Renewable Energy in Burundi: Challenges and Opportunities, Learning from International Best Practices

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Acknowledgments

This report is from the National Renewable Energy Laboratory (NREL), funded by the Climate Technology Centre and Network on behalf of the Burundi Ministry of Energy and Mines. The report provides and overview of the energy environment in Burundi, including renewable energy potential, stakeholders, the regulatory environment, and the country's energy and climate goals. A strengths, weaknesses, opportunities, and threats assessment based on the energy background follows. The report concludes with international best practices to promote renewable energy, including examples of renewable energy promotion centers and the different forms such a center could take in Burundi.

List of Acronyms

AEPC	Alternative Energy Promotion Centre
COE	Center of Excellence
EACREEE	East African Centre of Excellence for Renewable Energy and Efficiency
FIT	feed-in tariff
NDC	Nationally Determined Contribution
NREL	National Renewable Energy Laboratory
PV	photovoltaics
REGIDESO	Region of Production and Distribution of Water and Electricity
RETC	Renewable Energy Training Centre Indonesia
RPS	renewable portfolio standard
RSECE	Regional Sustainable Energy Centre of Excellence for Sub-Saharan Africa
SAC	Solar as Capital
SWOT	Strength, Weakness, Opportunity, and Threats
UNIDO	United Nations Industrial Development Organization

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1 Analysis of the Current Renewable Energy Environment in Burundi

1.1 Background

Burundi is a country in east-central Africa, located south of the equator. Its neighbors are Rwanda to the north, Tanzania to the south, and the Democratic Republic of the Congo to the west. The country is hilly and mountainous, which has historically led to dispersed traditional family compounds rather than the formation of villages. Despite this dispersion, Burundi has one of the highest population densities in Africa (the estimated population density is 452 persons per square kilometer). 87% of the population is rural ("Burundi" n.d.).

Burundi is one of the poorest countries in the world. In 2020, the international poverty[1] rate in Burundi was 72.8%, the gross domestic product per capita was USD 268.90 ("Burundi" 2021). The country relies on subsistence agriculture. This, combined with a growing population and inflation, has led to increased food insecurity ("Burundi" 2021).

1.2 Energy Background

1.2.1 Energy Supply

At first glance, Burundi's primary energy supply is largely made up of renewable energy (86%). The remainder of the primary energy supply is from oil ("Burundi Energy Profile" 2021). However, a majority (98%) of the renewable energy supply in Burundi is bioenergy. The remainder of the renewable energy supply is hydroelectric, and solar power ("Burundi Energy Profile" 2021). However, solar makes up a small fraction of energy supplied in Burundi due to its relatively low installed capacity of 5 MW ("Burundi Energy Profile" 2021).Solar made up 5% of all installed capacity in 2020, generating a total of 8 GWh of electricity for the year, which accounted for 2% of annual electricity generation in Burundi. Bioenergy is used for home cooking and heating. Firewood is the main source of this energy, as well as for industrial activities ("Burundi" 2022) The demand for firewood is higher than production. In addition, the use of firewood has led to significant deforestation ("Burundi" 2022). Less than 3% of the total land area in Burundi is forested ("Burundi" n.d.). For these reasons, firewood cannot be considered a renewable energy resource for Burundi.

1.2.2 Installed Capacity and Imported/Contracted Capacity

The total installed capacity of power generation plans operated by Region of Production and Distribution of Water and Electricity (REGIDESO), the state utility, is approximately 80 MW. The installed capacity is made up of the following:

- 33 MW: Total installed capacity of eight hydroelectric plants operated by REGIDESO
- 5.5 MW: Installed capacity of a thermal plant (burning fossil fuels), which is rarely used because of high operational costs.
- 5 MW: Installed capacity of a thermal plant (burning fossil fuels), which operates with subsidies from the World Bank and the European Union (Nsabimana 2020).

[1] The international poverty line, the universal standard for measuring global poverty, is USD 1.90/day. This is the threshold under which it is difficult to afford basic needs ("Global Poverty: Facts, FAQs, and How to Help" 2021).

- 7.5 MW: Installed capacity of a solar plant, financed by international firms and development banks. The electricity generated is sold to REGIDESO under a 25-year power purchase agreement (Bellini 2021).
- REGIDESO also contracts fossil fuel-generated power from the company Interpetrol. Interpetrol operates a 10-MW capacity thermal plant and a 30-MW capacity thermal plant (Nsabimana 2020). In addition, 16 MW is imported from hydroelectric plants (RUZIZI 1 and RUZIZI II in the Democratic Republic of the Congo) (Mtoka 2019) (Nsabimana 2020). See Figure 1 for an overview of the generation capacity sources in Burundi.

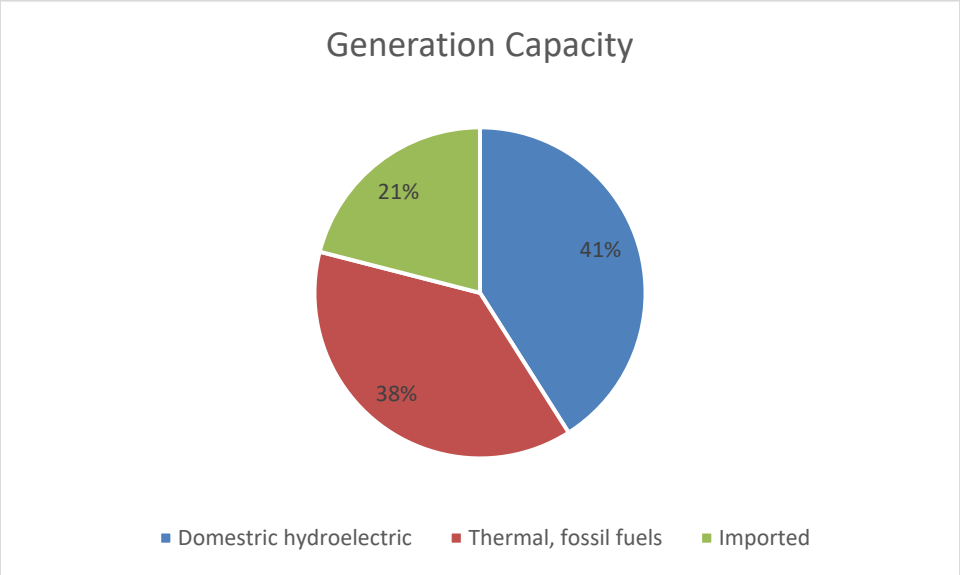

Figure 1. Generation capacity in Burundi

According to Global Climatescope data, the total installed capacity in the country in 2020 was as follows ("Burundi ClimateScope 2021" 2021):

- 18 MW solar photovoltaics (PV)
- 33.8 MW small hydro
- 4 MW of biomass and waste
- 40.5 MW of "other."

It should be noted that the literature review conducted by the authors revealed that there is not a consistent agreement on the generation capacity or electricity generation of Burundi. The dearth of energy data for Burundi is a significant weakness and will be discussed in the strengths, weaknesses, opportunities, and threats analysis section.

1.2.3 Renewable Energy Potential

Burundi has renewable energy potential, but it is largely unstudied. The following are estimates of renewable energy potential:

- Hydropower: 1,700 MW of potential. 300 MW are economically possible ("Burundi" 2022).

- Solar: Average daily solar insolation is 4–5 kWh/m2/day, indicating strong solar potential for Burundi ("Energy Profile Burundi" n.d.). There is a growing number of households, businesses, schools, and health clinics using distributed, off-grid solar. These systems can serve as an alternative to the poor quality, grid-supplied, electricity (Nsabimana 2020).

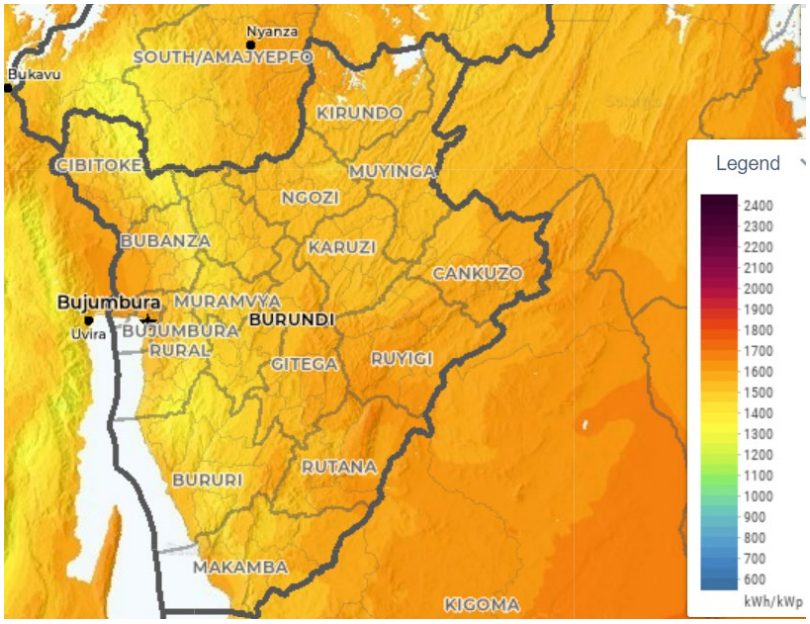

Figure 2. Data from Global Solar Atlas (globalsolaratlas.info) showing specific production for PV from 1,387 kWh/kWp to 1,606 kWh/kWp (adequate in all locations)

- Wind: The mean wind speed in Burundi is 4–6 m/s ("Energy Profile Burundi" n.d.). Small wind turbines need an average wind speed at least 4 m/s, meaning Burundi's wind could support electricity generation ("Wind Explained" 2022). One study found that total wind power potential in the country is 12–15 TWh per year (Mentis 2013). Another study found that the Bujumbura region has a high potential for wind energy harvesting (Placide, Lollchund, and Dalso 2021).
- Geothermal: According to the Burundi Ministry for Energy and Mines, the Rift Valley region of the country is likely to have geothermal potential (Manirakiza 2012). A study presented at the World Geothermal Congress in 2015 notes that geothermal energy can be used by hotels in the form of ground source heat pumps to heat water and cool rooms (Mtoka 2019).

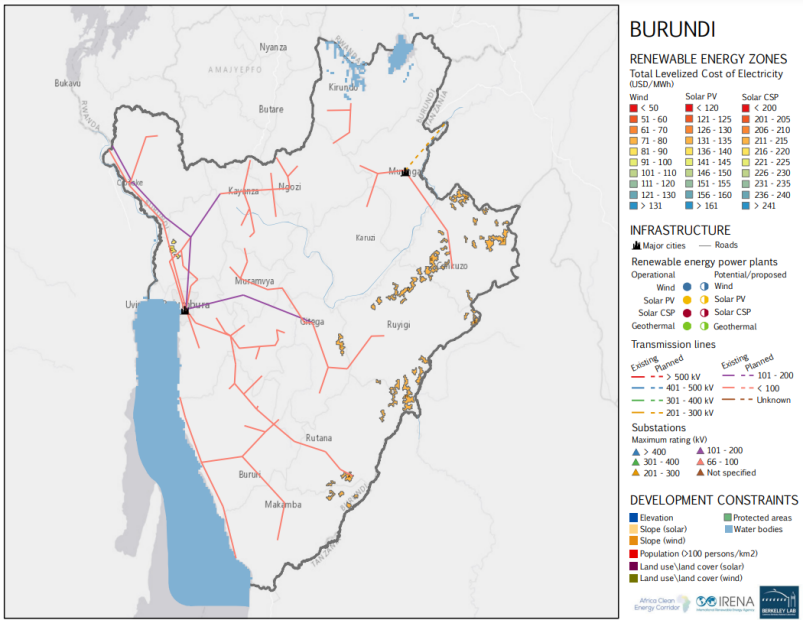

Figure 3. Global Atlas for Renewable Energy (globalatlas.irena.org) shows "development zones" with favorable characteristics (high solar radiation, ground slope, distance to loads and transmission lines, and population density) with levelized cost of energy varying from USD 0.13 to USD 0.14 per kWh delivered from PV

1.2.4 Electricity Access and Use

Approximately 7% of the population of Burundi has access to electricity. In rural areas, only 1% of the population has access. 49% of the urban population has access to electricity ("Burundi" 2022). In sub-Saharan Africa, the electrification rate is 26% on average ("Burundi" 2021).

For those connected to electricity, quality is low. Burundi experiences electricity shortages regularly. There are often rolling blackouts that impact households and businesses. At peak demand, the electricity shortfall is approximately 40%–50% ("Burundi" 2021). This can be contributed to many factors, including a lack of investment in the power sector (the last hydroelectric project was commissioned in 1989), high connection charges, the inability of supply to meet demand, and a lack of building standards (Nsabimana 2020).

Electricity consumption per capita is very low, at 25 kWh per person annually ("Intended Nationally Determined Contribution Burundi" 2015). Only seven other countries have lower electricity consumption per capita ("Per Capita Electricity Use" n.d.). One reason for low per-capita electricity consumption is the high tariff rate. Average power prices in Burundi are among the most expensive in the world, some sources citing the average tariff at USD 0.31/kWh ("REGIDESO to Nearly Triple Electricity Tariffs" 2017). This is driven by a lack of supply, grid inefficiencies (24% of supply lost due to transmission and distribution network technical issues (Nsabimana 2020)), lack of investment in new infrastructure, and dependence on a leased gas power plant ("Burundi ClimateScope 2021" 2021). Tariffs were raised in 2011, 2012, and 2017 in order to recover losses, leading to increased underconsumption (Nsabimana 2020).

The system also experiences nontechnical losses. REGIDESO is unable to collect on all of the bills. In 2009, REGIDESO began implementing a system of prepaid metering, which improved collection. Still, only 41.7% of bills were collected in 2017. Unpaid bills in the public sector are high, partly because the prepaid metering technology was not applied to water utilities (Nsabimana 2020). REGIDESO is in poor financial shape, the inability to recover tariffs leads to the inability to improve the system. According to REGIDESO, 60% of the grid requires upgrading or fixing to meet interconnection standards of the East African Power Pool ("Sustainable Energy for All Technical Assistance Program for Burundi Summary Report" 2019).

1.3 Stakeholders

The main electricity producer is REGIDESO. The state-owned, vertically integrated company produces and operates over 97% of the electricity in Burundi and is responsible for production, transmission, distribution, and marketing of electricity (Mtoka 2019). It operates under the supervision of the Ministry of Energy and Mines.

The Ministry of Energy and Mines (sometimes also referred to as the Ministry of Hydraulics, Energy, and Mines) designs and implements national energy policy, as well as the development of energy infrastructure. The ministry also supervises rural electrification ("About Ministry of Hydraulics, Energy and Mines" 2022). The Directorate of General Energy within the Ministry of Hydraulics, Energy, and Mines sets general energy policy, definition, and planning. The Directorate of General Energy has a department of renewable energy and energy efficiency ("Renewable Energy Market Landscape Study Volume II" 2017).

The Agency of Regulation of Water, Electricity, and Mines manages licensing, tariff setting, and dispute handling in the electricity sector. It is responsible for controlling, regulating, and monitoring electricity activities while promoting competition in the sector (Nsabimana 2020).

The Burundi Agency for Rural Electrification (ABER) is the government institution that plans and coordinates rural electrification projects. The agency develops microgrid projects. As of 2020, The Burundi Agency for Rural Electrification operates six small hydroelectric plants, which power small, isolated centers (Nsabimana 2020).

The International Electricity Society of the Great Lakes, is a regional body that is responsible for coordinating electricity projects and cooperation between Burundi, the Democratic Republic of the Congo, and Rwanda. It operates a hydropower plant in the Democratic Republic of the Congo and a regional substation.

Energy Regulators Association of East Africa is a regional association that pools expertise in energy sector regulatory matters. Member states include Burundi, Kenya, Uganda, Tanzania, Rwanda. The Agency of Regulation of Water, Electricity, and Mines represents Burundi in the Energy Regulators Association of East Africa ("About EREA" 2022).

The Burundi Renewable Energy Association is a nonprofit organization founded in 2012. It operates with the Ministry of Energy and Mining and brings together stakeholders in renewable energy in Burundi. The Burundi Renewable Energy Association is a member of the East African Renewable Energy Association, made up of renewable energy national associations of Burundi, Kenya, Rwanda, Tanzania, and Uganda.

There are also international development finance institutions and multilateral development banks working in Burundi. These include the World Bank, African Development Bank, The OPEC Fund for International Development, ICU, ElectriFi, U.S International Development Finance Corporation, Renewable Energy Performance Platform, Gigawatt Global, Inspired Evolution, Energy and Environment Partnership, the Belgian Investment Company for Developing Countries, and the Solar Electric Light Fund.

1.4 Regulatory Environment

Electricity sector reorganization in 2015 opened up the sector to private investment via private-public partnerships or concessions. The Act for Public-Private Partnership (Law No. 1/14, April 27, 2015) endorsed private-public partnerships for all sectors. The Law of Electricity Reorganization (Law No. 1/13, April 23, 2015, also known as the Electricity Act) created a legal framework to enable private investment in the electricity sector, opening up generation to independent power producers (Nsabimana 2020). The legislation states "the purpose of this law is to create a legal framework favorable to investment in the electric energy sector and to liberalize this sector while respecting the conditions of fair and equitable competition and the rights of users and operators." Due to the Electricity Act, there are no restrictions on foreign investment in the electricity sector (Mtoka 2019).

The Law of Electricity Organization established rules for the development of new generation sites, sets specific regulations for hydroelectric power plants, and also sought to unbundle the electricity sector into generation, transmission, distribution, and retail. This unbundling reformation was not successful, REGIDESO is still vertically integrated (Nsabimana 2020).

1.5 Strategies and Planning

According to Sustainable Energy for All In Africa, the energy strategy in Burundi is as follows ("Burundi" 2022):

- Increase national production capacity
- Promote international hydroelectric projects
- Promote interconnection with neighboring countries
- Promote renewable energy production solutions, especially for decentralized rural electrification
- Increase electrification
- Substitute firewood for cooking fuel
- Promote the use of other existing energy resources.

The National Development Plan (2018–2027) was written to help Burundi form a foundation for strong and inclusive growth. The Plan notes that the electricity deficit in Burundi is a major barrier to development. The Plan calls for increased energy production and recommends that the energy mix be diversified ("Plan National De Developpement Du Burundi 2018-2027" 2018).

The Burundi Poverty Reduction Strategy Paper, published in 2012, calls for improving the energy supply in order to reduce poverty. Renewable energy promotion is necessary to overcome the need for firewood consumption, which is unsustainable ("Burundi: Poverty Reduction Strategy Paper II" 2012).

Vision Burundi 2025 describes the actions and goals that Burundi will undertake to achieve sustainable development. The Vision calls for reducing wood burning, the promotion of renewable energy, and

reduced deforestation. The Vision also focuses on mini and micro renewable energy generation plants ("Vision Burundi 2025 – Policies" 2015).

The Decentralized Rural Electrification Strategy (2015–2017) aimed to maximize the social impact of distributed renewable energy for rural Burundians. This strategy was adopted to accomplish an electrification goal set in Vision Burundi 2025 (Hafner et al. 2019).

1.6 Climate and Energy Targets

Burundi's first Nationally Determined Contribution (NDC) in 2015 states that the country's vision for combating climate change is that Burundi is a state "that promotes development that is resilient to the harmful effects of climate change." The NDC notes the potential impacts of climate change on the energy sector in Burundi. Climate change will likely have a large impact on hydroelectric generation, as droughts will lead to frequent shutdowns. Increased rainfall can lead to "complete silting" of certain dams as well as frequent flooding of infrastructure will also lead to additional shutdowns. The NDC calls for the country to provide "support for facilities that use renewable energy resources" and lists programs that could promote renewable energy including small-scale hydro and research ("Intended Nationally Determined Contribution Burundi" 2015).

Burundi's second, updated, NDC from 2020 sets a target to replace 100% of traditional kilns and home ovens by 2030 with more efficient stoves. It also sets a target to increase electrification by 35%, indicating that this could be achieved by developing three hydroelectric plants (Wienges and Bucher 2016).

2 Strengths, Weaknesses, Opportunities, and Threats (SWOT)

This section conducts a strengths, weakness, opportunities, and threats analysis for the renewable energy sector in Burundi based on desk and interview research. The objective is to understand the decision-making context and process to maximize system improvements or achieve goals by identifying necessary changes that bolster strengths, minimize weaknesses, leverage opportunities, and mitigate threats.

Strengths and weakness are internal features in a system. Common strengths and weaknesses include technology, organization, process, reliability, customer satisfaction, transparency/trust, management capacity, knowledge, and transmission and distribution infrastructure.

Opportunities and threats are external advantages or risks. Common opportunities or threats include markets and non-market opportunities, competition, population changes, change in demand, electrification rate, fuel prices, supply/resource potential, supply chain vulnerability, transportation infrastructure, regulatory environment (including environmental and social), climate change, public awareness, economic maturity/poverty, and customer base.

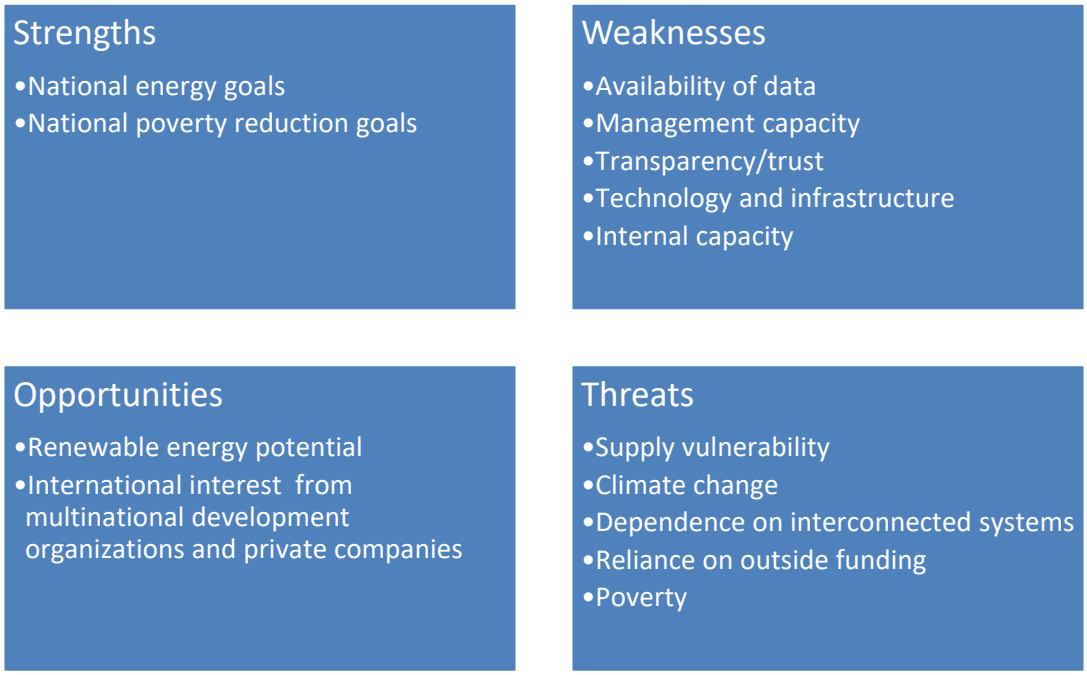

Figure 4. Summary of strengths, weaknesses, opportunities, and threats for the renewable energy sector in Burundi.

2.1 Strengths

Burundi has established a national institutional framework and legislation that enables energy management and sustainable energy development. Energy is regulated by the Ministry of Energy and Mines. Several agencies have been established to promote rural electrification, including the Burundian Agency for Rural Electrification and the Rural Electrification Agency. The 2015 Electricity Act enables foreign investments in the power sector. Laws are in place to allow tax benefits for energy investment

and public private partnerships. These laws can help accelerate investment in renewable energy infrastructure. However, direct foreign investment may weaken Burundi's jurisdiction and self-sufficiency.

National goals and plans to increase energy production, increase rate of electrification, and decrease greenhouse gas emissions support renewable energy technologies. Strategies for meeting national goals include exploitation of fuels and renewable energy, promotion of decentralized renewable energy for rural electrification, improving the sustainability of biofuels, and multilateral connectivity and trade. REGIDESO's vertical organization structure of and its management of both energy and water infrastructure facilitate implementing these strategies. Burundi's NDCs acknowledge climate change hazards to the energy sector. Other policies and plans that support renewable energy adoption include the National Climate Change Policy, National Action Plan for Adaptation to Climate Change, National Development Plan (2018-2027), Burundi Poverty Reduction Strategy Paper, and Burundi 2025.

2.2 Weaknesses

National legal frameworks, policies, and strategies present numerous challenges. The Power Sector Master Plan identifies USD 661 million needed over next 5 years to boost electricity access to 30% by 2030. The planned increase in capacity relies heavily on donors such as the World Bank, the EU, the European Investment Bank, the Government of China, the Exim Bank of India, and others. A list of 10 planned power projects and the financing sources demonstrates a heavy reliance on private-public partnerships and donors. Two of the ten projects are expected to be financed by the Burundian government (Nsabimana 2020).

There are generally a lack of incentives and policy instruments to support renewable energy infrastructure investment. Private sector development is constrained by an unattractive business climate, weak governance, and high dependence on foreign aid. Utilization of tariffs is considered a strength; however, tariffs in Burundi are considered high and ineffective.

Plans of expansion of hydroelectric supply do not directly acknowledge projected climate change impacts and vulnerability to the power sector. Drought and variability of precipitation have led to power rationing in the hydropower sector in the past.

There is a lack of power supply diversity, relying heavily on biofuel, hydropower, and imported fossil fuels for thermal power. Demand for already scarce biofuels outpaces production. Hydropower is vulnerable to drought, particularly under increasing uncertainty of precipitation due to climate change. A lack of domestically owned fuel sources to meet demand leads to import of fossil fuels for thermal power, leasing of gas power plants, and imported electricity. This has created supply deficit and dependence.

Biofuels are portrayed as a renewable energy source. As a result, the energy supply mix appears to be dominated by renewable energy. The percentage of renewable energy share of the mix has been declining. As traditional kilns and wood burning ovens are replaced, this may appear to be a negative indicator despite the benefits of electrification.

Electrification and electricity access are very low. Most homes utilize traditional kilns and woodburning home ovens. This likely has a disproportionate impact on women and children who are more exposed to

particulate matter and at risk of developing related respiratory illness. Additionally, REGIDESO applies high connection charges.

Efficiency and management capacity are areas with room for improvement. The national grid depends on interconnected networks that were built in the 1980s. Low voltage lines and lack of funding for grid improvements, result in transmission and distribution losses of 25%. Service interruptions are more likely for older systems.

Turnover in REGIDESO staff may lead to lack of continuity and leadership. From 2004 to 2017, seven Director Generals were appointed (Nsabimana 2020). Lack of metering, nonpayment of bills, and lack of mechanism to collect on unpaid bills reflect weak governance and management capacity. Despite high tariffs, they are considered ineffective. Metering is often collected by field survey. Although REGIDESO has a webpage, there is a lack of publicly available energy data and transparency. Data seems to be tied to reporting in conjunction with the International Renewable Energy Agency, World Bank, United Nations, and foreign ministries of aid. Data available through these sources is outdated, suggests lack of collection and reporting requirements and/or insufficient capacity to monitor.

2.3 Opportunities

Though the planned capacity does rely on international parties for financing, the plans demonstrate an interest from outside parties in supporting energy sector development in Burundi, including the World Bank Group, Sustainable Energy for All, the African Development Bank, and more.

Additionally, there is ample solar, wind, and geothermal technical potential within the country to substantively expand existing renewable energy capacity and diversify supply in support of meeting demand and other national goals (although more study is necessary to quantify this potential). See Section 1.2.3 above for more information about renewable energy technical potential.

2.4 Threats

While the literacy rate has improved over the last 20 years, high population growth, food insecurity, and rising extreme poverty continue to afflict the country. The COVID-19 pandemic interrupted a fragile economic recovery, intensified macroeconomic imbalances, and increased public debt (“The World Bank in Burundi” 2021). National energy plans do not adequately address projected climate change impacts on energy supply reliability, transmission and distribution efficiency, or demand for cooling under scenarios of increased social and economic development. Substantive renewable energy expansion and climate change resilience depend on foreign direct investment, nation to nation assistance, and nongovernmental organization support.

3 International Best Practices to Promote Renewable Energy Uptake

Robust and transparent policies and programs administered by the government are a key aspect of promoting and proliferating renewable energy uptake in a country. This section outlines the options for regulatory and financial policy tools, as well as best practices when engaging with the private sector. As seen in countries around the world, a combination of several policy tools is key to transforming the power sector and accelerating the deployment of renewable energy.

3.1 Policy Tools

3.1.1 Renewable Portfolio Standard (RPS)

An RPS, sometimes called a renewable electricity standard, is a regulatory policy tool that requires a certain share of electricity supplied to be renewable in a country or any jurisdiction. While RPS is a prominent renewable energy policy tool in the United States, countries around the world have also implemented an RPS, including Mexico and the Philippines. While the policies around the world may vary, certain aspects are integral to the design of an RPS (Heeter, Speer, and Glick 2019). These aspects include:

- A target of renewable electricity share of total electricity production in MWh
- An end-year target and a timeline of intermediate targets between when the policy is first implemented and the end-year
- A list of eligible technologies (i.e., solar PV, wind, hydropower, etc.)
- The definition of compliance entities
- The designation of the regulatory entity
- And any penalties for noncompliance (Heeter, Speer, and Glick 2019).

Table 1.Examples of Key Components of an RPS

(Heeter, Speer, and Glick 2019)

Key Component	Example
Target	20% renewable electricity by 2050
Interim schedule	5% renewable electricity by 2020, 10% by 2030, 15% by 2040
Eligible resources	All solar photovoltaics, wind, biomass, and hydropower facilities less than 10 MW that began commercial operation on or after July 1, 2019
Compliance entities	All load-serving electricity companies with more than 50,000 customers
Regulatory entity	Public Utilities Commission
Penalties for noncompliance	$50/MWh

In addition to standard design elements, countries can follow several steps to ensure a robust RPS program. This includes analyzing resources, engaging stakeholders, determining suitable renewable

resources, clearly defining the RPS, creating an enforcement mechanism, and providing a cost-containment provision:

- **A well-designed RPS policy starts with analyzing resource, technical, economic, and market potential.** These analyses can help countries understand the available solar irradiance or wind speeds, any topographic or land-use constraints, how cost-competitive different technologies are, and if there are any policy, political, regulatory, or financial constraints in the current market.
- **Engaging key stakeholders, especially early on, is crucial to garner and maintain support for an RPS scheme.** Oftentimes, collaboration across multiple stakeholders is necessary to plan, implement, and maintain a robust RPS policy.
- **Determining suitable renewable resources helps a country meet its objectives.** While typical renewable resources included in RPSs are solar, wind, geothermal, hydropower, and biomass, countries may select a subset of these resources to be eligible for an RPS based on environmental, financial, economic, and other factors. Another decision to make at this stage is the age of eligible renewable resources—should the RPS only take into account new resources, or preexisting ones as well. This consideration can influence how ambitious the target is for the RPS.
- **Clearly defining the RPS scheme is essential to avoid any misunderstanding of what the policy is.** Whether it be through legislation, regulation, or executive order, key aspects mentioned above, such as eligible resource types, targets, compliance entities, age of resources, and any exclusions should be clearly outlined.
- **An enforcement mechanism builds and maintains investor confidence.** When an authority has oversight over compliance and enforces penalties, when necessary, investors are more likely to make capital investments in renewable projects.
- **Cost-containment mechanisms protect customers from excessive cost increases.** As a result of new policies like an RPS, the cost of generation is uncertain and may be passed onto customers. Cost-containment mechanisms such as an alternative compliance payment or cost cap essentially sets limits to retail electricity rates.

3.1.2 International RPS Examples

Mexico

The Federal Clean Energy Standard in Mexico sets the country on a path to producing 35% of its electricity from clean source by 2024, with intermediate targets of 25% by 2018 and 30% by 2021 (Zinaman et al. 2018). This RPS scheme included a compliance mechanism as the Ministry of Energy created clean energy certificates, also known as renewable energy certificates, to promote the growth of clean energy. Clean energy certificates are certificates that represent a MWh of renewable electricity generated, thereby acting as proof of compliance with RPS policies. Should power producers fail to comply, the penalty is USD 200 per certificate.

Philippines

The Renewable Energy Act of 2008 opened the way to the Philippines realizing an RPS policy. The Philippines Department of Energy promulgated rules in 2017 and began implementation of the RPS scheme in 2020. The Philippines Department of Energy aims for the RPS scheme to help the Philippines meet its renewable electricity utilization target of 35% by 2030, by mandating all power suppliers increase renewable generation by 1% per year for 10 years. The RPS scheme defines renewable broadly and includes resources like biomass, wind, solar, waste-to-energy, geothermal, and others as resources

("Department Circular No. DC 2015-07-0014" 2015). Finally, the Philippines RPS also uses renewable energy certificates as a compliance mechanism, allowing third parties to purchase renewable energy certificates from renewable energy producers in a marketplace.

3.1.3 Feed-In Tariff (FIT)

Alongside RPS, a FIT is another prominent policy tool to incentivize production of renewable electricity. FITs work well because they typically provide power producers with long-term power purchase agreements, which provides market certainty. Designing a FIT policy begins with determining the payment levels. These should be adjusted as technology prices evolve and policymakers can set a yearly annual decrease or determine an appropriate timescale to implement adjustments less frequently (Couture et al. 2010). Payment levels can be set according to or independent of electricity market prices. Countries can determine payment levels several different ways:

- Determining the levelized cost of renewable electricity provides insight into the cost per unit of electricity, or per kilowatt-hour (kWh).
- Establishing the valuation of the utility's avoided cost of generation, ancillary grid benefits, and societal benefits such as environmental protection and reduced emissions.
- Resource quality allows payments to be aligned with generation costs at different sites. For example, payment levels can vary depending on a wind farm's yield compared to a reference yield.
- Integrating with competitive procurement auctions creates a hybrid model that has the benefits of keeping project costs low, while mitigating the issue of receiving bids from unreliable and inexperienced project developers. This hybrid model would require developers to both bid on tenders and demonstrate technical capability (Cox and Esterly 2016).

While a FIT policy can quickly encourage renewable energy deployment, it can also result in high costs. Cost-containment methods such as establishing a maximum installed capacity, reducing FIT payments on a set schedule, and ending the FIT program when existing funds run out are a few ways to mitigate this issue. Next, it is important to define the contract length under a FIT policy, with typical contract lengths varying from 10 to 25 years. Finally, policymakers should consider forecasting requirements, methods to streamline approvals, and consider linkages to other policies to ensure good and robust FIT design.

International FIT Examples

Indonesia

The FIT program in Indonesia showcases the flexibility of a FIT policy. The FIT in places where it is expensive to generate electricity, like Papua, is roughly 50% lower than in remote places where the cost of generating electricity is low, like Java or Bali. This not only continues to promote the development of renewable energy across the country, but also considers the local economic and geographic circumstances (Cox and Esterly 2016).

3.1.4 Competitive Procurement

Competitive renewable energy procurement, also known as renewable energy auctions or tenders, is a way for a government or authority to call for bids to develop a certain capacity or generation of renewable electricity (IRENA and CEM 2015). This method of deploying renewable electricity keeps project costs low as developers try to remain competitive and beat each other with lower bids to build projects. These bids typically come in as the price per unit of electricity (per MWh), as opposed to the

capacity of the project that is being proposed. This mechanism results in lower costs even when compared to directly negotiated projects (Eberhard et al. 2016).

To design an effective competitive procurement framework, several considerations should be made (Eberhard and Naude 2016):

- By establishing a clear renewable energy policy or objective, a country can attract more investors to bid on projects within the country as it provides a degree of market certainty. In addition to renewable energy policy, it is helpful to have policies that build and maintain an enabling business environment for the private sector.
- On top of renewable energy policies and other policies that support private sector engagement, political support is also important. This boosts investor confidence and provides longevity and continuity of the competitive procurement program. This support should be reflected throughout the government from decision makers down to the various agencies that approve and administer the program.
- Acquiring adequate assistance in designing the procurement framework through experts and international organizations can help with designing a successful program.
- Engaging with the private sector—project developers, private equity firms, and other lenders—early in the design stage will help determine whether the market conditions are right to attract competitive bids on projects. The design of the program should also be in reference to international best practices and experiences.
- Locking in financing at the beginning of a submission process shifts the responsibility for due diligence to the lender. This helps mitigate the issue of failed, delayed, or incomplete projects.
- To further attract investment in projects, it is crucial to provide a form of credit enhancement. This mitigates risk and improves security for the program.
- Fairness, transparency, and independence also help attract private investment. This can take the shape of procuring independent contractors to evaluate and monitor the program, as opposed to government officials. Maintaining open and continuous communication between the program administrator and the private sector is also encouraged.
- Developed capital markets help attract lender interest. In smaller and less mature economies, development banks can play a key role in funding projects.
- An influx of renewable energy generation is less impactful if there are significant transmission constraints. Proper grid planning and transmission expansion should complement the competitive procurement process for renewable electricity generation.

3.1.5 International Competitive Procurement Examples

Colombia

The Ministry of Mines and Energy in Colombia held the country's first competitive procurement auction for renewable energy in February 2019. The program was due to attract USD 400 million of private investment, allocating 1.2 TWh per year of long-term electricity contracts ("Snapshot of Colombia's First Long-Term Energy Auction" 2021). Due to antitrust requirements, no awards were given out at the end of the auction. However, the lessons from this first attempt were considered when implementing the second auction in October 2019. Supported by the U.S. Agency for International Development and the Scaling Up Renewable Energy project, the second auction resulted in nine awarded contracts, providing

1,374 MW of wind and solar PV generation, at an average price of USD 28 per MWh ("Colombia Engages Private Sector and Forges Energy Future" 2020).

South Africa

The Renewable Energy Independent Power Producer Procurement Programme launched in 2011 and is regarded as an example for other African countries. The program invited power producers to submit bids for projects of varying technologies, including wind, solar PV, concentrated solar power, small hydro, biomass, biogas, and landfill gas projects. Since its inception the program has produced 6,000 MW of generation capacity primarily in wind and solar PV projects ("Renewable Independent Power Producer Programme 2022). The Renewable Energy Independent Power Producer Procurement Programme has been successful, garnering almost 400 submissions across the first four bid windows (2011–2015), amounting to a total investment of USD 20.4 billion (Eberhard and Naude 2016).

3.2 Women and Youth

Energy poverty is defined by the International Energy Agency as a "a lack of access to modern energy services… defined as household access to electricity and clean cooking facilities." Women generally experience energy poverty more severely and in different ways than men. Often, women are responsible for household chores that are connected to energy like cooking. Cooking with biomass requires the time to collect fuels (in Burundi, firewood). These repressive societal beliefs and traditions reduces women's ability to go to school or be employed. As noted earlier, there are negative health impacts associated with cooking with biomass. Of the estimated 2 million deaths caused by biomass cooking-induced air pollution, women and children account for 85%. More women and children die annually due to illness caused by air pollution than HIV/AIDS, malaria, tuberculosis, and malnutrition combined ("Sustainable Energy for All: the gender dimensions" 2014).

3.2.1 Gender Mainstreaming

Gender mainstreaming is:

> "the process of assessing the implications for women and men of any planned actions, including legislation policy or programs in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring, and evaluation of policies and programs in all political, economic, and social spheres, so that women and men benefit equally, and inequality is not perpetuated." ("Gender Mainstreaming" n.d.)

Policymakers can practice gender mainstreaming when creating energy policy. The *Blueprint Guide for Creating Gender-sensitive Energy Policies* from the Clean Energy Solutions Center can serve as a road map for policymakers to create energy policies that are gender-inclusive (Morris et al., 2019).

3.2.2 Example in Tanzania

Equitable energy access is still uncommon around the world. Disadvantaged communities are more likely to be neglected by centralized power systems, while decentralized power systems can be costly. Low-income youths are just an example of the different types of disadvantaged communities affected by the lack of energy access. In Tanzania, a micro-capital investment program called Solar as Capital (SAC) has proven successful in encouraging young Tanzanians to adopt off-grid solar PV. This program is necessary, as Tanzania has one of the lowest electrification rates in Africa. Even though there is an abundance of renewable resources, there is a lack of capacity to provide public services, such as

electricity. Further, the scattered nature of the population makes it challenging to supply power in a centralized manner.

The SAC initiative—started by Sepon Limited, a micro-finance enterprise—enabled Tanzanian youths aged 18–35 to apply for an interest-free loan to finance a solar PV system. In addition to a 6-month load repayment period, applicants with an approved business plan received the financing and a packages of accompanying technology like batteries, phone chargers, haircutting machines, and TVs to supplement their micro businesses.

As a result, the SAC initiative created full-time employment for participants who were previously unemployed or seasonally employed. Awareness of the benefits of solar PV were found to be a driving influence for adoption and willingness to participate in this initiative. However, the awareness levels were limited and did not extend to the more technical details of maintenance, leading to a lack of upkeep of the solar PV systems. A notable outcome was the improvement in the lives of the women who participated in this initiative, as they no longer needed to retrieve firewood. In addition, the SAC initiative led to improved access to drinking water, mobility, and education (Simpson et al. 2021).

3.3 Renewable Energy Promotion Centers

A renewable energy promotion center (promotion center), also known as an Alternative Energy Promotion Center or a Center of Excellence (COE), operates at the intersection of government, industry, consumers, and others to coordinate stakeholders and get traction on the advancement of renewable energy in a country. The mission of a promotion center is to develop capacity to achieve and maintain renewable energy through training, planning, oversight, and monitoring; situational analysis, facilitation of stakeholder dialogue, communications and community mobilization; strengthening capacity of existing institutions, examine policy and recommend policy actions, and solve technical, financial and institutional problems that delay or impede renewable energy development in country. Figure 5 illustrates the many different roles that a promotion center may play.

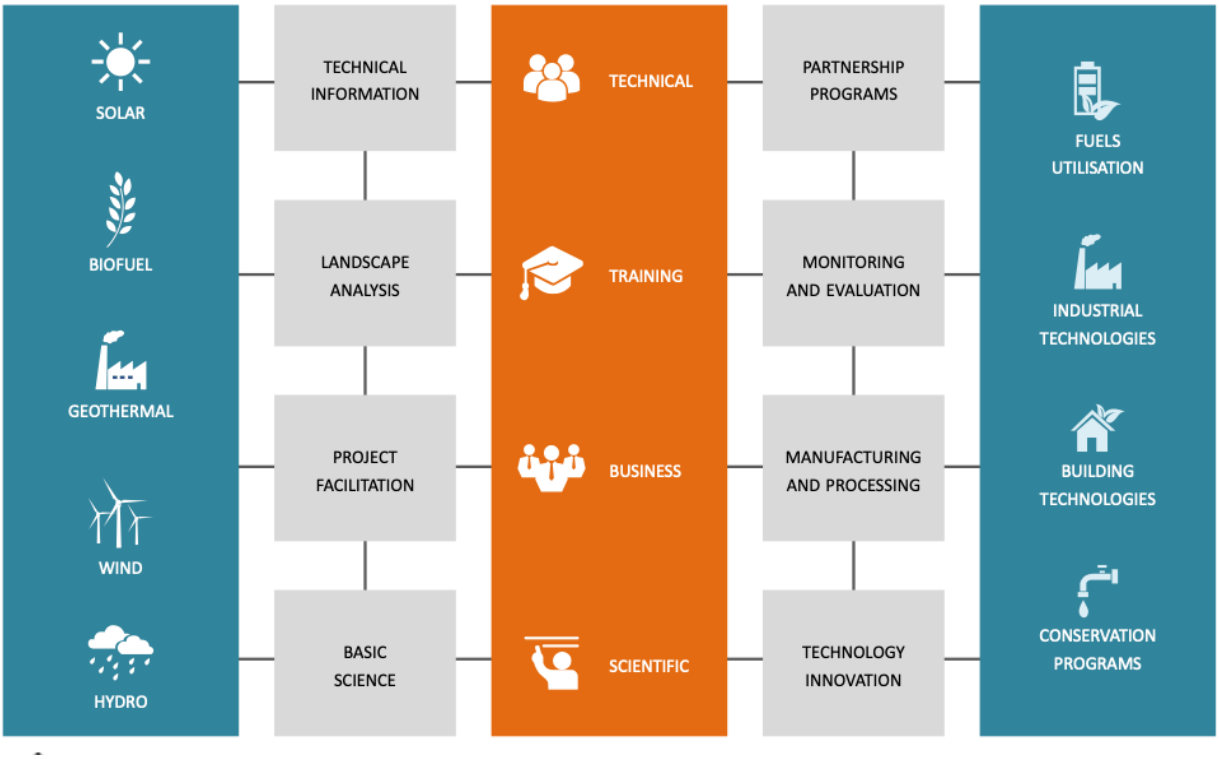

Figure 5. Potential activities for a COE to execute ("Center of Excellence for Clean Energy In Indonesia" 2015)

3.3.1 International Examples of Renewable Energy Promotion Centers

There are many examples of Renewable Energy Promotion Centers internationally from which Burundi can learn and replicate the model. While they are mostly called COEs, they function similarly and follow an archetype common across countries and regions of the world. Firstly, these COEs generally serve as knowledge-sharing hubs. Focusing on improving technical capabilities and nontechnical renewable energy knowledge of local energy professionals, COEs partner with academic and other training institutions to develop and deliver training materials. These include university courses, vocational training modules, and "train-the-trainer" workshops. Secondly, COEs act as policy research institutions or think tanks by developing policy frameworks to promote an increase in renewable energy deployment in their country or region of interest. This function is aided by the network COEs maintain, while fostering connections, cooperation, and partnerships between government entities, international funders, private industry, and nonprofit organizations. This is a key factor of the third common function of COEs—to connect private industry players to renewable energy projects and vice versa—to connect projects to financing or funding opportunities.

The organizational structure of these COEs is also very similar internationally. Almost all centers have an international funding partner (commonly a multilateral bank such as the Asian Development Bank and/or a foreign government development aid agency such as the German Agency for International Cooperation), an implementing partner in the form of a local nonprofit or regional consortium, and a host organization. The host organization is most commonly the same as the implementing partner, but is sometimes a research or academic partner such as a local university.

Nepal

In 1996, the Ministry of Science and Technology of Nepal established the Alternative Energy Promotion Centre (AEPC). Currently housed within the Ministry of Energy, Water Resources and Irrigation, the AEPC is an independent institution that aims to make renewable energy a mainstream resource for the country by increase access, knowledge and adaptability, while improving lives of the people of Nepal ("Mission, Vision, and Strategy – AEPC" n.d.). AEPC aspires to become an institution that promotes renewable energy beyond Nepal, across its region. The AEPCs status as an independent institution situates it well as an intermediary between government ministries, development partners, non-governmental organizations, and the private sector ("Roles and Responsibilities – AEPC" n.d.). As the focal agency across all these stakeholders, AEPC regularly works on formulating, planning, and implementing renewable energy and energy efficiency policies. In addition to being a resource center, AEPC is also used for standardization, quality assurance, and monitoring.

Indonesia

In 2018, a partnership between the Indonesian Ministry of Education and Culture, French Ministry of National Education, and Schneider Electric Foundation created the COE for Electricity, Automation, and Renewable Energy ("Creation of a Centre of Excellence in Bandung, Indonesia" 2019). Based in Bandung, Indonesia, this COE aims to train 320 vocational teachers and 50,000 students in the fields of energy management, building automation, industrial automation, building installation, and renewable energy over the course of 5 years (EARE CoE Bandung n.d.). Initially led by French energy experts, the curriculum is being embedded in the Indonesian National Competency Standard. Beyond this COE, the partnership between Schneider Electric and the Government of Indonesia will scale the transfer of knowledge across the country by upgrading laboratory facilities at up to 184 vocational schools.

In another effort, vocational training center Politeknik Negeri Bali and Dutch independent research organization, TNO, are developing the Renewable Energy Training Centre Indonesia (RETC) (Donker 2022). Establishing the RETC aims to build expertise among Indonesian energy stakeholders, including nonengineers, such as government officials, the financial sector, and youth. The establishing organizations see the RETC as a way to stimulate green recovery from the pandemic and spur job creation in the country. The RETC's planning and business model will be in line with international requirements, standards, and best practices (Donker n.d.). The RETC also acknowledges that youth make up a large portion of the Indonesian population (24%) and will play a key role in advancing the country's power sector and economy.

Regional Sustainable Energy COE for Sub-Saharan Africa (RSECE)

Based in Katsina, Nigeria, RSECE acts as a regional hub to promote sustainable development and the use of renewable technologies across Africa, particularly in the sub-Saharan region. It is strategically located within the Umaru Musa Yar'adua University, furthering the center's mission to expand renewable energy, environmental protection, and climate change knowledge across sub-Saharan Africa ("RSECE" 2019). The RSECE does this by acting as an Energy Information Resource Centre, as well as a developing courses on renewable energy and sustainable development. RSECE promotes research by offering interdisciplinary research opportunities for undergraduates, graduates, post-graduates, and visiting scientists ("RSECE" 2019).

In addition to research and education, the RSECE acts as a conduit between industry, government, and nonprofits in Africa. It collaborates directly with industry partners to bring technologies to market

("RSECE" 2019). In 2020, RSECE launched an initiative to collaborate with 774 local government areas across Nigeria to execute intervention projects in water, health, education, and entrepreneurship (Adepgna 2020). With the aim of reducing poverty and improving public health, RSECE is helping connect local governments with financial grants ("$3bn intervention grant for 774 LGAs underway" n.d.).

East African COE for Renewable Energy and Efficiency (EACREEE)

Spearheaded by the East African Community and supported by the United Nations Industrial Development Organization (UNIDO), the EACREEE was established in 2016 at Makerere University in Kampala, Uganda. The East African Community had initially intended to incorporate EACREEE as a new organization, instead, the College of Engineering, Design, Art and Technology of Makerere University was designated a Center for Excellence for EACREEE ("EACREEE's Legal Status" n.d.). As Burundi is a member state of the East African Community, it is also a partner state under the EACREEE, along with Kenya, Rwanda, Tanzania, and Uganda.

Where other COEs focus on research and development of renewable energy technologies, EACREEE is focused on developing and implementing policy frameworks, executing regional or national projects, and serving as a clearinghouse for incoming international funding for renewable energy and climate change projects ("Activities and Services" n.d.). In addition, EACREEE expertise and organizational independence situates it well to foster relationships and cooperation between public and private entities, as well as nonprofit organizations. This networking focus extends to research and education as EACREEE provides frameworks for capacity building activities and connects research and training institutions to strengthen cooperation. EACREEE's work is realized by funding from several core partners and non-core project donors. The core partners include UNIDO and the Austrian Development Agency, which support the organization's technical and institutional operations via long-term funding ("Institutional Structure n.d.). EACREE also receives support from other partners on a project-by-project basis, including the European Union, the International Renewable Energy Agency, and the German Agency for International Cooperation.

The establishment of EACREEE as a result of a partnership between the Austrian Development Agency and UNIDO is not unique. In fact, this specific partnership has spawned similar COEs in five other regions under UNIDO's Global Network of Regional Sustainable Energy Centres: southern Africa, western Africa, the Arab region, the Pacific, and the Caribbean (Monga 2015). While each center tailors its work toward its region, there are many similarities between them. Each center is focused on knowledge transfer and capacity building, development of local renewable energy industry, policy development and implementation, and serving as a networking and cooperation center. Each center also has similar organizational structures with a local or regional organization acting as the host/implementing partner and support coming from international core partners. The Austrian Development Agency and UNIDO are the two common core partners among all the centers, with additional core partners for some centers. This section is focused mostly on EACREEE, as it is the more relevant COE for Burundi, with a brief summary of each of the other centers below:

- **Economic Community of West African States Centre for Renewable Energy and Energy Efficiency** operates out of Cape Verde and receives operational support from the Economic Community of West African States ("Overview of ECREEE" n.d.). Established in 2010, it is the first of the five centers on this list. Since then, the Centre for Renewable Energy and Energy Efficiency has received additional support from the U.S. Agency for International Development and the

Government of Brazil. The Economic Community of West African States (and Centre for Renewable Energy and Energy Efficiency) member states include 15 countries across East Africa.

- **Southern African Development Community Centre for Renewable Energy and Energy Efficiency** is hosted in Namibia and serves member states of the Southern African Development Community ("History of SACREEE" n.d.). This includes 16 member states from the Southern African region. The center receives additional support from the European Union Energy Initiative Partnership Dialogue Facility.
- **Regional Centre for Renewable Energy and Energy Efficiency** in the Arab region serves as the technical arm institution for both the League of Arab States and Arab Ministerial Council for Electricity ("Who We Are n.d.). As such, the center provides support to 17 member states across the Middle East and North Africa. The center lists a slew of partners ranging from international organizations, such as the United Nations Development Programme and International Renewable Energy Agency, to development aid agencies such as the German Agency for International Cooperation.
- **Caribbean Centre for Renewable Energy and Energy Efficiency** is hosted in Barbados and receives operational support from Caribbean Community, which includes 15 member states in the Caribbean ("Our Partners n.d.). This center receives additional support from the European Union, the German Agency for International Cooperation, and the Spanish Agency for International Development Cooperation.
- **Pacific Centre for Renewable Energy and Energy Efficiency** focuses its work on energy access and security, and climate change mitigation and adaptation in Pacific Island Countries and Territories ("General Background" n.d.). This center receives additional support from the Royal Norwegian Ministry of Foreign Affairs.

African Network of Centres of Excellence in Electricity

The African Network of Centres of Excellence in Electricity is an initiative by the Association of Power Utilities in Africa. With support from the African Development Bank and the French Development Agency, this network aims to strengthen regional exchanges, facilitate knowledge transfer, and build the expertise of technical power professionals such as technicians and engineers, as well as nontechnical power professionals like policymakers ("African Network of Centre's of Excellence in Electricity Impact Evaluation" n.d.). The center functions as an education hub for utilities by offering training modules, training scholarships, and by supporting the expansion of existing training centers ("The ANCEE" n.d.). When established in 2015, the African Network of Centres of Excellence in Electricity set targets to train 7,500 professionals and 250 managers, designate 33% of training course for women and 50% for vulnerable employees, and design 25% of trainings to focus on energy transition ("African Network of Centers of Excellence in Electricity (ANCEE)" n.d.). The African Network of Centres of Excellence in Electricity consists of 10 training centers, each located within a national electric utility in countries spanning Africa. Examples include Zambia Electricity Supply Corporation in Zambia, Eskom in South Africa, and Kenya Electricity Generating Company in Kenya.

Egypt

Established in 2019, the Egypt COE for Energy aims to influence energy engineering education in the country, foster a culture of collaborative research, provide educational and industry opportunities, build local expertise, and serve as a knowledge repository ("Center of Excellence for Energy" 2022). This center is supported by the U.S. Agency for International Development, hosted by Ain Shams University, and is jointly executed by the Massachusetts Institute of Technology, Aswan University, and Mansoura

University. It is one of three Centers of Excellence under this initiative in Egypt, the others focusing on agriculture at Cairo University and water at Alexandria University (Hill 2020).

Singapore

The Sustainable Energy COE in Singapore is primarily an organization that aims to build capacity among Asian policymakers in the sustainable energy sector ("About" n.d.). With support from the Asian Development Bank and implemented by the Sustainable Energy Association of Singapore, this center serves as a knowledge-sharing platform for policymakers across Asia to share ideas and best practices, and connects sustainable energy companies to projects available across the continent. The Sustainable Energy COE does this by hosting seminars, workshops, and sharing sessions for up to 150 policymakers across Asian Development Bank's 46 developing country members (Sustainable Energy Center of Excellence" 2018).

3.3.2 Renewable Energy Promotion Center in Burundi

The renewable energy promotion center in Burundi can be an independent institution or be under the oversight of one of the government agencies or be part of the REGIDESO, or a combination of these options. More detailed information would be needed from the relevant stakeholders to make a specific recommendation.

A promotion center can take many different forms and serve different functions. The role of a renewable energy promotion center for Burundi could consider the following elements to build on strengths, reduce weaknesses, harness opportunities, and mitigate threats listed and identified in the SWOT analysis.

- **Renewable energy training center:** a promotion center could focus on the workforce development, training people in siting, installation, operations, maintenance, and more. The center can provide certifications/accreditations. As mentioned earlier in the report, Burundi has high technical potential across renewable sources like solar, wind, and geothermal. A training center could help train energy professionals to harness that potential and more effectively develop renewable energy projects in the country.
- **Resource clearinghouse:** a promotion center could be an internet-based clearing house of different resources for those involved in renewable energy deployment, such as forms, resource assessments, contract examples, etc. Burundi's intentions to develop and increase renewable energy adoption are documented across different policies and plans such as National Climate Change Policy, National Action Plan for Adaptation to Climate Change, National Development Plan (2018-2027), Burundi Poverty Reduction Strategy Paper (PRSP-II), and Burundi 2025. As a resource clearinghouse, renewable energy promotion center can act as a repository for all these resources in addition to providing context on how they can be harnessed by public and private actors. It can also serve as a forum for collaboration and communication between energy professionals in and out of country.
- **Research center:** a promotion center focused on research could conduct research into local renewable energy technologies, deployment, policies, incentives, and more. It could be an institution in-country that drives innovation in renewable energy. In Burundi, a research center could study different options that could be used to replace biofuels for cooking and heating to find the best solution for the Burundi context. Such a research center could partner with a local university to promote deeper learning and coordination. In addition, as a research center, it could collect, and store essential data required for continued renewable energy development. As there is currently a

lack of energy data in the country, this makes it difficult for public and private actors to provide technical, financial, and infrastructural assistance to Burundi.

- **Deployment and financing center:** a promotion center could focus on deploying renewable energy in the local context. The center could provide technical assistance or engineering assistance to selected renewable energy projects. For example, such a center in Burundi could focus on funding and implementing solar-plus-storage technologies for rural and remote households. The 2015 Electricity Act enables foreign investments into the power sector. In addition, laws in Burundi allow tax benefits for energy investment and public-private partnership. However, without coordinated and focused efforts to direct those investments to impactful projects and initiatives, these strengths can become a missed opportunity. A promotion center could set up a financing partnership program that attracts and facilitates foreign and in-country investment toward the deployment of the renewable energy technologies in Burundi in a concerted and focused manner.
- **Education center:** a promotion center focused on education could develop educational programs for students and teachers of all levels. Such a center could partner with local schools and universities to build programs to help grow the energy industry workforce by developing and implementing a workforce development plan.
- **Quality control center**: select and promulgate standards regarding equipment performance, installation, operations and maintenance, and disposal. A center focused on quality could also convene industry stakeholders (equipment suppliers, installers, operations and maintenance providers, financiers, insurance) to address common issues and enforce quality standards among members.
- **Government support center**: a renewable energy promotion center designed to support the government of Burundi would conduct activities like prepare 5-year plans for renewable energy development, review and analyze the impacts of energy policy on renewable energy development, as well as facilitate dialogue with developers and communities to ensure that the costs, benefits, risks, and impacts associated with renewable energy projects (social, environmental, or financial/economic) are equitably and justly distributed. Such a center would consult with government agencies and REGIDESO. In addition, a center could act as a central coordinating entity that pulls together cooperation and support across the different agencies tasked with energy development and rural electrification.

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