energy comprising of hydropower, solar, and onshore wind for Scenario S1 ET4, and hydropower and solar only for Scenario S2 ET4.

The Generation Mix presented under the three different scenarios would result in different emission reductions in SAPP and Malawi (see Figure 6 for SAPP and Figure 7 for Malawi) and different capital requirements for Malawi as shown in Figure 8 below.
As the carbon constraint becomes more stringent in SAPP, emissions in Malawi will reduce along with lower utilization of the coal power plants. In the deep decarbonization scenarios (80 percent, ET4), Malawi will not generate any emissions after 2037 (Malawi decarbonizes early from the rest of the SAPP as it is less expensive to do so in the country than in others).
With increased regional integration, even without emission constraint, investment increases significantly after 2037. The carbon constraints frontload capital needs (before 2030). The additional investment needs to reach 80 percent decarbonization level is US$2billion when the network is fully integrated (S2) and US$3billion when the trade is restricted in the base network (S1).

In summary, it can be said that both the SAPP decarbonization pathway and the Malawi Integrated Generation model are pointing to one conclusion. This conclusion is that, in order to optimize the carbon emission reduction as part of the National Determined Contributions to combat climate change, the country should pursue policies that would allow a power generation mix with multiple sources focusing on Variable Renewable Energy sources. However, coal should be considered to be part of the Generation Mix.

Policy recommendations for the decarbonization pathways in Malawi should include, among others, the following issues:

- In order to allow accelerated electricity connectivity of the population and meet growing demands, Malawi should adopt the off-grid solar installations as one of the key intervention strategies in the sector;

- In order to provide base load, which would enable uptake of variable renewable energy power generation in the Generation Mix, hydropower potential, which include damming of sites, should be developed. Mitigation measures to control flooding of rivers should be included in Climate Change Adaptation measures;

- Development of coal powered generation plants in Malawi should be implemented using clean coal technologies since future power demand can only be met if coal power generation is part of the National Generation Mix;
• Interconnecting the Malawi Power system with SAPP is part of the solution in meeting future power demands for Malawi and should always be considered as part of the National Generation Mix and decarbonization pathways;

• In the short- to medium-term, diesel generators will remain in the Generation Mix for capacity purposes and to ensure that the system reserve is maintained;

• In planning all power generation activities in Malawi, it should always be understood that climate change is real and mitigation and adaptation measures should guide policies and strategies for the sector;

• As Malawi updates its IRP (due for revision in 2022), the findings from the modelling should be seriously considered to embrace a sustainable decarbonization development pathway. The starting point should be to assess the demand, as today’s unmet demand and future demand growth are estimated. Development partners have a key role to play in building capacity in the ministry responsible for energy and its agencies to assess the demand and review the IRP;

• ESCOM as transmission and distribution licensee should strongly consider absorbing medium-sized renewable projects to leverage the fast-paced deployment and modularity benefits. ESCOM should also strongly consider strengthening the grid, as increased renewables require more power transmission and more sophisticated grid balancing controls and infrastructure; and

• There are strong signals that competitive procurement of renewables via energy auctions will unlock swift renewable project deployment. The critical enabler in this pathway for renewables adoption will also be development partners’ support in capacity building to fast-track the design and implementation of the auctions.

ii. IRP – Focus on Renewables, Priority Projects, Focus on Greening the Generation Mix

Renewable energy will drive Malawi towards a modernized, reliable, and low-cost grid that meets the economic development objectives of the country, as stipulated in the Malawi Vision 2063, while decarbonizing the electricity sector. Malawi is well endowed with renewable energy resources which include hydro (over 1200 MW), wind (about 800 MW), geothermal (30 MW based on preliminary studies but could be more) and solar (21MJ/m²/day on average), among others.8 The Government of Malawi intends to increase the share of renewable in the electricity mix to 80 percent by 2030, and to reach 500 MW of renewable power generation by 2025.9

In view of the foregoing, the Government has signed PPAs on solar technologies with IPPs totaling 216 MW and on wind totaling 50 MW. Other PPAs on wind totaling about 152 MW are at an advanced stage of finalization. Between 2016 and 2022, the Government has signed MoUs on solar technology with IPPs totaling about 2,800 MW; wind totaling 366 MW; and 350 MW on geothermal. This well illustrates the potential of renewable energy development in the country which is on the pathway to decarbonizing the electricity sector. The fact that much of the infrastructure is yet to be built means that the country has an opportunity to leapfrog to climate technologies, that is, technologies that reduce emission of greenhouse gases.

iii Retirement of Diesels

Until April 2022, ESCOM had a PPA with an IPP for peaking diesel power generation with an installed capacity of 78 MW. EGENCO also has emergency diesel generators with a total installed capacity of 53.22 MW. These generators proved to be too expensive not only to ESCOM, but to the country as a whole. Paying for electricity from these diesel generators negatively affected ESCOM’s financial position.
Although the total annual share of diesel generation in Malawi is quite low, almost half of the total system costs, that includes fixed and variable operational and maintenance costs, come from fuel costs. The review of the IRP, which is underway, foresees a significant level of new renewable sources with the objective of replacing the diesel generators with more competitive technologies - thus, reducing the total system costs and answering the global call for phasing out fossil fuels. This will displace the traditional thermal generation in the country’s current Integrated Resource Plan, and directly impact vulnerable populations in a country that has just 12.4 percent access to the national electricity grid.

A recent rapid cost benefit analysis done by the Government of Malawi, in collaboration with the Global Energy Alliance for People and Planet (GEAPP), has shown that a quick replacement of the diesel generators in the country could be possible, with optimal deployment of grid-integrated battery energy storage systems (BESS). In the recent decade, BESS has been constantly developing, increasing its technical capabilities on one side, and decreasing its costs on the other. With an increase of solar PV penetration with inflexible generation pattern, the role of BESS becomes crucial. Just like for solar PV cost projections, several research papers have been published with a goal to properly estimate investment costs for BESS, which would further facilitate strategic planning activities towards a clean energy future.

The rapid cost benefit analysis recommended solar PV + BESS with a four-hour BESS that can provide sufficient firm capacity which will together with hydro units ensure sufficient reserve margin. However, this needs to be ascertained with a comprehensive modelling that will investigate costs and all benefits - the results of which should inform the revision of the IRP.

Currently, there is one BESS at Golomoti tied to a solar PV power plant, 10MWh in size with 5 MW maximum power which is undergoing commissioning tests. Another BESS is conceived to be connected in 2023, which is 240MWh in size with 60 MW maximum power.

**iv) Enabling Environment (Policy and Fiscal Framework to Attract Private Sector Participation)**

Malawi should enact relevant legislation to ensure the unbundling of ESCOM and attract private sector participation in the generation segment. This will result in an increased generation capacity that is required to meet the country’s power needs. In line with this policy, the Government of Malawi, with support from MCC, amended the Electricity Act of 2004 to, among other things, allow private sector participation in the electricity sector and enable the restructuring of the sector. As mentioned earlier, this resulted in the carving out of the generation function from ESCOM and the creation of EGENCO as a SOE responsible for generation of electricity. ESCOM was given the transmission and distribution functions. It also assumed the functions of System and Market Operator (SMO) and Single Buyer (SB). The Government later, in 2018, unbundled ESCOM further by taking out the SB function and creating another SOE, Power Market Limited (PML) as SB.

The unbundling of ESCOM as a vertically integrated SOE created an enabling environment for private sector participation in the electricity sector to complement the Government’s and EGENCO’s efforts in increasing power generation capacity in the country. The Government has signed over 80 MoUs with potential IPPs owing to the unbundling of ESCOM. The private sector can invest as IPPs or through Public-Private Partnership (PPP) financing model. There is room for investment in hydro, solar, wind, waste-to-energy, geothermal, gas, and other technologies.

The Government, also with support from MCC, developed the IRP to prepare a least-cost investment plan in generation, transmission, and demand-side covering a 20-year period, that is, 2017 to 2037. The generation projects are for development by EGENCO or by IPPs with long-term contracts with PML. In addition to the IRP, the Government also developed the Independent Power Producer (IPP) Framework to establish a clear, robust process for securing investment in the power sector that well
balances the interests of consumers for cost-effective, reliable power supply with the commercial interests of private investors. The IPP Framework forms part of the power market restructuring to level the playing field for IPPs. The Framework provides information on the roles and responsibilities and structures for procurement processes that are relevant to IPPs that are considering investments in the country. It also covers step-by-step IPP procurement processes for both solicited and unsolicited IPPs. Just like the IRP, the IPP Framework is also undergoing review.

According to the IPP Framework, investors are supposed to submit their expressions of interest (EoIs) for investment in the electricity sector to the Single Buyer, that is, PML. The IPPs are free to, first of all, approach the Ministry of Energy or the Malawi Investment and Trade Centre (MITC) for guidance before submitting their EoIs to PML. The Ministry of Finance in collaboration with MITC can provide to investors sovereign guarantees and/or incentives in form of tax- and duty-free waivers. The power industry in Malawi is categorized as a Priority Industry, hence the provision of incentives.

v) Energy Efficiency (Building Designs, Conversion of Manufacturing Processes)

The National Energy Policy has noted that there is currently a lot of wastage of electrical energy and biomass energy in buildings and end-use activities such as cooking, water, and space heating caused by use of inefficient appliances and devices. In this regard, the National Energy Policy has a whole chapter on Demand Side Management (DSM) outlining actions by various players including ESCOM, Government, customers, civil society organizations (CSOs), and the private sector.

Actions by ESCOM include the introduction of time of use tariffs. In this regard, ESCOM has set off peak tariffs at US$0.05 while peak demand tariffs are at US$0.14/kWh. ESCOM is also conducting energy audits to provide energy efficiency advice to industrial consumers, and installing energy efficient bulbs in industries and households to help consumers reduce their bills and the stress on overburdened utility systems. Among others, DSM actions for customers, according to the Energy Policy, are acceptance of the installation of load limiters in electric meters to prevent consumers from using more than a predetermined amount of electricity during peak periods. Other actions include the installation of roof-mounted solar water heaters, which will serve as an alternative source of energy for water heating, thereby, reducing the amount of electrical energy used for this purpose. Government actions include instituting appliance testing, labelling and standards, which will include minimum energy performance standards (MEPS); enforcing building codes on energy-efficiency requirements in the construction of new buildings; reducing or eliminating import duty and taxes on energy efficient products, and instituting mandatory energy audits and energy use reductions by large customers, among other actions. CSOs and the private sector will play a crucial role in programme design and management to assist government agencies and utilities with the structuring and implementation of energy efficiency initiatives and information dissemination and awareness-raising.

It should be mentioned that buildings are amongst the largest end-use sectors of energy use in the country. Improving energy efficiency in buildings can significantly reduce energy and carbon dioxide (CO2) emissions from the building sector with some broader environmental benefits. The Malawi Energy Regulatory Authority (MERA), with support from the Malawi Bureau of Standards (MBS), has developed building standards to promote energy efficiency in buildings. However, there is a lack of enforcement of these standards, since they are voluntary. Making these standards mandatory should be considered, with the National Construction Industry Council (NCIC) in collaboration with MBS enforcing them. It is recommended that Malawi should consider issuing Energy Certification of buildings as a key policy instrument for reducing energy consumption and improving energy performance of new and existing buildings.

According to the Malawi Energy Demand Assessment (MAED) Report prepared by the Ministry of Energy, the manufacturing industry is also one of the major consumers of electrical energy in the
country - some of the major consumers being sugar-producing, tobacco and textile companies, and water boards. The current electrical energy demand by the manufacturing industry is projected to increase by about ten times in 2030, according to the MAED Report. In view of this, the Government and ESCOM should consider instituting mandatory energy audits and energy use reductions in the manufacturing industry.

**vi) Transition from Current Uses (Charcoal)**

The Government, in the development of the National Energy Policy 2018, recognized that the most relevant challenges to the energy sector included “dependency on biomass energy from unsustainable sources; ...reliance on end-use devices with low energy efficiency; ... adverse impacts of the urban household energy mix on the environment and on health and safety”. These same issues have not only persisted but have worsened considerably as evidenced by the increase in the percentage of urban households using charcoal for cooking from 45 percent in 2011 to 76 percent in 2018. There has also been an increase in the number of commercial operations and institutions utilizing illegal and unsustainably produced charcoal (including poultry farms, hotels, etc.) and firewood (including prisons, schools, etc.).

As reported in the World Bank (2022) “Malawi Country Climate and Development Report (CCDR) Clean Cooking Sector Background Note”, it is quoted that according to the Malawi Fifth Integrated Household Survey (IHS5) 2019-2020, 98.8 percent of the households were using solid fuels as their main fuel for cooking. A higher proportion (79.1 percent) of households was using firewood, followed by 18.5 percent that were using charcoal and 1.2 percent electricity. By place of residence, a higher proportion (90.9 percent) of households in the rural areas was using firewood as a fuel for cooking, as compared to 18.9 percent of the households in the urban areas. About 75 percent of the households in the urban areas were using charcoal as their main fuel for cooking, compared to 7.5 percent of the households in the rural areas. Within this context, the demand for charcoal and firewood is driving deforestation and forest degradation in Malawi, and is undermining agricultural productivity and food security, water security, and hydroelectric generating capacity - leaving the country more vulnerable to climate shocks.

Prioritizing and addressing these unsustainably met cooking and heating energy demands, which are driving forest cover loss across the country, underlies the Government’s goal of defining a way to meet current and growing cooking and heating energy demands, while conserving and restoring forests, and the vital environmental services they provide. The demand by urban households for charcoal (primary driver) followed by commercial and institutional demands for charcoal and firewood (secondary drivers) is driving deforestation and forest degradation. This unsustainably met energy demand directly undermines agricultural productivity and food security, water security, and hydroelectric generating capacity - leaving the country more vulnerable to climate shocks. While recognizing that charcoal and firewood will continue to feature as sources of cooking and heating energy in the country, and recognizing that trees, charcoal, and firewood are renewable resources that can be managed sustainably, the Government seeks to address this challenge in order to slow and reverse the rate of deforestation and forest degradation. The Government specifically seeks to promote alternative cooking fuels and more efficient cookstoves to decrease pressure on forests by addressing urban household demand for illegal and unsustainably produced charcoal. It is estimated that households in Blantyre, Lilongwe, Mzuzu and Zomba consume more than 95 percent of the charcoal produced illegally and unsustainably in rural areas across the country. Alternative cooking fuels are also required for addressing institutional demands for firewood and charcoal (including prisons, military barracks, larger schools, hotels, and lodges).

Scaling-up the adoption of fuel-efficient, improved charcoal cookstoves (ICC), and sustainably produced charcoal will significantly contribute to a reduced rate of deforestation in the short- to medium-term. Additionally, fuel switching options such as electricity and alternative biomass (for example, pellets coupled with gasifiers) will help to significantly reduce pressure on the remaining...
forests and propel the country towards a greener, more sustainable, cleaner cooking and heating trajectory for the future.

However, development gains in both areas are based on the premise of a renewed commitment to regulating and enforcing restrictions on illegal charcoal production, transportation, and sale, in accordance with the amended Forestry Act. At present, most alternatives cannot compete with the artificially low price of illegal and unsustainably produced charcoal. The development gains are also premised on a mix of incentives and improved regulation required to foster private sector investment at a scale that will contribute to widespread adoption of efficient and/or fuel switch energy and technologies, especially for low-income households and institutions. The Government must play an active, supportive role if a large-scale transition to cleaner cooking is to succeed. This will necessarily include a mix of incentives (for example, tax relief and carbon finance resources) and improvements to the regulatory framework (for example, for licensing LPG distributors). This is expected to attract private sector investment at the scale needed to drive the transition, especially of low-income urban households and institutions that are currently dependent on inefficient cookstove technologies, and/or are using unsustainably harvested charcoal and firewood for their cooking and heating needs.

e. Resilience Measures

Just like in most low-income countries, the energy sector in Malawi is not impervious to disasters. For instance, energy infrastructure was significantly damaged due to Cyclone Idai in 2019, and Tropical Storm Ana in January 2022. The country needs to build disaster-resilient structures for electricity generation and distribution. The aspirational resilient growth path for the energy sector is anchored mainly in the design of energy infrastructure to better withstand climate shocks and support the same aspirations of reaching 50 percent electricity access by 2030. This would be achieved through building back better for existing infrastructure and enhanced climate sensitive designs for future infrastructure, as outlined in Strategy 3 under Section 3: Policies/Strategies for Climate Adaptation. This strategy is under consideration for energy infrastructure that was damaged by Tropical Storm Ana in the southern part of the country. Guidelines or standards for construction of disaster resilient power lines should be developed to be used for power lines in disaster-prone areas.

In addition to this, the other strategy for climate resilience is to have redundancy in the design and building of energy infrastructure. This is much more applicable in power transmission and distribution, where network loops feeding the same area are routed through different areas that would be unlikely to be impacted by adverse effects of climate variabilities at the same time or to the same extent as to cut off power or render power unreliable in any particular area. Building redundancy for resilience against climate shocks is much costlier than change in design; thus the strategy is a long-term intervention than an immediate quick-fix solution for climate resilience.

In Malawi, therefore, this strategy is part of the long-term network expansion plan that is guided by the IRP as the policy document. Examples of such climate resilience interventions implemented or under planning for the Malawi power network are as follows: first is the transmission line loops implemented for the City of Lilongwe under the MCC Compact; second is the planned Western Backbone Transmission Line from the Centre to the north of Malawi that was intended not only to increase the power transfer capacity to and from the North to the Centre and Southern Regions of Malawi, but also act as a second transmission line to complement the existing eastern transmission line along Lake Malawi. Beside these strategies, Malawi should diversify both the sources of power generation and the location of power plants. The country should move away from the Shire River and explore other power generation technologies.

The main cause of the damage to energy infrastructure at the time of Cyclone Idai was the trash that was carried along by the run-off, due to change in landscape use. There is need, therefore, to have strategies in place that are aimed at regaining and maintaining the natural regeneration
of the landscape to avoid these disastrous run-offs. This is a multi-stakeholder assignment – the major stakeholder being the Ministry responsible for Agriculture. There is a pressing need to review agricultural production technologies and practices in the Shire River catchments to promote best practices that can reduce soil erosion and run-off, and increase productivity on available land. Degraded forests and deforested areas should be restored, including stabilization of the river/stream banks through tree planting, and management and promotion of natural regeneration. Community forests or woodlots should be promoted through introduction of incentives for the area conserved. To prevent trash from clogging machines, there is a need to install trash booms at the hydropower ponds at Nkula, Tedzani, and Kapichira hydropower stations. This will render the power stations resilient to trash emanating from environmental degradation in the watershed.
3. Cost-Benefits of Decarbonization

a. Reduced Energy Expenditures, Reduced Energy Imports, Reduced Operating Costs

Decarbonization of the energy supply in Malawi will result in significant reduction in energy expenditure in a number of ways. First, the use of renewable energy such as solar, wind, and geothermal removes the cost of buying fuels such as diesel. This means that the country’s total energy expenditure will be reduced immediately. Second, the cost of the environmental damage will be eliminated in terms of sector contribution to GHG emissions. This tends to reduce the cost of cleaning the environment due to pollution resulting from carbon dioxide emissions. Third, sickness resulting from environmental pollution will be reduced. This means that by decarbonizing the energy supply systems, the sector will be contributing to the wellbeing of the population in Malawi.

Decarbonization will also reduce energy imports in that the country would not import power from neighboring countries if it can produce its own power by using naturally occurring renewable resources such as solar, wind, and geothermal. In addition, the import of diesel, heavy oil, or coal for power generation will be removed because solar, wind, and geothermal are supplied naturally, and are freely occurring. The reduction in import of fuel for energy production will mean that the country will dedicate its scarce financial resources to other sectors such as health and education.

In electricity generation, fuel supply can constitute a significant operating cost for the utility. Decarbonization will offer immediate benefits in that the operating costs of the power plants will be reduced by the use of solar, wind, and geothermal. The reduction in operating costs may result in reduction of electricity tariffs, which in the end would benefit the wider economy of the country. Decarbonization, therefore, would result in a number of financial benefits not only to utilities and electricity consumers, but also the overall economy of the country.

Clean cooking is a key climate mitigation measure of Malawi’s National Determined Contributions (NDCs), aligned with achieving the UN SDG 7 along with SDGs 1, 3, and 13. It is quoted (on Page One) that “...cooking with traditional stoves and fuels in Malawi has adverse impacts on health, gender, climate, the environment, employment, and society”.

The report has further stated that the negative impacts can be given a dollar value to quantify and estimate the costs associated without action in addressing access to clean cooking. The total cost of inaction on the clean cooking agenda in Malawi is estimated to be US$7.3 billion per year, stemming from the negative externalities for health, gender, and climate. The health impact is estimated at US$2.3 billion per year linked to deaths and disability-adjusted life years (DALYs) from household air pollution (HAP).

The gender impact associated with the time spent performing cooking-related tasks, such as fuel collection, cooking, and stove cleaning, and lost productivity is estimated at US$3.8 billion per year. The annual cost of inaction on climate and environment is estimated to be US$1.1 billion per year.
4. Link to World Bank Diagnostics


The climate change adaptation, mitigation and resilient strategies outlined in this Energy Background Note are fully linked to the World Bank Group (WBG) Country Partnership Strategy. For example, under the Country Partnership Framework, the WBG plans to strengthen Malawi’s early warning and disaster preparedness systems to mitigate the impact of worsening climate shocks. Since Cyclone Idai in 2019, the WBG has pivoted from disaster response to better anticipate, prepare for, and respond to natural disasters. The WBG further plans to assist the Government in ensuring that the country can take advantage of innovations in agricultural risk insurance financing and shock preparedness to mitigate the impacts of climate change.

In the Energy Sector, the Country Partnership Strategy has identified access to electricity, including from renewable sources, as an area of interest. It is envisaged that structural transformation and economic diversification hinge, in large part, on Malawi’s ability to improve access to electricity, including being connected to SAPP. It is strongly believed that access to electricity would provide an alternative source of energy for household thermal requirements. This will, in turn, reduce the demand on firewood and charcoal, thereby reducing deforestation and mitigating climate change. The Malawi Electricity Access Project financed by the WBG aims to increase access by connecting an additional 300,000 households to the grid, and another 200,000 customers using off-grid solutions.

The Country Partnership Strategy has further identified that unreliable and expensive electricity is consistently cited as a binding constraint to private sector investment. This has also emerged as an area of concerted WBG collaboration involving policy action, technical assistance, and regional approaches.

It should also be noted that under the Country Partnership Strategy, the WBG supported the production of an IRP for 2017–2037, which sets out a least-cost plan for on- and off-grid electrification to achieve the government’s 2030 target of 30 percent electricity access, as well as supporting the Government’s decarbonization plan under the NDC. Malawi also has an opportunity to leverage the SAPP for imports and exports of electricity over the medium-term. In 2020, the World Bank approved the Mozambique/Malawi Regional Interconnector Project to connect Malawi with Mozambique’s transmission systems, enabling bilateral and regional power trade within the SAPP. To deepen and sustain this approach to access, the WBG and development partners will scale Malawi’s connectivity with Zambia and Tanzania through a proposed Sustainable Transmission and Energy Access Project in 2022, linked to ESCOM’s turnaround strategy.

The decarbonization plan under the NDC will also see the WBG financing the Mpatamanga Hydropower Project in 2022 in which the government and the IFC are co-developers. This is a flagship Public Private Partnership (PPP) project. Once completed, Mpatamanga is expected to integrate 350 MW into the grid, doubling generation capacity in the country. This means that the use of diesel generators will not be necessary once Mpatamanga is in operation, thereby speeding up the process of decarbonization of the energy sector. With the WBG-supported unbundling of the sector, the project represents a flagship initiative to market-test new Government policies and strategies espoused in this Energy Background Note for attracting private finance.

The climate change adaptation and mitigation measures under the NDC are assisting the Government of Malawi to diversify the energy base. This is seen in that Malawi is promoting solar IPPs, with solar projects either approved or in the pipeline, are expected to deliver 216 MW of capacity, including Salima Solar (60 MW), for which IFC signed a financing mandate and MIGA provided a political risk guarantee with the support of the IDA Private Sector Window. Recent investment in solar energy is a promising indication that the private sector sees an opportunity for bankable decarbonization projects in Malawi.
b. Country Private Sector Diagnostic (2021)

The Malawi energy sector policies and strategies articulated in this background note have highlighted adaptation, mitigation, and climate resilient strategies, which are feeding into the World Bank diagnostic for private sector participation. According to the Country Private Sector Diagnostic of June 2021, titled “Creating Markets in Malawi,” increasing access to reliable power is one of the four strategies articulated. Among the other private sector issues the diagnostics has identified, two objectives in the energy sector are as follows:

- Improve the management and performance of ESCOM and continue the phased increase in the national electricity tariffs to allow cost recovery, which will help the national utility become financially sustainable and thus a more reliable contractual partner with current and potential IPPs, and
- Ensure adequate resource allocation to support the development and implementation of energy projects - most notably the Mpatamanga Hydropower Project - and the approval, tendering, contracting, construction, and completion of new solar and wind IPP projects.

These World Bank country private sector diagnostic strategies will significantly assist in achieving the much-needed adaptation, mitigation, and climate resilient measures through decarbonization of the energy sector in Malawi.


The systematic country diagnostic by the WBG has identified several pathways to address and break the cycle of low economic growth and slow poverty reduction of the country. Pathway number II where the objective is to diversify the economy and create jobs has outlined a number of interventions. Under priority policy intervention number 3, it is demanded that the country should address energy infrastructure deficits to support private sector development and service delivery. It also calls for increasing access to electricity in order to enable economic growth and enhance the wellbeing of Malawians. This is in line with the strategies contained in the Country Partnership Strategy document, that support government initiatives to provide energy alternatives to firewood and charcoal at a household level.

The Systematic Country Diagnostic has also recommended that the Government should improve and expand its electricity transmission and distribution network and create an enabling environment for off-grid market development. Extra financial resources should be mobilized based on a good-practice, bankable financing plan. Additionally, extensive technical assistance is needed to strengthen the energy sector institutions.

The Country Diagnostic report has further demanded that Malawi should urgently diversify and expand its energy sources. Malawi should tap into the SAPP regional grid to help meet the generation gap and ensure supply, especially considering low hydrology. This is in line with the NDC strategies, which also require that the country should implement mitigation measures to climate change for sustainability of the energy sector to be achieved.

At the same time, the performance of ESCOM should be improved, including by implementing cost reflective tariffs, which could help contain demand growth, support revenue needs and investment, and help attract private investment through IPPs. Finally, given the importance of the Shire River to Malawi’s energy security, increased adoption of natural resource management practices is needed to sustain and protect energy security.

All these WBG programs are directly supporting Government efforts in addressing climate change issues through adaptation, mitigation, and climate resilient strategies that have been outlined in this Energy Background Note. It is, therefore, expected that the NDC strategies would receive financial support from both unconditional and conditional resources.
Annex 1

Access to Electricity in Africa

By proportion of the population, 2019 data.

Source: The International Energy Agency

efisha.com
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Notes


7 Available at https://www.globalforestwatch.org/dashboards/country/MWI/.


