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RENEWABLES READINESS ASSESSMENT

BURKINA FASO

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ABBREVIATIONS

ABER	Agence Burkinabe de l'Electrification Rurale (Burkinabe Rural Electrification Agency)
ADFD	Abu Dhabi Fund for Development
AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
ANEREE	National Agency for Renewable Energy and Energy Efficiency
ARSE	Autorité de régulation du secteur de l'énergie (Energy Regulatory Authority)
ATI	African Trade Insurance Agency
BGFA	Grid Fund for Africa
BOAD	West Africa Development Bank
CO_2	carbon dioxide
COOPEL	Sociétés Coopératives d'Electricité du Burkina Faso (Cooperative Electricity Companies of Burkina Faso)
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EIB	European Investment Bank
FDE	Fonds de développement de l'électrification (Rural Electrification Fund)
FEI	Facility for Energy Inclusion
FMO	Entrepreneurial Development Bank (Netherlands)
GCF	Green Climate Fund
GDP	gross domestic product
GIS	geographic information system
GoBF	Government of Burkina Faso
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
IRSAT	Institut de Recherche en Sciences Appliquées et Technologies (Research Institute for Applied Sciences and Technologies)
kW	kilowatt
kWh	kilowatt hour
MIGA	Multilateral Investment Guarantee Agency
MoE	Ministry of Energy
MRAH	Ministère des Ressources Animales et Halieutiques (Ministry of Animal Resources and Fisheries)
MW	megawatt

ABBREVIATIONS

NDC	Nationally Determined Contribution
PACAO-BF	Programme d'Appui à la Compétitivité de l'Afrique de l'Ouest- volet Burkina Faso
PADOEL	Cost-Effective and Reliable Electricity Supply Project
PANER	Plan d'Action des Energies Renouvelables (Renewable Energy Action Plan)
PARSE	Programme d'Appui aux Reformes de l'Energie (Energy Reform Support Programme)
PASEL	Projet d'Appui au Secteur de l'Electricité (Electricity Sector Support Project)
PDCEL	Projet de Développement des Connexions à l'Electricité (Project for the development of electricity connections)
PEPU	Projet d'Electrification des zones Peri-Urbaines (Peri-urban electrification project)
PNB	Programme National Biodigesteur
PNDES	Plan National de Développement Economique et Social (National Plan for Economic and Social Development)
PRAEL	Grid Development and Access Project
PREDEL	Projet de Renforcement de l'efficacité dans le domaine de l'électricité
PRODERE	Regional Program for the Development of Renewable Energy and Energy Efficiency
PV	photovoltaic
RLSF	Regional Liquidity Support Facility
ROGEAP	Regional Off-Grid Electrification Access Project
RRA	Renewables Readiness Assessment
SOLEER	Projet Solaire à Large Échelle et d'Électrification Rurale (Large-Scale Solar and Rural Electrification Project)
SONABEL	Société Nationale d'Electricité du Burkina (National Electricity Company of Burkina)
SONAHBY	Société Nationale des Hydrocarbures (National Hydrocarbon Company)
TDE	Taxe de Développement de l'Electrification rurale (Electrification Development Taxes)
toe	tonnes oil equivalent
UEMOA	Union Économique et Monétaire Ouest Africaine (West African Economic and Monetary Union)
UN	United Nations
UNDP	United Nations Development Programme
USD	United States dollar
VAT	value-added tax
WACEC	West Africa Clean Energy Corridor
WAEMU	West African Economic and Monetary Union
WAPP	West African Power Pool
XOF	West African franc

Village in Burkina Faso

EXECUTIVE SUMMARY

Burkina Faso's economy is driven mainly by the agricultural, livestock, mining, financial services and telecommunications sectors. Agriculture employs a quarter of the population, which lives primarily from subsistence agriculture and farming. The mining sector, including gold production, has more than doubled in the last decade and accounts for 70% of export income and 11% of gross domestic product (GDP) (INSD, 2020a). The economy is vulnerable to the country's challenging security situation – which affects the mining and agricultural regions – as well as to the volatility of gold prices. In addition, the restrictions imposed by the COVID-19 pandemic have strongly impacted both the economy and society.

In 2019, Burkina Faso had one of the lowest electrification rates of the member countries of the Economic Community of West African States (ECOWAS), with only 22% of the population having electricity access, leaving 15.9 million people without access. Rural residents rely mostly on traditional biomass, such as charcoal and fuelwood, to meet their energy needs, contributing to deforestation, indoor air pollution and other impacts. The second largest energy source after biomass is imported oil. The country is fully reliant on oil imports, and nearly a quarter of these go towards electricity generation. The situation is critical, as oil imports accounted for nearly 20% of the national account balance in 2019.

When electricity services are available, urban areas of Burkina Faso have access to expensive and unreliable electricity supply. Without significant decarbonisation of the energy mix, economic growth and improved access to energy would result in increased oil imports, potentially further undermining the economic balance of the country. Economic development in Burkina Faso is linked to increased energy consumption. With GDP growth of 5-6% annually since 2015, the country's energy supply mix is under increasing pressure.

The current energy situation is not scalable or sustainable – from both an environmental and an economic standpoint – due to subsidies and imports. The country is currently deploying a strategy that could satisfy the growing needs of the economy as well as support the goal of reaching universal energy access. To be successful, the strategy should build on solutions that deliver sustainable and affordable energy, with predictable prices.

Access to affordable energy involves access to electricity services as well as to clean cooking, shifting away from traditional charcoal or wood-based biomass. The underlying drivers of these access objectives include social and economic development in rural communities. With the recent security threats and the COVID-19 pandemic, there is a growing need to boost the resilience of communities to external threats.

Public infrastructure, for instance, is necessary to establish the link between the central government and remote localities. Continuous energy supply during critical events is a requirement for sensitive building locations such as hospitals, schools, telecommunications and public buildings – as well as for remote communities in zones of high instability. In many locations, the availability of local renewable energy resources can supply local, affordable and reliable energy.

Burkina Faso has sufficient renewable energy potential to meet its national targets. The renewable energy projects currently identified in the country's pipeline are based primarily on grid-tied solar photovoltaics (PV), as it is affordable, scalable and can be deployed over short time frames.

Dependency on a single resource, however, implies the need to adjust to its availability and variability. The integration of a single source of variable renewable energy (*i.e.* solar) would need to be supported by additional investments in storage technologies and balancing on the regional grid.

Being well connected to its neighbours (Ghana, Ivory Coast and Togo), Burkina Faso has the potential to balance out its electricity imports from the regional grid. Strong integration into a regional electricity market is also an efficient means to look towards high shares of renewable energy on the network, without the need to increase the back-up capacity from fossil-based fuel plants – provided that the market can absorb excess production.

If other renewable energy resources could be harvested, additional power system management strategies might be integrated, as the different resources (wind, hydropower) carry different variability time frames. The capacity credit[1] of renewables could be higher for a portfolio of technologies than for a single resource.

Burkina Faso has had previous experiences with biogas and biofuels, albeit for non-power uses, and despite large uncertainties of the resource. This could be an asset in addressing the issue of inefficient cooking and deforestation.

Employment in the energy sector could be a key socio-economic benefit of renewables in the country, as the informal economy represents a significant loss of national income. The informal sector employs an estimated 74% of the non-farming workforce and may contribute up to 25% of the GDP (Ouedraogo, 2021). Renewable energy projects would require both skilled and unskilled workforce and can create formal job opportunities.

With adequate policies, renewable energy could provide avenues for technological innovation and the opening of new sectors for economic value creation. The same may be true for energy efficiency, where small entrepreneurs and companies can be involved in the adoption of energy-efficient appliances and equipment for energy self-generation.

Renewables are expected to reduce emissions, as greenhouse gas emissions from the country's energy sector have increased four-fold between 1995 and 2015. Emissions are expected to nearly three-fold between 2015 and 2030 (GoBF, 2021a).

In its Nationally Determined Contribution (NDC) towards reducing emissions under the Paris Agreement, Burkina Faso has committed to reducing its emissions to nearly 30% by 2030 compared to the 1995 base year. The NDC already emphasises the use of alternative and renewable energy sources to achieve this target. Renewables also offer the most prominent low-carbon solution to meeting the country's climate targets.

Burkina Faso has developed a number of strategies for the energy sector, including the Renewable Energy Action Plan (PANER) of 2015 and the National Plan for Economic and Social Development (PNDES) of 2016. Expanding on the PNDES, the Energy Strategy 2019-2023 identifies the challenge of energy dependency and its cost to the economy. Adopted in 2018, the Strategy notes the lack of production capacity in the country and the decommissioning of fossil fuel power plants scheduled from 2020 onwards.

The Energy Strategy seeks to ensure sustainable access to modern energy services, to promote energy efficiency and to build on endogenous resources and regional co-operation. Compared to the PNDES, which targets the year 2020, the Strategy looks to 2022 and increases the targets related to grid coverage (raising it from 80% to 90%), urban access (from 75% to 80%) and national access (from 45% to 60%).

Currently, many of the success indicators that would demonstrate compliance to the implementation trajectory are not met. Implementation is delayed related to national grid coverage, the national electrification rate (particularly in rural areas where the gap is the largest), the share of renewables in total energy production, and the installed renewable capacity.

[1] Defined as the contribution of a power plant to reliably meet demand.

Financing the energy transition

The renewable energy sector of Burkina Faso is considered to be a strategic priority for international co-operation and investment, for several reasons. These include the government's strong commitment to the development of renewables as an alternative to costly imported fuels, the high rates of solar irradiation in the country, the current financial soundness of the national off-taker (SONABEL) and the strategic status of the Sahel region for development aid.

On-grid renewable energy projects developed in Burkina Faso are financed mainly by international lenders and investors, although efforts are being made to involve regional and local banks in the financing of renewables in the country. The off-grid sector also requires massive and relevant investments from both local and international financing sources. The increasing need for equity and debt financing and for other specific financing instruments (to bridge financing gaps, finance development tasks, etc.) is an opportunity for both international and local financing actors to support urban and rural electrification in Burkina Faso.

The main financing instruments for renewable energy projects are debt instruments, granted by development finance institutions and, to a lesser extent, by regional and local banks. Some projects developed by the state can benefit from grants and subsidies, but also from external concessional financing from development finance institutions. Several guarantees can also be leveraged in Burkina Faso to strengthen the financial structuring of renewable energy projects. Over the past decade, many regional and national policies and programmes have been developed to reinforce the financing framework of renewable projects in the country, mobilise international and local funding sources, and develop financial incentives. However, some factors still hinder the financing of renewables. For example, the regulatory framework specific to renewable energy project financing, as well as existing regulations, need to continue to be reinforced and consolidated. Financial institutions also have raised concerns about the long-term financial stability of SONABEL. Moreover, it appears necessary to increase investments in grid capacity and electricity storage and to support new financing instruments specifically for the development of projects and the off-grid sector. Finally, the growing security risk challenges further development and financing of renewable energy projects.

Key Recommendations

The key recommendations to improve Burkina Faso's readiness towards the adoption of renewable energy and to help overcome these challenges, including how to attract financing to the country's renewable energy sector, as outlined in the report, are as follows:

Reinforce the institutional framework. Burkina Faso has well-developed regulatory frameworks and policies, but their performance is not up to standards. The institutional framework also is well developed, with each actor having a clear mandate. However, a gap lies in enforcement of the existing mandates and regulations and in assessing their impact. There is an urgent need to fund the regulatory bodies to meet expectations, to build internal capacities of the institutions, and to secure stable financing in order to fully operationalise their legal mandate.

Develop and iteratively update an Integrated Resource Plan. The country lacks integrated planning and clear investment plans for on-grid capacity and infrastructure. The country is facing a shortage of capacity, lacks electricity access and faces high power prices despite high subsidies to the power sector. Current programmes are targeted at filling the capacity gap with solar PV (mainly) and improving access primarily through grid extension.

The capacity shortage is the main driver for investment decisions. However, the planning of future investments lacks appropriate demand forecast modelling and optimisation of the energy supply in order to meet the peak demand in the medium to long term. An Integrated Resource Plan (IRP), regularly updated, is needed to clarify future investments moving forward and to address the structural fiscal deficit of the power sector. The IRP should build on realistic demand projections that encompass grid-connected loads – including the potential connection of some mines and industrial centres to the main grid, self-generation on the distribution networks, off-grid self-generation, mini-grids and solar home systems – in order to clearly establish the physical boundaries and to articulate the interactions among segments over time.

Reinforce the grid and develop storage solutions at a large scale. While investments currently focus on the generation of additional electricity (especially at the utility scale), a significant share of investment should now be concentrated on grid reinforcement and the large-scale development of storage solutions., This would make it possible to absorb the additional generated capacity and therefore reassure investors about the sustainability of the country's renewable energy sector.

Develop business models for rural electrification that are attractive to private investors. Rural access to electricity relies on a failed business model for co-operative electricity companies (COOPELs). This model is falling short to scale up access through diesel mini-grids across the country. Several co-operatives have struggled to maintain efficient management of the systems and to deliver quality service to customers, in part because the tariff was insufficient to cover the operations and maintenance costs, and because the revenue collection can be challenging in rural communities where income is scarce and impacted by agricultural outputs. Business models for rural electrification should be developed to attract private investors.

Strengthen the existing legislation and contracts to create financial and fiscal incentives. There is a need for more stringent enforcement of existing legislation and contracts to create incentives for developers and therefore attract additional developers and investors in the country. The existing renewable energy regulatory framework should be amended to allow for self-generation projects in order to reduce the existing obstacles to the development of such projects and to accelerate the deployment of new projects for large industries and mines.

Develop specific and affordable renewable energy financing instruments, including with local financing institutions. The renewable energy finance ecosystem remains weak in Burkina Faso. While international development finance institutions and lenders commonly provide traditional instruments to finance renewable energy projects in the country, there is a lack of hybrid financing instruments and of local financial players and services (local banks and insurers), especially for small-scale off-grid projects. Developing specific renewable energy financing instruments and supporting players could offer more flexibility to the market, increase available resources, and drive down costs, thus fostering project development.

Operationalise on-grid rooftop solar, net metering and prosumers. Self-generation and net metering are currently not available, despite their potential advantages to support distribution grids. Awareness, financing, net metering, and certification of installations and materials should support the emergence of rooftop solar PV, both in the commercial and industrial sector and in the household segment. On-grid rooftop solar, net metering and support for prosumers would benefit the management of distribution grids.

Consider and regulate the solar home system market as a sizeable market segment for access. Electricity access is currently provided through an unregulated market for solar home systems. Burkina Faso accounts for 10% of the solar home systems sold in West Africa but is essentially an unregulated market for energy access services, with discrepancies in prices and quality of service to consumers. Consideration should be given to regulating the solar home system market as a sizeable market segment for energy access, thus providing opportunities for affordable, quality energy access services to be provided to a large share of the population.

Develop a strategy to position local industries across renewable energy value chains. Local entrepreneurship is underdeveloped due to asymmetric competition from imported low-cost equipment, in the absence of quality certification. However, Burkina Faso demonstrates skills in several renewable energy sectors, such as solar panel assembly, assembly of solar devices, biodigesters and hydropower. It also has local competence centres, which have the capability to train young professionals and women in the sector.
©
Standards and quality assurance mechanisms are needed to ensure that products perform according to specifications and are reliable, safe and durable. This is particularly important in rural areas, where consumers have limited room to select their supplier. By referring to appropriate standards in the legislation, and ensuring compliance, one outcome is to create a competitive market for renewable energy technologies based on quality and safe products and services. This can create a competitive level playing field for local small and medium enterprises, which have struggled to emerge in a market supplied by low-cost imported products.

Assess the bioenergy potential for power generation, transport sector and clean cooking. The bioenergy sector has large potential yet lacks strategy. Despite an urgent need to move away from unsustainable uses of traditional biomass, there is a lack of capacity in bioenergy technology, standards, deployment and maintenance of bioenergy products. Due to the small-scale of the projects and the low purchasing power of consumers, private sector investment is lacking, and capacities to initiate projects are limited.

The bioenergy potential from residues and waste should be assessed in detail, and the scalability of existing demonstration projects and their market potential should be clarified, to identify promising avenues and to discard prototypes that lack scalability potential. One recommendation is to use the Bioenergy and Food Security Rapid Appraisal (BEFS-RA) methodology of the Food and Agriculture Organization of the United Nations (FAO) to undertake a robust and comprehensive assessment of the potential to develop sustainable bioenergy at the national and, if need be, sub-national levels.

Review the hydropower potential and current project proposals. Estimates of the hydropower potential are outdated, which limits the appetite to prospect opportunities and exacerbates the country's dependency on a single variable renewable resource. Technical support is needed to review past studies and to assess the bankability of the hydropower potential in terms of refurbishment, repowering and new sites. If operated flexibly, hydropower may be able to provide baseload capacity and support for the integration of variable renewable sources.

Grand Mosque Ouagadougou, Burkina Faso

I. INTRODUCTION

1.1 Country Background

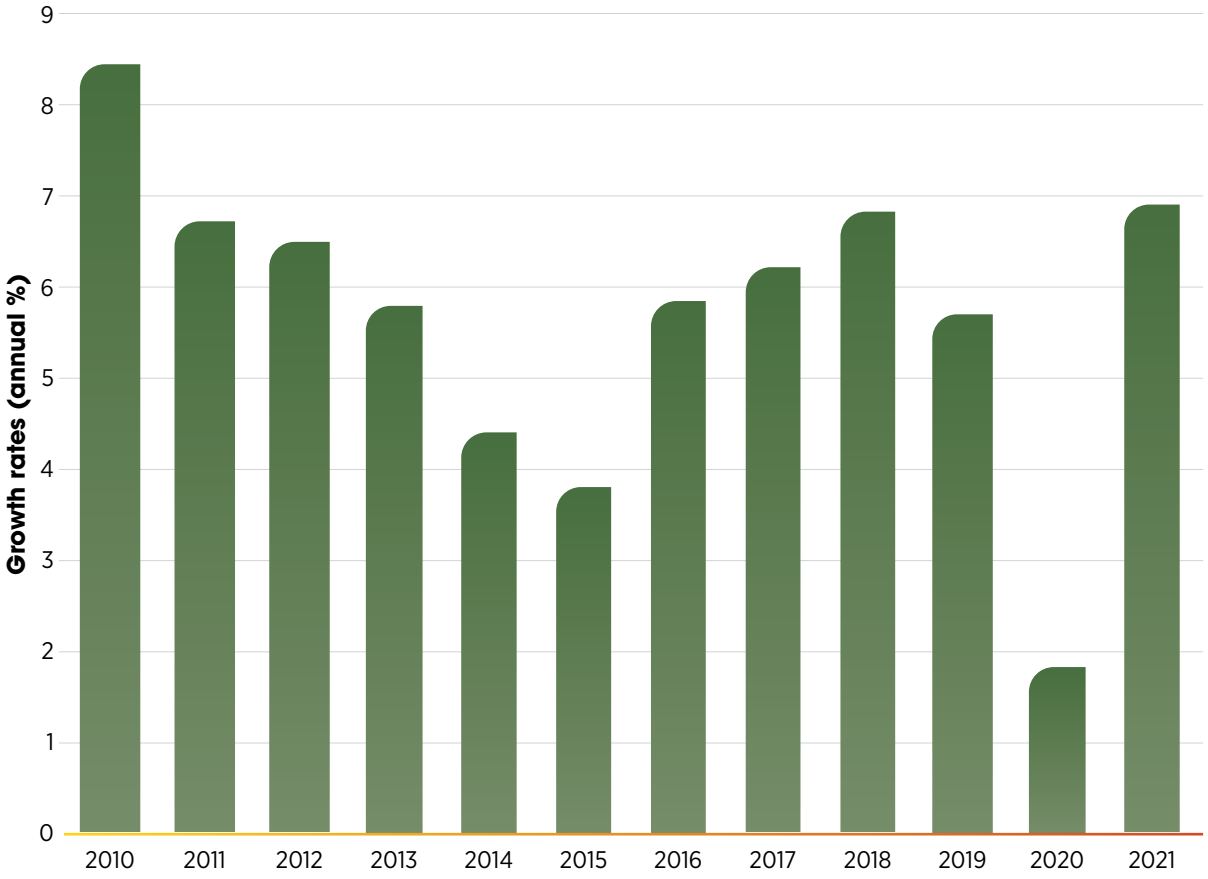
Burkina Faso is a landlocked country located in western Africa. The territory extends over 272 000 square kilometres (km^2) and mainly occupies a plateau with altitudes ranging from 250-400 metres (m) above sea level. Most of the country is flat and covered with savanna in the north and sparse forests in the south. In the south-west, the Banfora Escarpment borders sandstone plateaus. Three rivers – the White, Red and Black Volta – traverse the country and converge in Ghana to form the Volta River. Of these rivers, only the Black Volta flows throughout the year, with seasonal variations. Burkina Faso suffers from water shortages due mostly to the seasonal variations of some rivers, mainly in the north.

The capital city, Ouagadougou, is located in the centre of the country. The territory is divided into 13 administrative regions and 45 provinces. The official language of Burkina Faso is French, although several languages from the Niger-Congo family are widely spoken, such as Moore, Dyula and Fulani. The official currency of the country is the West African Franc or CFA Franc (XOF), which is a common currency across the West African Economic and Monetary Union.[2]

Burkina Faso's climate is shared between the country's semi-arid north and its tropical wet-dry south. Decreasing rainfall, higher yearly variability and increasing temperature are expected effects of climate change that will likely impact the already vulnerable agricultural sector. Since the early 1970s, the country has experienced "quasi-drought" conditions, while severe flooding has concurrently occurred in the northern and central regions in the past three decades. The dry season brings the harmattan winds, causing sandstorms in the country's central areas (World Bank, 2021a). In 2016, Burkina Faso's greenhouse gas emissions per capita totalled 0.183 tonnes of carbon dioxide (CO_2), among the lowest in the world.

[2] In 2019, the replacement of the XOF by the ECO, a common currency proposed by the Economic Community of West African States (ECOWAS), was announced. Reforms towards the creation of the ECO are ongoing.

Figure 1: Real GDP growth rate in Burkina Faso, 2010-2021



Source: World Bank, 2021b; AfDB, 2020a; World Bank data portal.

The country's economy rests on the agricultural, mining, and financial services and telecommunications sectors, which contributed around 30%, 20%, and 50%, respectively, to the gross domestic product (GDP) in 2020 (GoBF, 2021b). Agriculture employs around 26% of the population (World Bank, 2020a), which lives primarily from subsistence agriculture and farming.[3] The national income comes mainly from crop production, with cotton export contributing 11% of the income total, and oleaginous nuts and seeds and derived flours contributing 7%. The gold mining sector has more than doubled in the last decade; in 2018, it reached 54.7 tonnes (t) and accounted for 70% of the export income and 11% of GDP (INSD, 2020a).

The economy could potentially be impacted by Burkina Faso's challenging security situation – which affects the mining and agricultural regions – as well as by the volatility of gold prices. In addition, the restrictions imposed by the COVID-19 pandemic have strongly impacted both the economy and society. Real GDP growth reached 5.7% in 2019 and then fell to -2% in 2020 due to the pandemic-related slowdown (World Bank, 2021b) (Figure 1). Real GDP growth before the pandemic was driven mainly by growth in the secondary and services sectors, along with continuous growth in private and public consumption (AfDB, 2019a). The country's external debt risk rating continues to be moderate.[4]

The 2019 census estimated a total population in Burkina Faso of 20.5 million inhabitants (INSD, 2020b), up 46% since 2006 (INSD, 2008). Most of the population is sparsely distributed across the country, while a few high-density centres are located mainly along the railway corridor linking the city of Ouagadougou to Abidjan in Côte d'Ivoire. The exodus from rural to urban areas has continued, with the share of the population living in urban areas rising from 6.4% in 1975 to 29.3% in 2018.

According to 2020 estimates, 6.4% of the total labour force is unemployed (UNDP, 2021); however, the informal economy employs an estimated 74% of the non-farming workforce and may contribute up to 25% of GDP (Ouedraogo, 2021). The services sector employs 48.6% of the labour force, followed by agriculture (26.3%) and industry (25.2%) (World Bank, 2021c). Around 31% of the population lives below the international poverty line (of USD 2.15 a day), and the country faces numerous challenges related to health and education (World Bank, 2023). The United Nations Development Programme (UNDP, 2022) reports a Human Development Index rating of 0.452 for Burkina Faso in 2020, up 54% from the 2000 level of 0.293 but still comparatively low.

[3] Predominant crops are cereals (sorghum, millet, maize, rice, fonio), cash crops (cotton, groundnut, cowpea, sugar cane), root and tuber crops (cassava, sweet potato, yam) and fruits and vegetables (FAO, n.d.).

[4] Standard & Poor's rating as of March 2021.

Despite the ongoing terrorism menace that has displaced populations, the economy performed well in 2019, driven by growth in the tertiary sector and under the guidance of the National Economic and Social Development Plan (PNDES) (IMF, 2020). In 2020, the economy was greatly affected by the effects of the pandemic, suffering from reduced trade, transport, tourism and hotel activity. Moreover, inflation rose to 1.4% in 2020, following the 2.3% deflation of 2019, due largely to rising food prices (AfDB, 2020b).

Burkina Faso ranked 151st from the top (out of 190 countries) in the World Bank's Ease of Doing Business index in 2020. This included sub-rankings of 183rd on "Getting Electricity" (due mainly to low scoring on factors such as the reliability of supply, transparency of tariffs, excessive cost to complete connections and excessive lengthy procedures); 165th in "Enforcing Contracts" (due to lengthy procedures and high costs); and 88th in "Starting a Business" (World Bank, 2020b).

Delays and cancellations of projects in the electricity and water sectors are to be closely monitored, as they will have a direct impact on the ability of the country to achieve the desired level of economic development through the PNDES. Agriculture and water availability are also at increased risk, as climatic conditions are likely to worsen with climate change.

1.2 Role of energy in development in Burkina Faso

Energy is a key driver of economic growth in Burkina Faso, and a reliable energy supply is required to ensure the continued development of relevant sectors of the economy.

- **Energy for services:** Services are among the highest energy consumers in the Burkinabè economy, after households and transport. Renewable energy sources have a significant role to play in the development of this sector by providing affordable, reliable and sustainable energy supply. The communication sector has relied on solar photovoltaics (PV), operating around 1.3 megawatts (MW) of installed capacity in 2014 (GoBF, 2015). Solar PV also has played an important role in powering local government services, including municipal and social infrastructure (schools, health centres) (MoE, 2020a).

- **Energy for tourism:** Tourism has limited weight in the country's economy and has suffered from restrictions related to the COVID-19 pandemic as well as from the deteriorating security situation over the last decade. Some tourist attractions have invested in solar PV installations to cover all or part of their electricity needs. Compared to stand-alone diesel generators, solar PV provides a noise-free electricity supply and has lower operation and maintenance costs.

- **Energy for agriculture:** Subsistence agriculture generates around a third of the country's GDP. It relies on traditional farming methods and is essential for stabilising food security, although it is vulnerable to climate events. Water pumping with renewable energy could help to limit dependency on rainfall and could increase production yields (MoE, 2020b). The use of biofuels at large scale has not been implemented yet, although some production sites for sugar and edible oils have set up individual energy facilities that generate heat and electricity (GoBF, 2015).

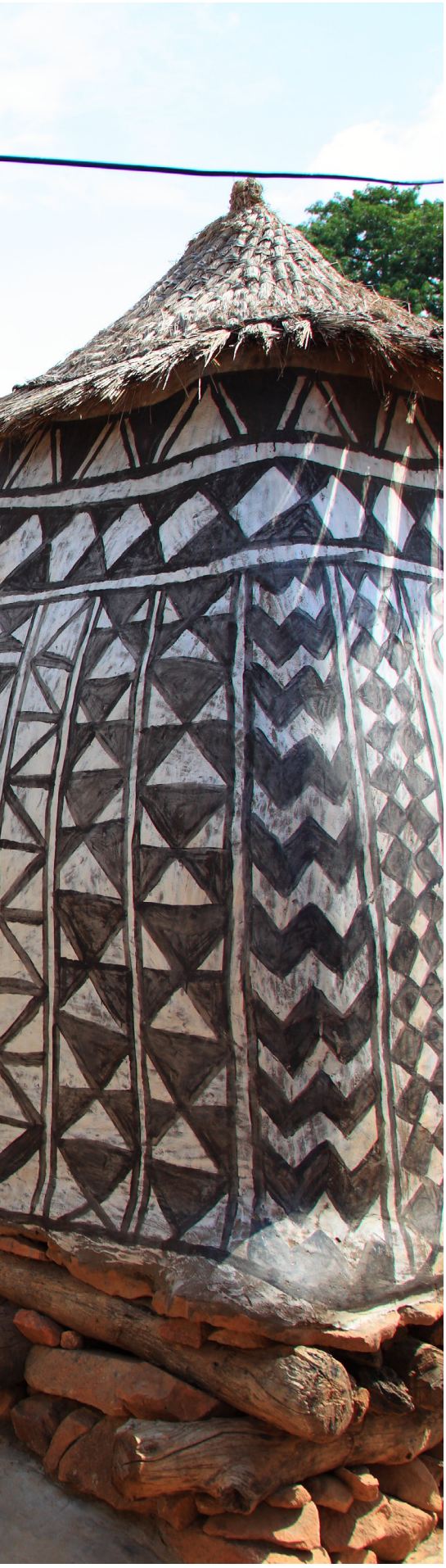
- **Energy for industry and mines:** Energy shortages result in losses to the national economy, in particular to the industry and mining sectors, which have struggled to take off. According to the Ministry of Mines and Energy,[5] Burkina Faso has 17 mines in operation, with an estimated total capacity above 400 MW. The Ministry is actively seeking to connect some of these facilities to the main electricity grid. Some mining companies have invested in stand-alone fossil-fuelled energy systems, although recent interest has arisen in hybrid generation combining solar PV and diesel generators (IFC, 2019).

- According to a World Bank survey, in 2009 more than 91% of the companies surveyed suffered from power cuts, lasting 3.3 hours per day on average (World Bank, 2009). At the time of the survey, electricity was considered among the top business obstacles for firms. According to the Ease of Doing Business Index, power reliability (score of 0 out of 8) remains a concern today.

- **Regional electricity integration:** Burkina Faso is a member of the West African Power Pool (WAPP) and depends on imports from neighbouring countries for its electricity supply. To reinforce this electricity transfer, three interconnections are foreseen: the Bolgatanga-Ouagadougou interconnector (Ghana-Burkina), in operation since 2018, as well as the North Core and Dorsale Nord Regional Power interconnector (across Nigeria, Niger, Burkina Faso and Benin) and the Ghana-Burkina Faso-Mali interconnector, both in the preparation phase (MoE, 2018a). These projects are aligned with the WAPP's ambition to create a fully functional regional energy market (AfDB, 2020c). In the WAPP's Regional Master Plan for 2019-2033, Burkina Faso has been identified to host a regional solar park of 300 MW to be deployed in two phases of 150 MW each, the first during 2024-2029 and the second during 2030-2033 (WAPP, 2019a).

[5] Input from the Renewables Readiness Assessment validation workshop.

Traditional buildings, Burkina Faso



2. ENERGY CONTEXT

2.1 Regional energy context

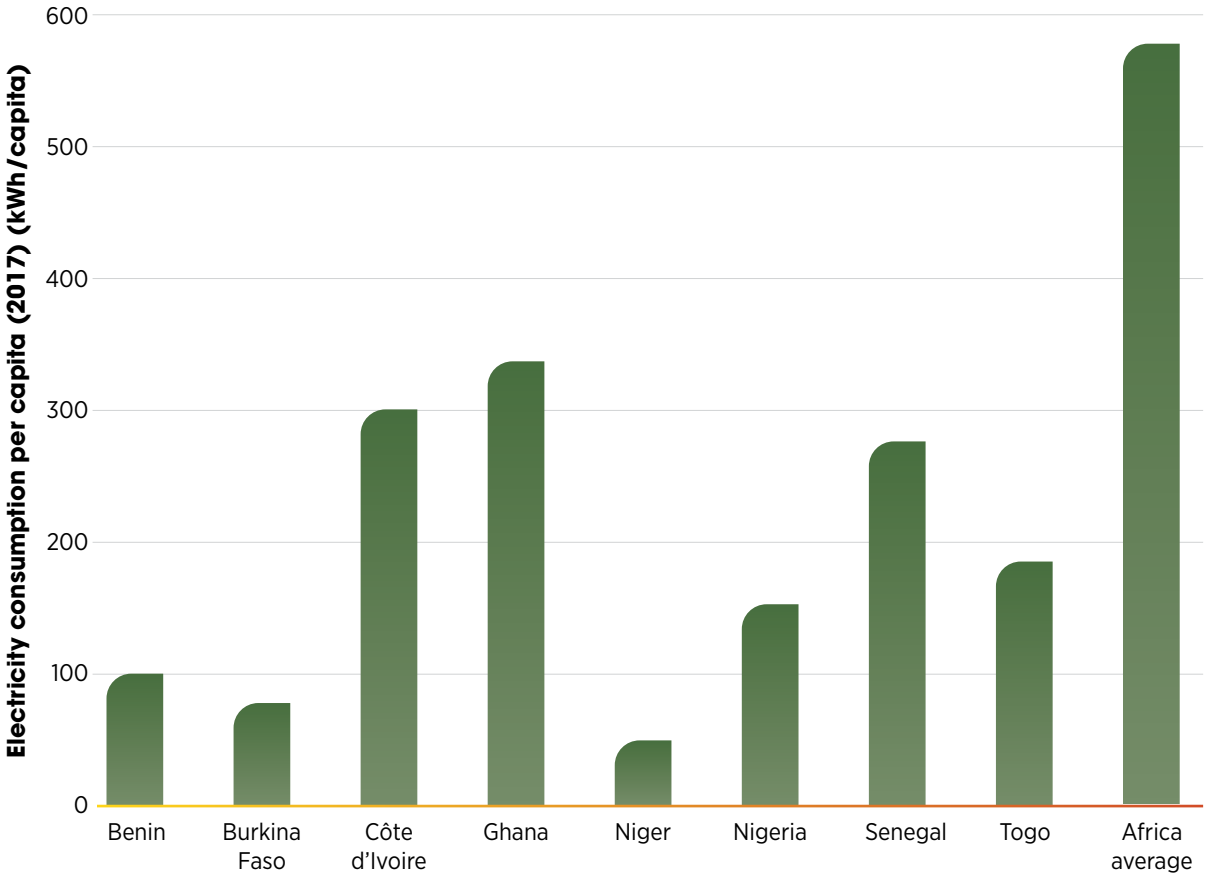
The West Africa region[6] has among the lowest levels of economic development on the continent, with significant disparities among its members. For example, in 2019 the per capita annual GDP in Cabo Verde was USD 3 604 and in Sierra Leone was USD 522 (compared to USD 796 in Burkina Faso). For comparison, the average per capita annual GDP in the Sub-Saharan Africa region was around USD 3 800 in 2019.

Energy security affects both economic growth and industrial development and remains of high importance to the governments of West Africa. The region endures energy vulnerability, fuel price volatility and system unreliability. The region is highly dependent on fossil fuels: in 2018, natural gas, oil and coal accounted for 75% of the electricity generated among the eight countries of Benin, Burkina Faso, Côte d'Ivoire, Ghana, Niger, Nigeria, Senegal and Togo. Systemic dysfunction – including a lack of governmental policies, low investment, and poor operation and maintenance of energy infrastructure – has resulted in a severe energy crisis.

Energy poverty, energy security, and climate change mitigation and adaptation are correlated challenges facing the energy sector in the region. West Africa has among the lowest electricity consumption per capita in the world, below the average of the African continent (Figure 2), although these data are limited as half of the countries of the ECOWAS region do not adequately track this indicator. Great disparities exist even within the ECOWAS community, with per capita electricity consumption in 2021 ranging from 470 kilowatt-hours (kWh) in Ghana, to 323 kWh in Senegal, to 127 kWh in Burkina Faso. Disparities in energy access and prices also exist between urban and rural areas, with urban areas typically having access to expensive and unreliable electricity supply (ECREEE, 2012).

[6] Defined here as the Economic Community of West African States (ECOWAS): Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

Figure 2: Electricity consumption per capita in selected ECOWAS countries, 2017

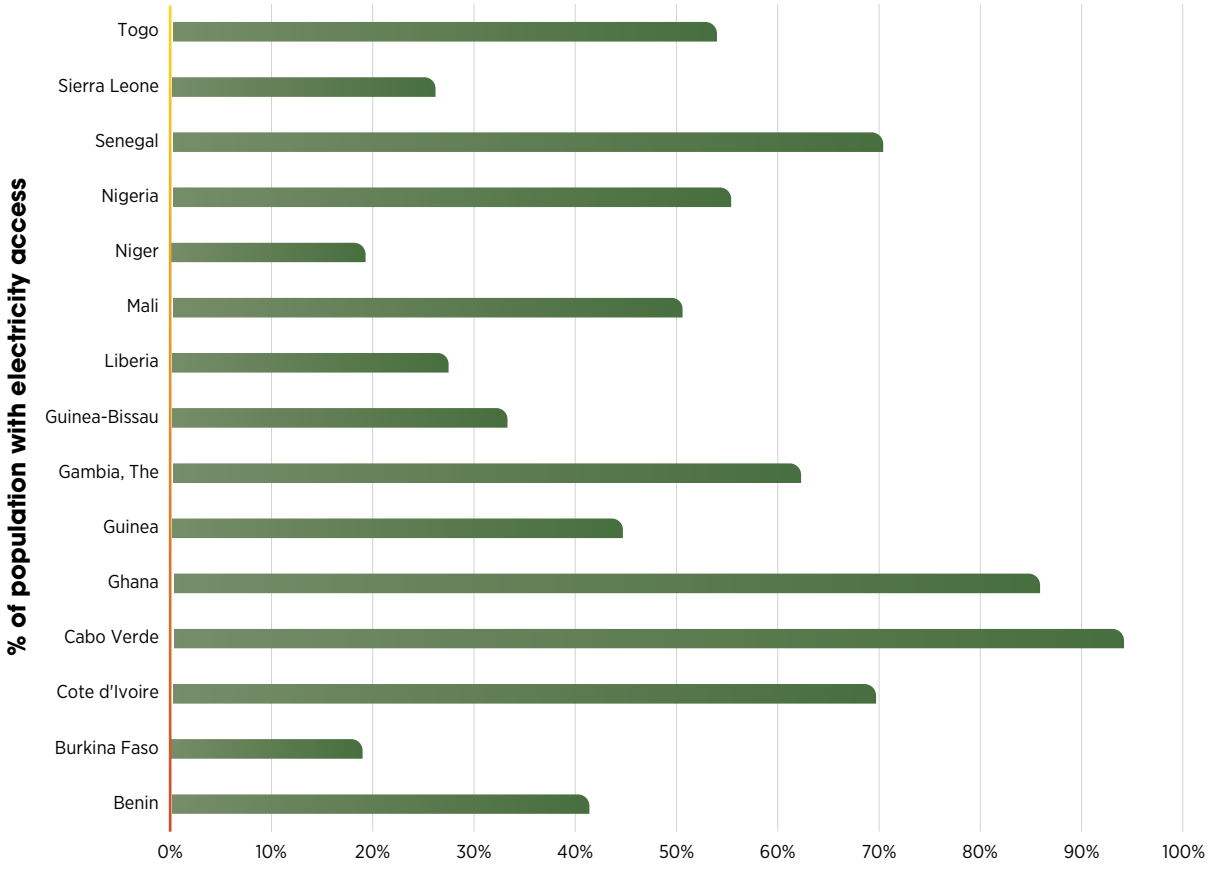


Based on IEA, n.d.; MoE, 2017.

Note: Figure includes only those countries where official data are available.

More than half of the countries in the region have low rates of electricity access (Figure 3), with the average access rate in 2019 below 50% – leaving more than 170 million people without access (ESMAP 2022). In Nigeria, where the electricity access rate was just above 60%, an estimated 77.1 million people were still without access. Burkina Faso had among the lowest rates in the region, with only 22% of its population having access to electricity, leaving 15.9 million people without access; this ranked the country third from last in the region, followed only by Liberia and Niger.

Figure 3: Electricity access rates in the ECOWAS region, 2020



Source: SDG 7 tracking framework (ESMAP, 2022).

Access to clean cooking is also a challenge in the region. Rural populations rely mostly on traditional biomass, such as charcoal and fuelwood, to meet their energy needs (primarily for cooking), contributing to deforestation, indoor air pollution and other health and environmental impacts. In sub-Saharan Africa, 73% of the population (729 million people) had no access to modern energy cooking services as of 2020 (ESMAP, 2020).

Economic Community of West African States (ECOWAS)

ECOWAS, established in 1975, includes 15 member countries[7] covering the western part of Africa. It was set up to promote economic and political co-operation and is organised in the form of institutions and 22 specialised agencies to address specific themes. ECOWAS is mandated to promote economic integration in the fields of industry, transport, telecommunications, energy, agriculture, natural resources, commerce, monetary and financial issues, as well as in social and cultural matters.

Energy-related achievements of ECOWAS include:

- developing the Regional Power Market and setting up the regulatory and economic environment;
- promoting renewable energy and energy efficiency technologies and services;
- signing the Supplementary Act on the Dakar-Abidjan Corridor and laying the first stone for the regional electricity project covering Côte d'Ivoire, Guinea, Liberia and Sierra Leone; and
- concluding a feasibility study for extension of the West African Gas Pipeline network (ECOWAS, 2016).

[7] Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.

ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)

Established in 2010, ECREEE is a specialised agency of ECOWAS that aims to promote renewable energy and energy efficiency and related topics, such as energy security, greenhouse gas emission reduction and the mitigation of climate change impacts on energy systems. It is an independent body operating within the legal, administrative and financial framework of ECOWAS rules and regulations. ECREEE's mandate is aligned with the strategic goals of the ECOWAS Vision 2020 and contributed to the goals of the ECOWAS Strategic Plan 2011-2015.

ECREEE has actively participated in activities including policy development, capacity development, knowledge management and awareness, investment and business promotion, and other specific projects together with other international organisations and institutions. Policies with notable impact on the ECOWAS member countries are the ECOWAS Renewable Energy Policy and the ECOWAS Energy Efficiency Policy (ECREEE, 2015a), described below. An impact assessment of these policies is available in ECREEE (2020). More recently, ECREEE 2023 - 2027 strategic plan has been launched as a comprehensive roadmap that outlines the Centre´s goals, objectives, and the methods it will employ to achieve them.

ECOWAS Renewable Energy Policy (EREP)

The EREP is a regional plan adopted by the energy ministers of the ECOWAS region in 2013. It includes a renewable energy plan, with the aim of defining national targets and activities. The EREP vision acts as a driver for the region regarding universal access to electricity by 2030 and more sustainable and safe provision of domestic energy for cooking. The Plan is further cascaded to the ECOWAS member countries through National Renewable Energy Action Plans (NREAPs) and corresponding Action Plans. EREP includes three groups of energy targets plus a target for local manufacturing, described as follows (ECREEE, 2021a):

- **Grid-connected renewable energy applications.** The objective is to increase the share of renewables (including large hydropower) in the overall electricity mix to 48% by 2030, and to increase the share of renewables (excluding large hydropower above 30 MW) in the overall energy mix to 10% by 2020 and 19% by 2030. This should lead to the installation of 2 425 MW of renewable generation capacity (from wind, solar, bioenergy and small-scale hydropower) by 2020, and 7 606 MW by 2030.

- **Off-grid and stand-alone applications.** The objective is to increase the share of the rural population served by decentralised renewable energy services (*e.g.* mini-grids and stand-alone systems) to 22% by 2020 and 25% by 2030.

- **Domestic renewable energy applications.** The objectives are to:
  - ensure universal access to improved cookstoves (100% access) by 2020;
  - increase the share of the population served with modern fuel alternatives (including liquefied petroleum gas [LPG]) 36% by 2020 and 41% by 2030;
  - increase the share of efficient charcoal production to 60% by 2020 and 100% by 2030;
  - increase the share of solar water heating technologies for sanitary hot water and preheating for commercial and industrial processes;
  - introduce blending ratios for ethanol/biodiesel in transport fuels of 5% by 2020 and 10% by 2030;
  - conduct research on the use of ethanol and other domestic cooking fuels;
  - prepare a separate regional policy for sustainable use of bioenergy, including biofuels and waste to power, to be adopted by the ECOWAS ministers in charge of energy; and
  - create instruments for financing sustainable energy, including carbon finance, by the end of 2013, and in the longer term establish a regional fund for the development and implementation of sustainable energy projects.
- **Regional manufacturing of renewable energy equipment.** The objective is to ensure that 7% of the renewable energy equipment, by value, installed in 2020, is regionally manufactured. This share should reach 20% by 2030.

ECOWAS Energy Efficiency Policy (EEEP)

Together with the EREP, the EEEP forms a co-ordinated regional response to address the energy crisis in the ECOWAS region. The overall target is to double the annual improvement in energy efficiency and free the equivalent of 2 gigawatts (GW) of generation capacity through:

- phasing out inefficient incandescent bulbs by 2020;
- reducing losses in electricity distribution, from the current 15-40%, to under 10% by 2020;

- achieving universal access to safe, clean, affordable, efficient and sustainable cooking for the entire population of the ECOWAS region by 2030;
- establishing an ECOWAS Technical Committee for Energy Efficiency Standards and Labelling, and adopting initial region-wide standards and labels for major energy equipment by the end of 2014;
- developing and adopting region-wide efficiency standards for buildings (*e.g.* building codes);
- creating instruments for financing sustainable energy, including carbon finance, by the end of 2013, and in the longer term, establishing a regional fund for the development and implementation of sustainable energy projects (ECREEE 2021b).

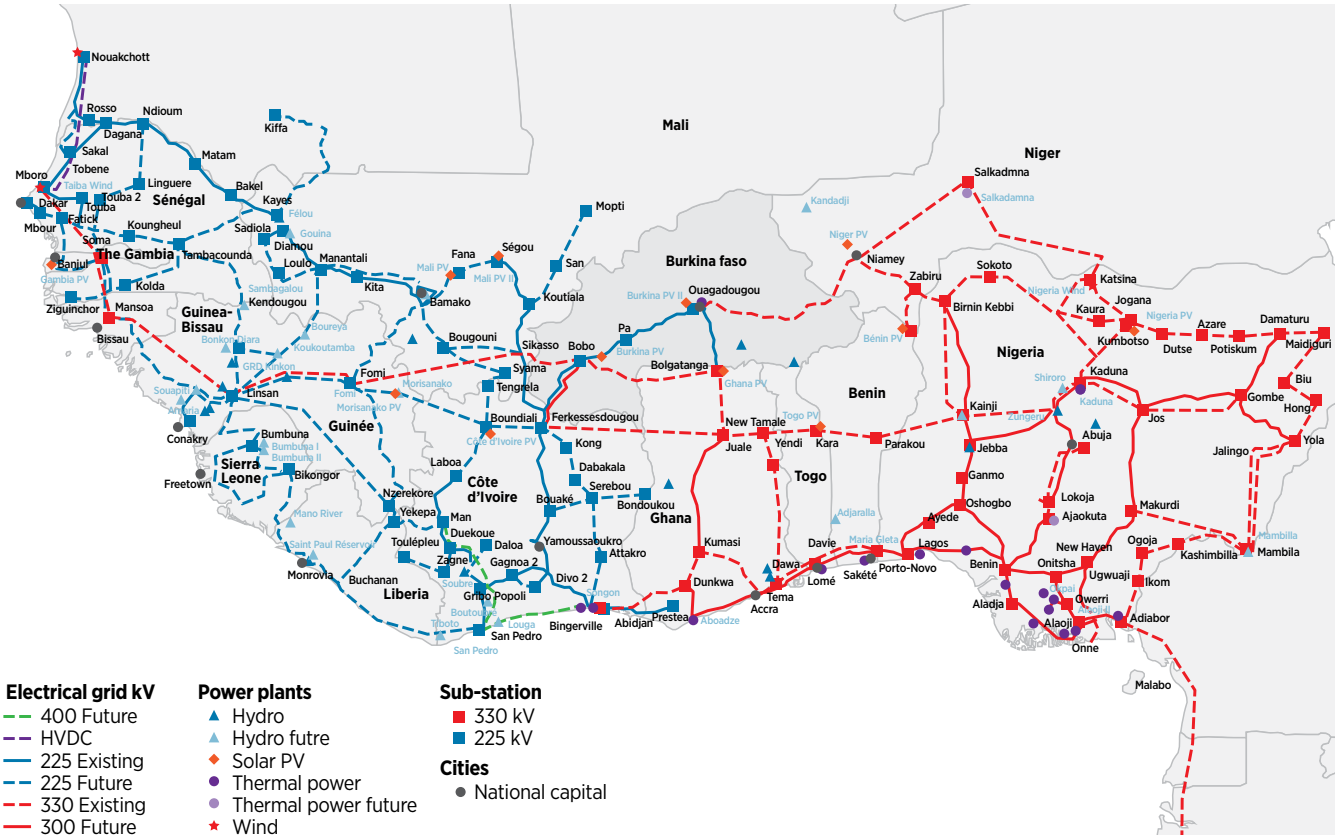
West African Power Pool (WAPP)

The WAPP was established in 1999 to integrate the national power systems of participating countries into a unified regional energy market. The members of the WAPP are 36 electric utilities – national utilities, independent transmission companies and independent power producers – from 14 of the 15 ECOWAS member countries (excepting Cabo Verde). Under ECOWAS auspices, the WAPP aims to promote and develop electricity-related infrastructure, guarantee the co-ordination of electric power exchanges among member countries through the creation of a regional market, and ensure access to stable, reliable and affordable electricity supply over the medium and long terms.

ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure

In 2018, the WAPP defined the ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure, 2019-2033 (WAPP, 2019b) (Figure 4). The Master Plan was designed to respond to ongoing developments in the region, which included investments within member countries to update national power generation and transmission master plans, and a renewed interest to integrate renewable energy sources in the energy mix, particularly solar. The studies conducted to define the Master Plan identified the least-cost investments for generation and transmission elements and verified the technical feasibility to achieve system stability and reliability.

Figure 4: High-voltage transmission network and interconnection projects under the West African Power Pool



Source: WAPP, 2019b.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers

The identified projects to be deployed between 2019 and 2033 include:

- 75 regional projects with an estimated investment of USD 36.4 billion;
- 28 projects of high-voltage transmission lines – around 22 932 km, with an estimated cost of USD 10.5 billion, of which four projects involve Burkina Faso; and
- 47 generation projects with a total capacity of 15.49 GW and an estimated cost of USD 25.9 billion (10.67 GW of renewable energy, of which 3.15 GW is solar and wind; this includes two solar PV projects in Burkina Faso totalling 300 MW in two phases).

The short term (2019-2022) roll-out of this plan includes the North Core and Dorsale Nord Regional Power and the Ghana-Burkina-Mali 330-kilovolt (kV) interconnectors. The medium term (2023-2029) includes the 150 MW solar PV regional park, and the long term (2030-2033) envisages the 150 MW extension of the solar PV regional park. Implementation is ongoing, with the feasibility study of the solar PV regional park under preparation and the pre-investment studies of the Ghana-Burkina-Mali interconnector being updated. The interconnection with the neighbouring regions of northern Africa and central Africa is foreseen with the trans-Saharan backbone (Chad, Niger, Burkina Faso, Mali, Mauritania).

ECOWAS Regional Electricity Regulatory Authority (ERERA)

ERERA was established in 2008 to regulate cross-border power exchange and to contribute to setting up a regulatory and economic environment by supporting national regulatory bodies and entities. The objectives of the strategic plan 2016-2020 address energy security and interconnectivity, developing organisational and institutional capacity, and environmental sustainability. Within these priority areas, specific objectives are defined to clearly support renewable energy integration into the market and promote energy efficiency. For renewable energy, this is achieved through the adoption of regulating principles and the harmonisation of the renewable energy regulation within member countries (ERERA, 2016).

West Africa Clean Energy Corridor (WACEC)

The ECOWAS region, in collaboration with the International Renewable Energy Agency (IRENA), initiated the WACEC initiative in 2016 with the objective of promoting increased renewable power generation and supporting the creation of a regional power market. This collaboration resulted in the adoption of the WACEC by the Heads of State in 2017. Its implementation is done as a collaboration among ECREEE, ERERA, the WAPP, the ECOWAS Commission for Energy and Mines, and development partners such as IRENA and the German development agency GIZ.

In April 2019, energy ministers participating in the Specialised Technical Committee on Transport, Transcontinental and Interregional Infrastructure, Energy and Tourism of the African Union recommended that the ECOWAS Member States, as well as regional and continental bodies in Africa, integrate the concept of "clean energy corridors" into their renewable energy and climate change agendas – as well as in the design, implementation, and update of regional and continental initiatives and programmes – to support the continent's transition to more sustainable, reliable and affordable energy systems (IRENA, 2019a).

2.2 Energy supply and demand

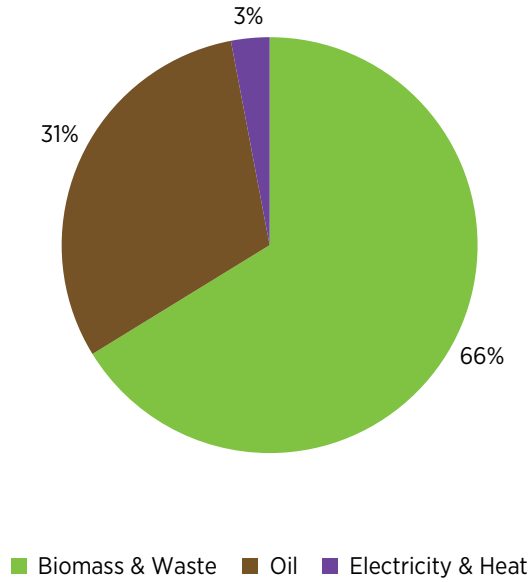
According to available data for 2020, the total primary energy supply in Burkina Faso (199 821 terajoules [TJ] in 2020) is dominated by traditional biofuels and waste (66%), followed by oil products (31%) and a small share of renewable energy production and electricity imports (around 3%) (Figure 5). The country's petroleum product needs are fully reliant on imports, and nearly a quarter of these imports go towards electricity generation (AFREC, 2019).

Households remain the main sector of energy consumption in Burkina Faso (Figure 6), reliant on local biofuel and waste resources. Meanwhile, the industry, agriculture and forestry sectors all have limited energy demand. Industrial energy use has declined due to load management policies imposed on large customers during periods of high energy demand; these policies have affected the country's economic performance and social progress.

Due to the limited rate of electricity access, the actual electricity demand in the country is currently unknown. IRENA developed projections in 2018 (Figure 7) estimating that demand could increase 170% over the next decade. The integration of mines to the main power grid could further increase electricity demand, although the impact is not yet fully assessed. Notably, such scenarios would require – under the current paradigm – further increases in electricity and oil imports.

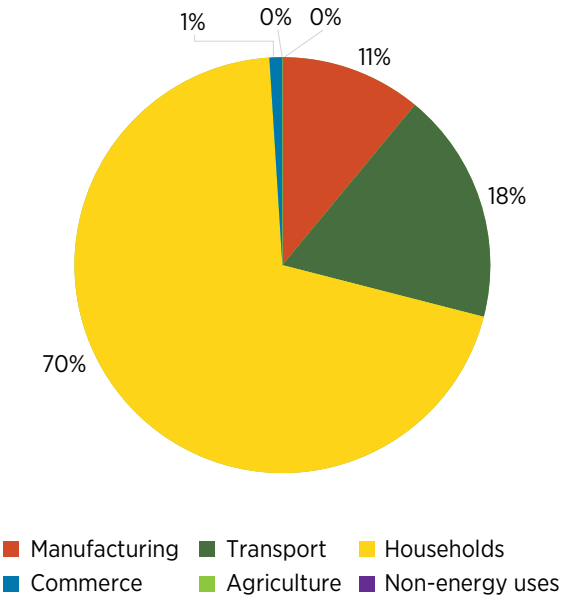
Across Africa, resource-intensive economies grow strongly when commodity prices increase. The economy of Burkina Faso is vulnerable to brutal changes in these prices. Real GDP in the country grew 1.9% in 2020 and an estimated 6.7% in 2021, and is projected to grow a further 5% in 2022 (AfDB, 2022a). The national account balance recorded a GDP surplus of 1.2% in 2020, following a deficit of 3.4% in 2019. The growth in 2020 reflected a 21% increase in the value of gold exports and a 13% increase in cotton exports; meanwhile, the import value of petroleum products fell 20% due to the reduced economic activity during the pandemic (AfDB, 2022a). In a scenario as in Figure 7, and without significant decarbonisation of the energy mix, oil imports would increase greatly, potentially causing the economic balance of the country to deteriorate.

Figure 5: Total primary energy supply in Burkina Faso, 2020 (ktoe)



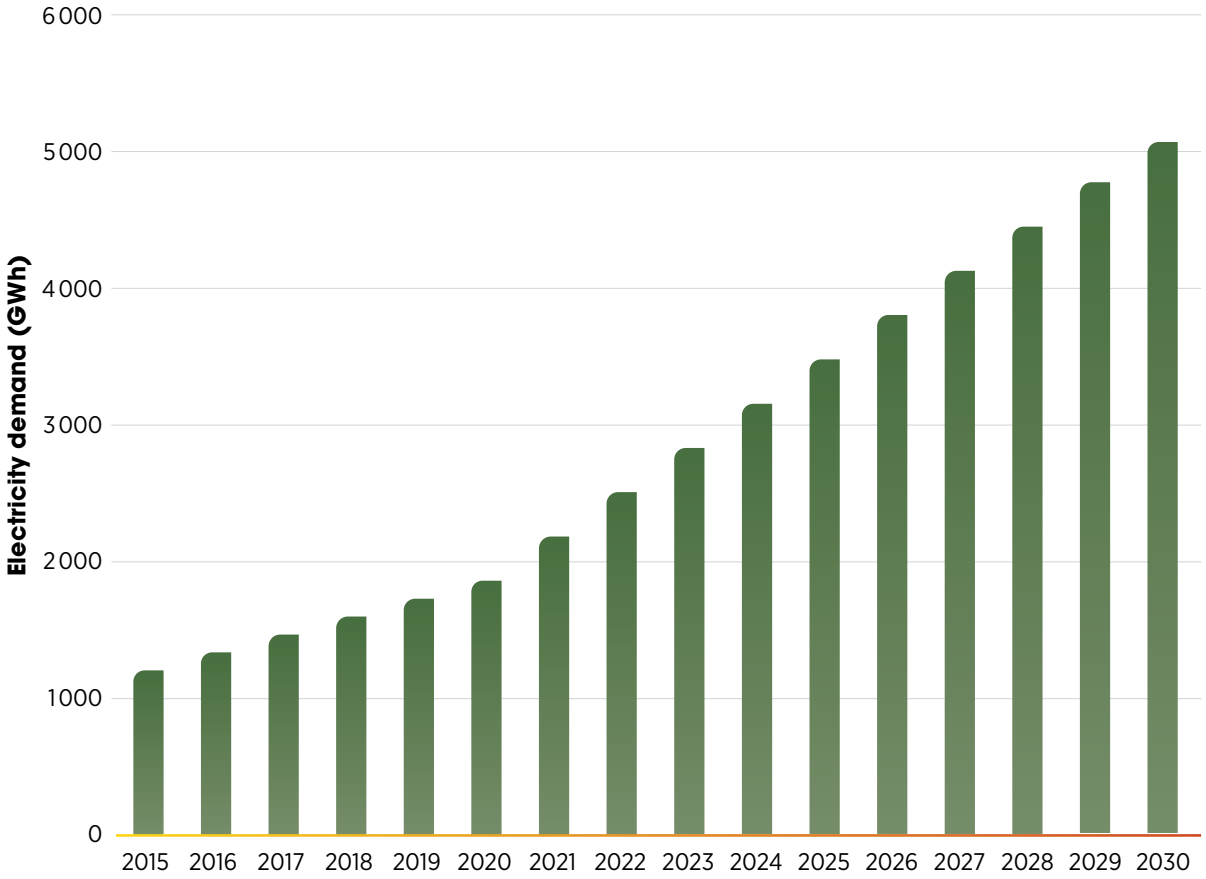
Source: UNSD, 2023.

Figure 6: Total final energy consumption by sector in Burkina Faso, 2020 (%)



Source: UNSD, 2023.

Figure 7: Electricity demand forecast for Burkina Faso, 2015-2030 (GWh)



Source: IRENA, 2018.

2.3 Electricity sector

In Burkina Faso, the Ministry of Energy, Mines and Quarries governs the electricity sector, while the Energy Regulatory Authority (ARSE, created in 2017) oversees the regulation of the energy sector and guarantees its economic and financial balance.

In 2016, the National Agency for Renewable Energy and Energy Efficiency (ANEREE) was created to monitor, promote and supervise renewable energy and energy efficiency markets, support and promote large-scale projects, federate partners in the sector, and foster research and innovation.

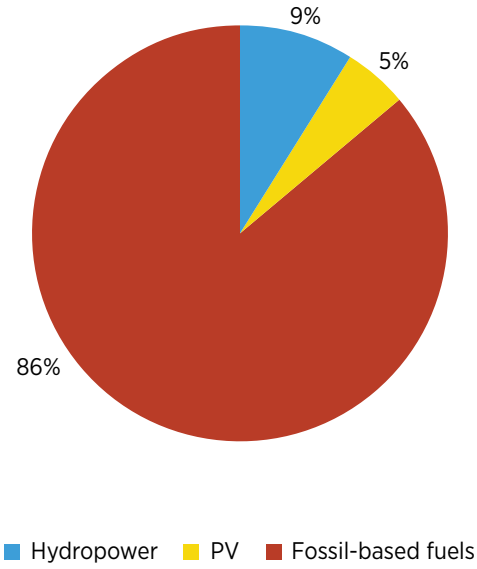
To address rural electrification, the Burkinabe Rural Electrification Agency (ABER) was created in 2018 (replacing the Rural Electrification Fund, FDE, that was created in 2003). ABER is in charge of promoting the rural electrification plan, assisting with implementation of projects and facilitating access to electricity.

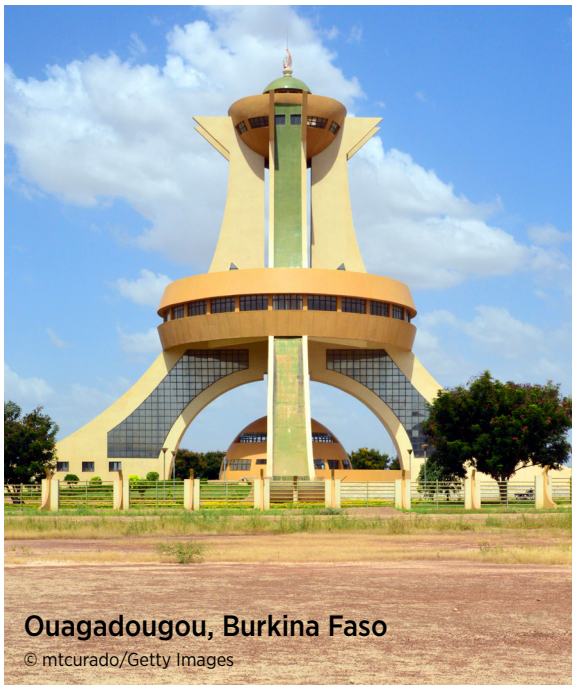
The state-owned utility company Société Nationale d'Electricité du Burkina (SONABEL) is mandated to supply electricity in sufficient quantity and to improve access to it. SONABEL was named in 1984 after multiple transformations since 1954. It is responsible for electricity production, transport, distribution and retail. The electricity sector operates on a single-buyer model with the production, distribution and rural electrification segments open to competition and a monopoly in the transport segment.

Electricity supply

Burkina Faso relies heavily on fossil fuels for its electricity generation, with 86% of the total coming from these sources and the rest from hydropower and solar PV (Figure 8). The country's installed generating capacity is 359 MW, divided among 27 centralised and decentralised generators. The installed capacity has fluctuated over the years, although new generation plants – mainly fossil-based fuels – have been commissioned, and around 65 MW was decommissioned between 2009 and 2018.

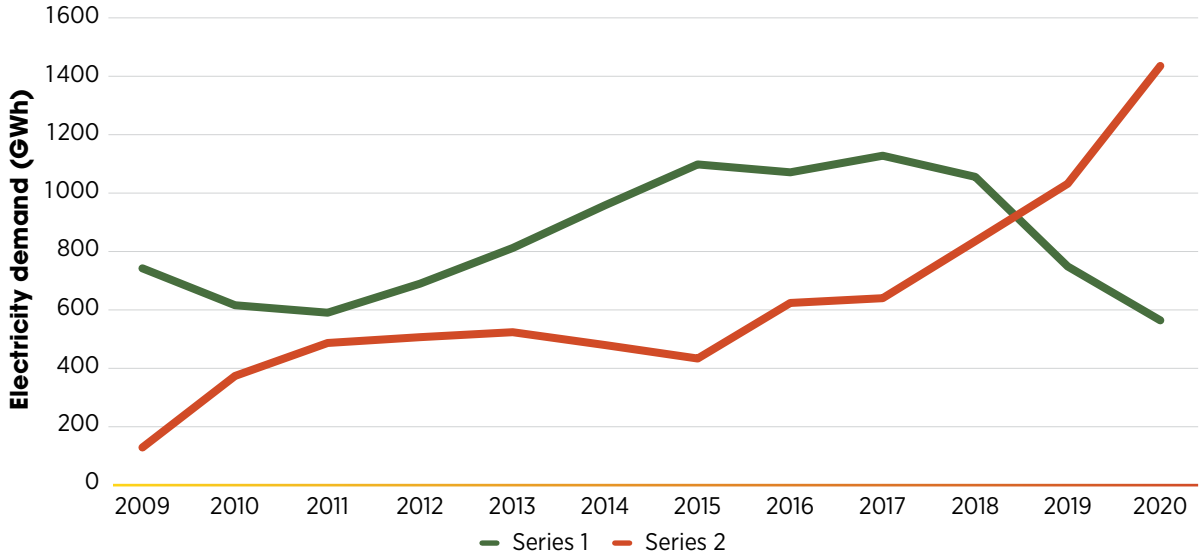
Figure 8: Share of electricity generation by source in Burkina Faso, 2018




Ouagadougou, Burkina Faso
© mtcurado/Getty Images

Source: MoE, 2018b.

Figure 9: Domestic electricity production versus imports in Burkina Faso, 2009-2020 (GWh)



Source: MoE, 2018b; ARSE, 2020.

In 2020, the domestic installations produced 572 gigawatt - hours (GWh) of electricity (down from 752 GWh in 2019 largely due to the pandemic and impacts on production due to infrastructure expansion works), based primarily on hydropower, while energy consumption reached 2123 GWh. To fill this gap between domestic supply and demand, 1425 GWh was imported from neighbouring countries in 2020, up from 1 GWh in 2019 (Figure 9). More than 65% of the 2020 imports came from Ghana, followed by Côte d'Ivoire (34%) and Togo (less than 1%). Compared to 2019, the additional 400 GWh imported in 2020 was deducted from the fossil-based fuel production.

Electricity consumption has increased continuously at more than 9% per year, due to expanding access, increased industrial and commercial demands and growing population . In recent years, imports have also increased, while electricity production has been stable in the same period, and recently decreased. More than half of the electricity produced in the country has been consumed in the central region, where most load centres are located. In 2020, amid the pandemic, as a result of recent additions and improvements in the generation fleet, the Burkinabe power system achieved balance between electricity supply and demand for the first time in a decade (GoBF, 2020).

The need for additional generation capacities has led to the identification of generation expansion strategies. Among these, the Electricity Sector Support Project (PASEL), financed by the World Bank, aims to reinforce security of supply and energy access. Under PASEL, a new fossil fuel power plant (Fada), and the reinforcement of two fossil fuel power plants (Komsilga and Kossodo) have been financed. Additional actions to expand generation were identified in the Energy Sector Policy Letter 2016-2020 (LPSE), aiming to strengthen fossil-based fuel power generation through public-private partnerships and regulatory reforms of the sector.

The electricity mix has been constant over the years, and diversification started in 2017 with the first large-scale solar PV plant. Several new generation plants were recently commissioned or are being expanded, as follows chronologically:

- Zagtouli (33 MW) solar PV power plant, located in the periphery of Ouagadougou, commissioned in 2017.
- Ziga (1.1 MW) solar PV power plant, commissioned in 2017.
- Off-grid Essakane (15 MW) solar PV plant, commissioned in mid-2018 to supply energy to a mining site, located close to the Malian and Nigerien border.
- Aggreko fossil fuel power plant, a temporary 50 MW generator that came online in June 2019.
- Samendeni hydropower dam (2.6 MW), entered into service in late 2019.
- Fada fossil fuel power plant, commissioned in October 2020, adding 7.5 MW to the grid.
- Komsilga fossil fuel power plant, being expanded from 90 MW to 140 MW.
- Kossodo fossil fuel power plant, being expanded from 60 MW to 110 MW.

Current developments in renewable energy

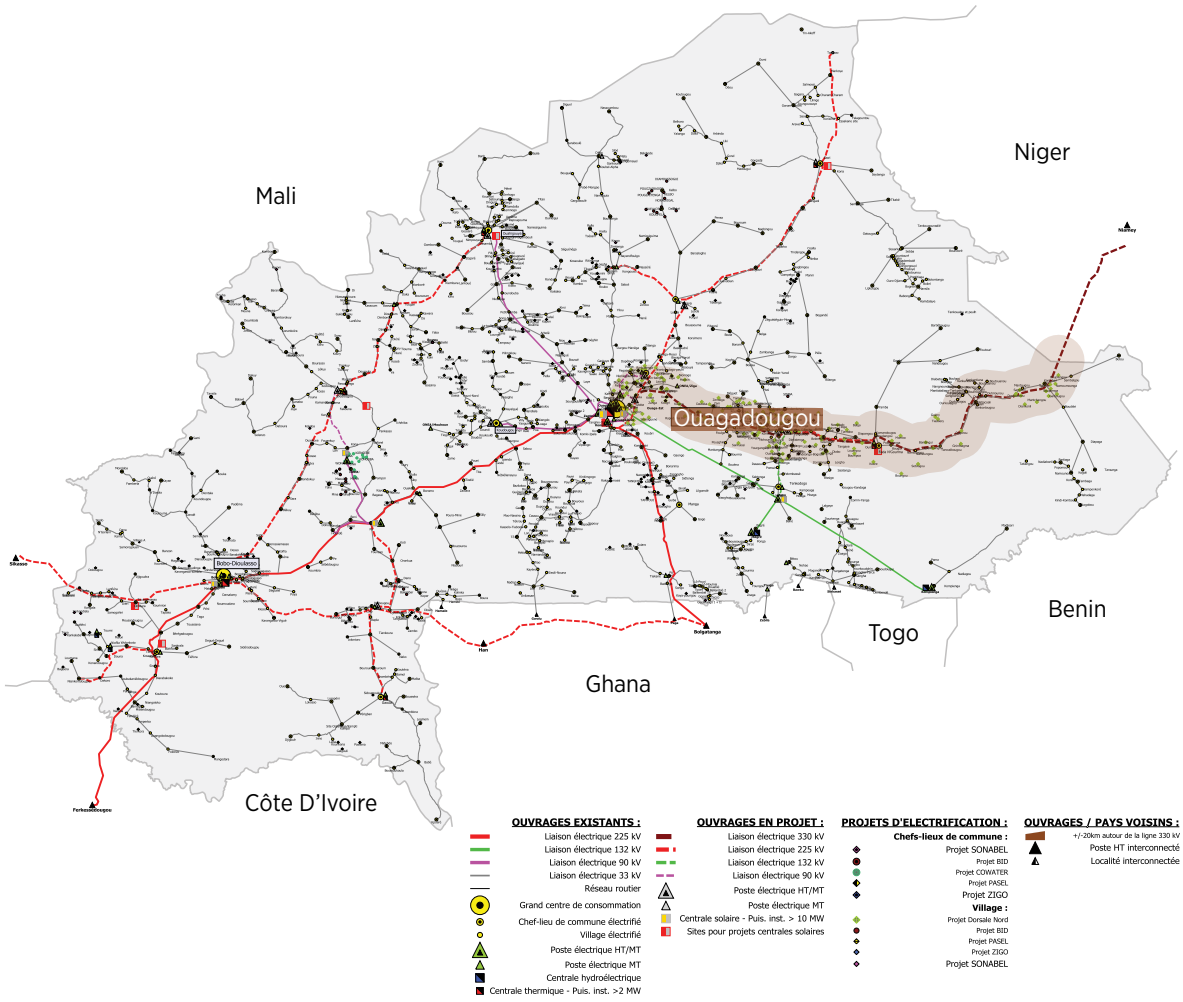
In recent years, the government of Burkina Faso has prioritised solar PV technology as part of the National Economic and Social Development Plan (PNDES). Since the commissioning of the Zagtouli solar PV power plant in 2017, the government of Burkina Faso has successfully attracted foreign investment and donors to support the PNDES and the national Energy Strategy 2019-2025.

The ongoing status of developments is detailed in Annex 1, listing 91 MW of hydropower projects and a staggering 744 MW of PV projects, of which 79 MW were commissioned, 96 MW are tendered or in progress, 133 MW are committed, and 411 MW are conditional (as per the NDC). For the latter category, a noticeable project is a 300 MW project "Kaya 1 and Koupela 1 & 2" is indicated as conditional by the NDC. In addition to this list, three small hydropower projects (the Ouessa, Bassiéri and Banwali dams) reportedly entered the examination phase of their preliminary design studies.

Grid infrastructure

Following the development and construction of several megawatts of solar PV capacity, the government of Burkina Faso is planning to reinforce distribution and transmission links to inject the additional power capacities into the national grid. The limited existing grid infrastructure is among the reasons for the country's low rate of electricity access. Several programmes are being deployed to extend electricity access and to reinforce the system through domestic and cross-border interconnections (Figure 10).

Figure 10: Burkina Faso electricity system



Source: SONABEL, 2019

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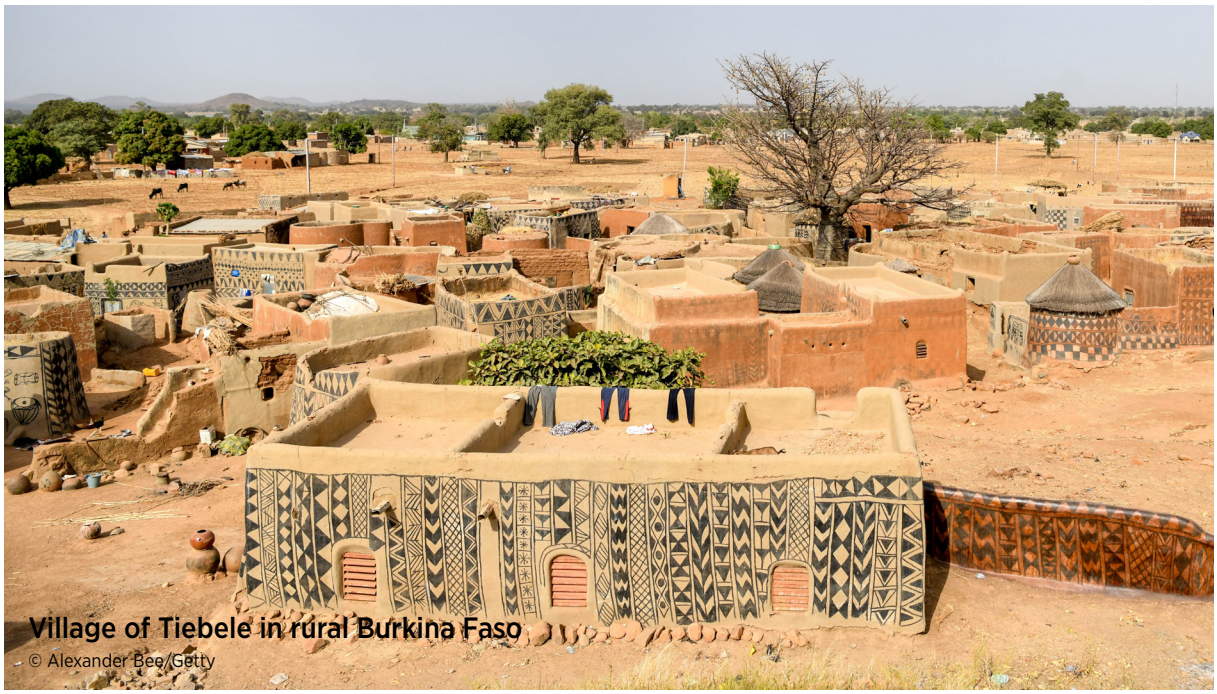


Village of Tiebele in rural Burkina Faso

© Alexander Bee/Getty

Among the most recent initiatives to extend the domestic grid infrastructure are the following:

The Electricity Sector Project (PASEL) seeks to address, among others, electricity supply in major demand centres and to increase electricity access. PASEL foresees supporting connection charge subsidies to improve electricity access for the poor and to connect "households, schools, clinics, local administration facilities, recreational centres and other units". Despite delays in implementation, the project is demonstrating progress. As of December 2020, more than 600 000 persons had benefited from improvements in electricity access (World Bank, 2021d).

The Peri-urban Electrification Project (PEPU) aims to increase the electricity access rate through extension of the electrical network and the connection of new consumers. The project was deployed in the peri-urban areas of Ouagadougou and Bobo-Dioulasso cities between 2018 and 2020. PEPU was financed by the African Development Fund, the government of Burkina Faso and SONABEL and will be completed by end 2023.

The Project for the Development of Electricity Connections (PDCEL) aims to facilitate electricity access by allowing customers to pay the initial connection fee on a monthly basis over a five-year period. PDCEL is being deployed in three phases (2019-2020, 2021-2025 and 2026-2030) and targets connecting 250 000 new clients per year. The first phase of USD 21.6 million was financed by SONABEL. ARSE (2020) reports modest progress as of December 2019, with less than 1 000 connections yet realised, 3.5 km of medium-voltage grids built and 52.5 km of low-voltage grids built. In 2020, overall progress was reported by ARSE (2021). The kick-off for the second phase, to be financed by AfDB, took place in December 2022.

The Project for Extension and Reinforcement of the Electrical Networks (PERREL) was designed to increase access to the electricity grid through a medium-/low-voltage component and the Kossodo-Ziniaré link component. The project was financed by the Islamic Development Bank. ARSE (2021) reports progress as of 2020, with a disbursement of 54% of the budget.

The Nord-Sahel project aimed to connect more than 27 000 new customers to the grid in the northern regions of Burkina Faso. The project was financed by the French Development Agency (AFD). ARSE (2020) reports significant progress as of December 2019, with an achievement rate of 74.6% for the number of connections and a rate of 52.6% for the deployment of meters.

The Bolgatanga-Ouagadougou project, built in 2018 to reinforce the interconnection with Ghana, has electrified 25 villages, adding more than 3 500 customers along the transmission line. The project was financed by AFD, the EIB, GRIDCO (Ghana Grid Company), SONABEL and the World Bank.

As discussed in detail later, Burkina Faso is facing high internal electricity prices and capacity shortages. These could potentially be addressed through cross-border exchanges, which increased significantly during 2015-2019 (Figure 9). In response to capacity shortages, the country is also attracting large pledges and projects for large-scale solar PV development, including regional projects. The large pipeline of variable solar generation plants would require balancing via the West African Power Pool (WAPP) (although a level of storage capacity is foreseen).

Both of these drivers explain the need for reinforced cross-border interconnection projects. Current identified projects are as follows:

- The ongoing **North Core/Dorsale Nord Regional Power Interconnector project** will connect Nigeria, Niger, Burkina Faso and Benin through a 330-kV transmission line. It is intended to promote energy exchanges among the four countries. This project is part of the WAPP initiatives to promote a regional power market between the countries and is supporting Burkina Faso, Niger and Mali in diversifying their energy supply with energy from Nigeria. This project, in the implementation phase, is expected to also connect populations along the line to the grid. Financing has been provided by the AfDB, AFD and World Bank.

- A feasibility study for the **Ghana-Burkina Faso-Mali interconnection project** was launched by AfDB. The connection should allow power exchanges between Sahelian countries and coastal Ghana. Burkina Faso and Mali will be given access to cheaper energy sources (hydropower and fossil-based fuels).

- The **Trans-Saharan interconnection backbone project** will allow power exchanges among G5 Sahel countries. This project, financed by the AfDB, is in the context of the regional Desert-to-Power initiative led by the AfDB.

Cost and tariffs

SONABEL suffered from a deteriorating financial situation during 2011-2015, which had a direct impact on the company's operational and commercial performance. Its generation fleet and electrical network have suffered from delays in rehabilitation and maintenance, due mainly to these financial difficulties (AfDB, 2015).

The situation improved considerably after a performance contract between the government of Burkina Faso and SONABEL was adopted and implemented in 2015. This contract included support to the utility's financial balance and a new tariff structure for fuel purchased for electricity generation (AfDB, 2015). The fuel prices adopted were defined as "market" prices, capped at a threshold to be revised yearly, reflecting SONABEL's cost efficiency.

SONABEL purchases its fuel at prices set by the Interministerial Committee for the Determination of Hydrocarbon Prices (CIDPH) through the state-owned oil company SONABHY, which receives government subsidies to cover the fuel prices above the defined ceiling price. This configuration limited the impact of the fuel purchase price and the tariff increases of end users but has entailed a heavy burden in state subsidies totalling USD 274 million during the 2016-2019 period (Table 1).

Over the last four years, SONABEL produced less electricity and increased imports. As a consequence of the reduction in fossil-based power production and increased imports, the overall subsidy volume decreased over the same period. Although the net results of SONABEL depend on the subsidy, it recorded its fourth consecutive year of positive net income in 2019 (ARSE, 2020).

Operating efficiency remains an issue for the company. Despite sales increasing more than 28% during 2016-2019, SONABEL's net results have plummeted nearly 66%. The net profit ratio, in particular, dropped 3.8% between 2018 and 2019.[8] In 2020, despite increased sales (in current XOF), a larger customer base, and a higher rate of invoice recovery (96.7% versus 91.6% in 2019), the net results plummeted 75% on a year-to-year basis.

The consumer tariff rate for electricity has remained unchanged since 2006 by will of the government of Burkina Faso (AfDB, 2015). The average household rate of USD 0.201 per kWh in 2017 is still among the highest in the ECOWAS region (Table 2). However, the current tariffs are insufficient to cover SONABEL's operating costs (World Bank, 2016a), which need to be recovered (and optimised) in order to improve the financial situation of the utility.

Table 1: Fuel-indexed subsidies used by SONABEL for electricity generation, and SONABEL net income, 2016-2020

		2016	2017	2018	2019	2020	Four-year trend
Production	GWh	973	1 095	1 021	902	698	↓
Imports	GWh	630	647	837	1 087	1 485	↑
Subsidy	USD million*	75.84	62.87	65.95	70	N/A	↓
Subsidy per kWh consumed	US cents/ kWh	5.8	4.3	4.2	4.2	N/A	↓
Sales SONABEL	USD million	276	303	331	354	384	↑
Net result SONABEL	USD million	9.3	12.5	16.5	4.1	1.17	↓
Net profit (Net results / sales)	%	3.4	4.1	5	1.2	0.3	↓

Source: ARSE, 2020; SONABEL, 2020.

Note: N/A = data not available; * Conversions in XOF 2021.

[8] In 2020, motivated by the economic downturn caused by the COVID-19 pandemic, the government of Burkina Faso implemented social measures in the electricity sector to reduce the negative impact of the slowdown, which could further impact SONABEL's bottom line. These measures include free electricity services for customers in category A (less than 3 amperes), a 50% reduction for the next category (5 to 10 amperes), and a waiver of penalties for consumption in the second quarter of 2020.

Table 2: Comparison of electricity tariffs (without taxes) among ECOWAS countries, 2017

Country	Average household rate (USD/kWh)
Benin	0.19
Burkina Faso	**0.201**
Côte d'Ivoire	0.108
Ghana	0.116
Niger	0.16
Senegal	0.177
Togo	0.179

Source: MoE, 2018b.

The collection of payments from customers was an issue in 2017-2018. The overall level of payment collection[9] recorded in 2018 decreased compared to 2017, with the collection rate of households dropping 5 points and of government dropping 40 points (MoE, 2019). The situation improved sharply in 2020, with a recovery rate of 96.2% for households and 97.6% for administrations (SONABEL, 2021).

Since the creation of ARSE in October 2017, the definition and proposal of electricity tariffs are now under its management.[10] The role of ARSE could be instrumental in improving SONABEL's operational efficiency. For instance, due to its role in maintaining the financial equilibrium of SONABEL, ARSE participates in determining the government subsidy to the state oil company SONABHY, as it sets the prices triggering the subvention. Tariffs may reflect the need to recover reasonable operational costs, based on efficiency benchmarks. The affordability, availability and access to power in Burkina Faso largely depends on the operational capability of the regulator to implement its mandate to the highest standards.

Rural electrification

According to the SDG tracking framework, the rate of electricity access among the population reached 19% in 2021, with significant disparities between urban (66% access) and rural populations.

Numerous rural electrification initiatives have been ongoing in the country. The government's LPSE targeted an overall electrification rate of 32% by 2020, which includes rates of 75% for urban populations and 19% for rural populations (increasing to 95% and 50%, respectively, for 2030).

Overlapping this, the Renewable Energy Action Plan (PANER) defined an objective for 13% of the rural population to be supplied by off-grid renewable systems by 2020 and 27% by 2030, representing 3.6 MW of renewable off-grid capacity in 2020 and 10 MW in 2030. As of 2021, IRENA records 1.5 MW offgrid capacity of solar lights and solar home systems and 783 kW for minigrids (IRENA, 2021d).

The rural electrification model is based on energy co-operatives (COOPELs), which are granted concessions in exchange for the fulfilment of service obligations towards customers. The COOPELs are managed by local citizens who hire contractors to build grid extension or mini-grid projects. Those contractors ("farmers") can be retained for operating the system.

Since 2018, rural electrification development has been co-ordinated by ABER (formerly the FDE – Rural Electrification Fund), and several projects have received funding and been deployed in the last decade (Table 3). In 2018, rural electrification in Burkina Faso included 14 mini power plants with a combined nominal power of 2 MW. Most of these plants were diesel generators, while only three were hybrid (PV-diesel) generators (MoE, 2018a).

9 Collection rates in 2018 were 94% for household customers and 72% for government customers.

10 The current tariffs are presented in Annex 2 for reference.

Table 3: Rural electrification projects overseen by ABER

Project name	Communities targeted	Technology	Funding (USD million)
CONSEIL DE L'ENTENTE	3	Solar home systems	0.09 per year
PERD/ENR	42	Solar PV on- and off-grid	15
ECED MOUHOUN	16	On- and off-grid	15
TDE	174	On- and off-grid	27
PASEL	229	On and off-grid (green mini-grids)	43
PERD/PV	45	On-grid (solar PV), off-grid (green mini-grids) and solar street lights	13.4
ERD ZIGO	45	Solar PV on-grid	2
YELEEN	264	Green mini-grids (solar PV), solar PV stand-alone	90
GORI	1	Solar PV and diesel	0.45
SINCO	65	Solar PV on-grid	14.5
2 000 ECO VILLAGES	13	Mini-grid solar PV and storage	3,6

Source: ABER, 2020.

The rural electrification effort has accelerated in recent years. According to ABER's latest available data, construction work has been finalised in 93 communities and is ongoing in 50 communities, while 166 communities are in the beginning stage of work. The current security problems have had a direct impact on deployment in 13 communities, suspending construction activities (MoE, 2020c).

For the PASEL project, the World Bank (2021e) indicates matching figures, with grid extension civil works completed for 116 localities; 16 mini-grids were achieved, and contract execution for civil works was delayed in order to comply with environmental and social requirements. Further support from the institution is anticipated from the "Solar Energy and Access Project" (P166785), which foresees increasing access in 300 rural localities through both network expansion and green mini-grids involving private sector investment.[11]

A project for the electrification of medical centres through solar PV with storage is also mentioned in the country's 2021 Nationally Determined Contribution (on an unconditional basis), in addition to the acquisition of 50 000 solar home systems (conditional). IRENA has also partnered with SELCO Foundation and the Health and Energy Ministries of Burkina Faso to assess the opportunities for integrating DRE and energy-efficient appliances to strengthen the healthcare sector of the country (see also Box 1 below on "Electrification with renewables: Enhancing healthcare delivery in Burkina Faso").

Other initiatives at the regional level may support the uptake of rural electrification in Burkina Faso. For example, the Green Mini Grid Market Development Programme, a multilateral initiative involving the AfDB and Sustainable Energy for All (SEforALL), seeks to enable a favourable mini-grid environment across the African continent (SEforALL, 2017). Meanwhile, the ECOWAS Programme on Access to Sustainable Electricity Services (EPASES) seeks to implement 60 000 mini-grids across the region and to enable market development for distributing 2.6 million stand-alone energy systems between 2015 and 2020 (ECREEE, 2015b). More recently, the Beyond the Grid Fund for Africa (BGFA) has signed further agreements to scale up solar home systems in remote areas of Burkina Faso, aiming to benefit up to 19 000 new households and approximately 2 000 businesses through local subsidiary of ARESS, and up to 28 000 households through off-grid solar system provider Oolu. The Global Green Growth Institute (GGGI) has also enabled the installation of 45 solar pumps in three regions of Burkina Faso.

[11] Also mentioned by the Nationally Determined Contribution submission.

So far, a consistent framework has been missing in the support brought to the sector. The diversity of actors, of sources of financial support and/or of subsidies brought to the COOPELs has created a wide range of investment situations with various financial requirements. As a consequence, business models may differ greatly from one COOPEL to the next, impacting the bankability and sustainability of some co-operatives. This element is currently under consideration by ARSE.

ARSE (2020) refers to ongoing work in this area, including: substituting certain COOPELs that are not able to fulfil their concessional obligations by SONABEL; the regulation of charges applied by SONABEL to the COOPEL; the difference in public support between COOPELs that were established by ABER (receiving fuel subsidies; investment subsidies, etc.) and COOPELs operated by private operators, which did not benefit from such subsidies. The intent would be to bring consistency in the public effort to support rural electrification, which could enable future growth of the segment through solar PV mini-grids involving private equity.

2.4 Climate action

In October 2021, Burkina Faso submitted its revised Nationally Determined Contribution (NDC) towards reducing emissions under the Paris Agreement, for the period 2021-2025 (GoBF, 2021a). The NDC notes a 91.37% achievement of the country's unconditional emission reduction target for the period 2015-2020, but only 24.36% achievement of the conditional objectives, due to challenges in mobilising resources. For adaptation measures, the country achieved 89% of its objectives.

The revised contribution calls for reducing emissions 29.42% by 2030 according to the business-as-usual scenario; of this, 19.6% is unconditional and 9.82% is conditional. By 2050, the reduction effort could reach 34.43%.[12]

For the energy sector, the revised national inventory anticipates emission growth of 6% per year. In 2030, emission reductions could reach 638 545 gigagrams of CO_2 equivalent (unconditional and conditional).

The review of the mitigation actions shows an energy strategy based primarily on expanding the country's grid-connected solar capacity (128 MW unconditional and another 400 MW conditional) and adopting efficient public lighting. Conditional activities include further diversification of the energy supply, such as 50 000 solar home systems and a 10 MW biomass and waste-to-energy plant. For power generation, a consolidated list of projects is presented in Annex 1. Table 4 also compares these targets to the PANER, which could be seen as more ambitious than the NDC. The NDC submission does not specify the time horizon for the different projects.

2.5 Energy efficiency

The government of Burkina Faso has been engaged in energy efficiency activities for the last 15 to 20 years through several strategies and plans. As in the electricity sector, these measures are often overlapping, and their alignment, consistency and validity have yet to be evaluated. The documents related to energy efficiency generally include specific targets and a number of key performance indicators, which could allow for more systematic monitoring.

The promotion of energy-efficient equipment is supported by a variety of projects, plans, and strategies, as listed below (MoE, 2018a). A more detailed review of the regulatory framework for energy efficiency can be found in section 4.

- The National Energy Efficiency Action Plan 2015-2030 (PANEE), adopted in 2015, aims to double the energy efficiency improvement rate through the creation of the ANEREE. It operationalises the energy efficiency aspects of SEforALL and supports energy efficiency standards and labelling, as well as the application of energy efficiency in buildings, industry and the overall public sector.

- On the project side, the Electricity Sector Development Project (PDSE), adopted in 2000, defined the main guidelines for the energy sector and was revised in 2009 and 2011. The results of the PDSE demonstrated the potential for energy savings and provided the basis for elaborating the PANEE in 2015.

- The Energy Sector Policy Letter 2016-2020 (LPSE), adopted in 2016, aims to make energy accessible and available through several measures (listed in Annex 3), including the promotion of energy efficiency and clean cooking.

- The recent NDC submission (GoBF, 2021a) includes a set of measures related to energy efficiency, which may support some of the LPSE objectives. Those measures include activities related to efficient public and household lighting. In addition, the NDC mentions the purchase of solar equipment for public buildings and efficient cooling.

[12] Table 2 on page 8 of the NDC report shows a 34.43% reduction potential by 2050, while the preamble mentions 30.76%.

Between 2004 and 2021, the World Bank supported Burkina Faso with a programme of energy efficiency measures in administrative buildings. The project allowed for around XOF 1.2 billion (USD 2.2 million) in savings, with energy efficiency measures having reduced the annual electricity consumption of public buildings by 18% and the subscribed power by 21%.

2.6 Renewable energy potential and use

Burkina Faso has considerable potential for renewable energy, in particular solar and biomass sources. If used to their full capacity, these untapped renewable resources have the potential to reduce the country's dependency on fossil-based energy, increase electricity access, foster local economic development, enhance energy security and address climate change.

The country has significant technical potential for biomass, solar PV and potentially wind power (Table 4). According to IRENA's estimation in 2015, no technical potential for concentrated solar power (CSP) is identified, while the potential for hydropower (large and small) may be around 148 MW.

In September 2021, IRENA released a utility-scale wind and solar suitability analysis for the country. The estimated technical potential for solar PV is high at 95.9 GW and for wind energy is lower at 1.96 GW. Although that report does not look into economic aspects of this development, the large technical potential of the two technologies provides hope for their future growth in the country (IRENA, 2021a).

Biomass use in the form of biogas for energy was introduced in the 1970s through a research and development programme, and three biomass facilities exist to produce electricity, totalling less than 1 MW.

Large-scale solar facilities have existed in the country since 2017, today representing more than 62 MW peak of installed capacity. Small solar PV facilities have been present for many decades, and around 5 MW peak has been installed by enterprises, individuals and governmental initiatives. Solar water heating and cooking are used mainly for households and public installations.

Hydropower has been developed in limited quantity due to the seasonality of the resource. The existing installations in the country are limited to two hydropower installations and three small-scale installations, for a combined 34 MW of installed capacity.

Table 4: Estimate of renewable energy technical potential in Burkina Faso and comparison with achievements and targets

	Technical Potential (MW)	Installed capacity in 2020 (MW)	PANER in 2030 (MW)	NDC (mixed 2030/2050 horizon)
Solar PV	95 900	62.39	210	128 + 400*
Biomass*	1 075	0.75 (biogas) 0.15 (liquid biofuels)	13	10 (biomass + waste)
Wind	1 960	0	0	0
Hydropower	148	34.5	100	0
CSP	-	0	50	0

Source: IRENA, 2018, 2021a, 2022a; GoBF, 2015, 2021a; interviews with local stakeholders.

Note: CSP = concentrated solar power;

* Represents resource potential for co-generation;

** Of which 300 MW might correspond to component 2 of the "Solar Energy and Access Project" (World Bank, P166785, 2021e), which includes 300 MW peak of solar projects with storage. Part of the funding is from private sector engagement.

Non-power uses

Traditionally, most of the population is dependent on traditional biomass for cooking and heating. Only 11% of the population has access to clean cooking (ESMAP, 2022). A lack of land management and increasing demand for resources due to population growth have resulted in land degradation (GIZ, 2013).

In recent years, several biogas units, using agricultural and household waste, have been installed through the National Biodigester Programme (PNB), aimed at the construction and operation of biodigesters for rural and peri-urban populations. The cross-sector programme is managed by the animal resources ministry (MRAH) addresses the entire value chain from breeding to energy and includes agriculture and gender aspects.

The process of developing this Renewables Readiness Assessment (RRA) revealed that PNB Phase II achieved 10 000 biodigesters in 2014, and PNB Phase III (2022-2026) is seeking to deploy 26 000 biodigesters by 2025. The programme's target is 38 000 digesters by 2030 (GoBF, 2015). Progresses are material, as IRENA recorded an increase in biogas production for cooking over the period 2012-2021, from 737 - 3 612 cubic metres (m^3). Over the period, the persons using biogas for cooking increased from 8 000 in 2021 to 42 000 in 2021, with however a modest growth on period 2017-2021 (39 000 to 42 000) (IRENA, 2021b).

Solar thermal uses in Burkina Faso have been deployed through the SOLtrain West Africa Programme under ECREEE administration. The programme ran between 2015 and 2018 and was intended to install demonstration systems in public buildings (schools and hospitals) (ECREEE, 2015c). Although less disseminated, solar dryers are employed to dehydrate fruits and agricultural products, and a few solar cookers are used by local food enterprises (ECREEE, 2015d).

Box 1: Regional Alliance for biodigester

The AB-AOC (Alliance pour le Biodigesteur en Afrique de l'Ouest et du Centre) is a regional Alliance for Biodigester in West and Central Africa, led by Burkina-Faso and headquartered in Ouagadougou. The member countries include Benin, Cote D'Ivoire, Guinea, Mali, Niger, Senegal and Togo.

The aim of the Alliance is to help improve the living conditions and resilience of rural and peri-urban populations through the development and promotion of biodigester technology in member countries. Within the framework of this alliance, the biodigesters to be promoted can be of the domestic, semi-industrial or industrial type, depending on the support needs expressed by the countries.

Its mission consists of

- **support the development and establishment of a commercial sector for biodigester technology in member countries;**
- **develop expertise in biodigester technology in member countries;**
- **monitoring and evaluation of national biodigester programs;**
- **capitalisation and sharing of experience;**
- **support for the mobilisation of resources to finance programs;**
- **support for research and development;**
- **conducting advocacy and political negotiations with member countries and their respective institutions to support biodigester development;**
- **capacity building for member states.**

* Adopted from www.ab-aoc.org

Bioenergy

Biomass

In the country, a few biogas power plants produce electricity using by-products of the agri-food industry. The SN SOSUCO sugar company produces electricity from sugarcane bagasse to produce heat and electricity, the SN CITEC company produces electricity from cottonseed cake, and the FasoBiogaz installation (275 kilowatts [kW]) converts slaughterhouse waste into biogas and is connected to SONABEL's distribution network.

According to estimations of bioenergy potential from agroforestry and wood crops, Burkina Faso may produce around 15 million t/yr. of short-rotation woody crops. An estimated 75% of the country's land area is suitable for agroforestry practices and could combine the production of 44 kt of short-rotation woody crops with 842 kt of maize for food purposes (IRENA, 2019b).

Overall, the biomass/bioenergy potential is relatively undocumented, as discussed in the following sections.

Biofuels

Several local biofuel initiatives were launched between 2000 and 2010, and by 2015 around 14 stakeholders were involved in the production of biofuels, including for use in the non-power sector. Nearly all exclusively used the Jatropha curcas crop, while some used a mix of jatropha and castor oil or sunflower. The International Civil Aviation Organization (ICAO, 2018) notes that in 2014, 3 000 farmers were engaged in jatropha activities in the province of Sissili, where more than 10 million jatropha trees were planted. The lack of a functioning market, and lower than expected yields, led to the suspension of operations.

Limited information is available on the potential of sustainable biofuels in Burkina Faso. IRENA indicates potentialities for jatropha, sugar cane and soybean (Table 5) (IRENA and KTH, 2014). The main conclusions of the IRENA study are:

- Under rain-fed conditions, sugar cane is the least suitable crop among the three for cultivation in Burkina Faso, as 98% of the land falls under certain restricted criteria.[13] However, under irrigated conditions, sugar cane becomes an attractive crop with more than 50% of the land available for its cultivation. The ethanol production estimates for irrigated lands reach 3 700 million litres.

- Jatropha potential is available only under rain-fed conditions, and available land is limited. According to the estimates, 1% of these lands would have a yield of 1 t/ hectare (ha) of biofuel.

- Soybean has promising potential, as 50% of the land is available under rain-fed conditions and land restriction criteria. Around 18% of the land available could yield more than 1 tonne of biofuel per hectare. Without restrictive land conditions, the land available with this yield increases to 41%.

Table 5: Available land area and potential yield (dry mass) for three biofuel feedstocks in Burkina Faso

	Total land area without applying restriction criteria, and its potential				Available land area after applying restriction criteria, and its potential			
	Rain-fed		Irrigated		Rain-fed		Irrigated	
	Restricted land	% land area yield (> 1 t/ha)	Restricted land	% land area yield (> 1 t/ha)	Restricted land	% land area yield (> 1 t/ha)	Restricted land	% land area yield (> 1 t/ha)
Sugar cane	96%	0%	**9%**	**19%**	**98%**	**0%**	49%	9%
Jatropha	91%	1%			**96%**	**1%**		
Soybean	15%	41%			**50%**	**18%**		

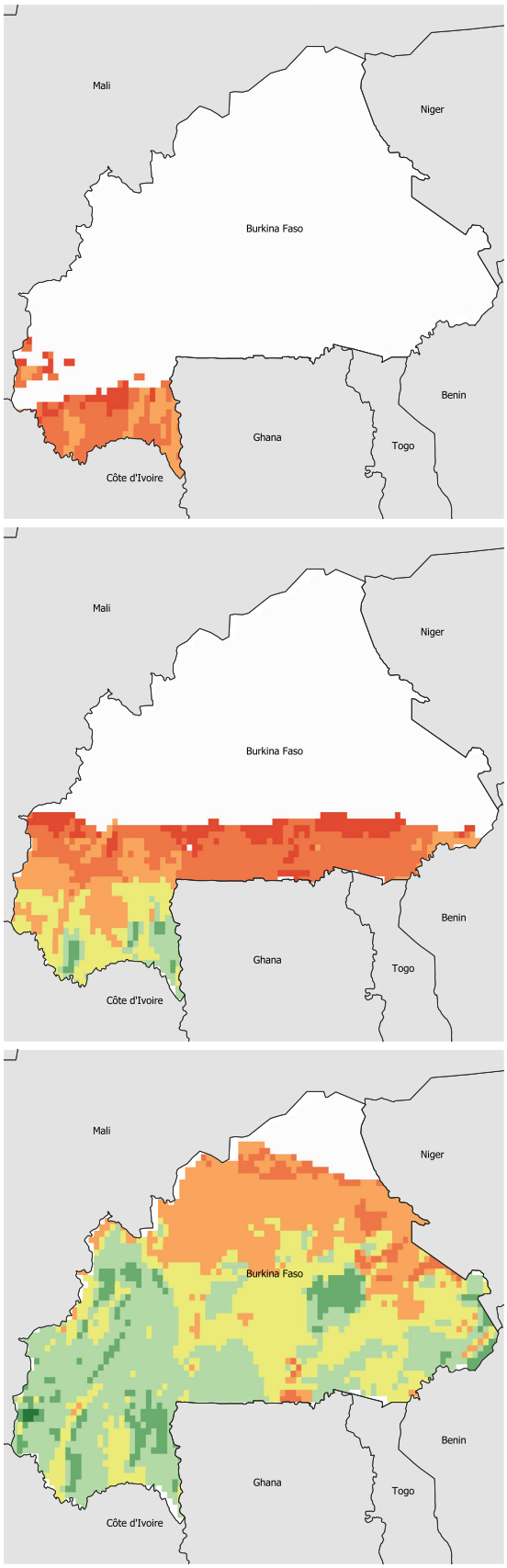
Adapted from: IRENA and KTH, 2014.

Note: t/ha = tonne per hectare.

[13] Cities and urban areas; protected areas; water bodies and wetlands; sloped areas; existing agricultural land; forest area.

The tabulated results under rain-fed conditions are also reflected in the suitability index maps of Burkina Faso for high-input farming conditions for sugar cane, jatropha, and soybean, as presented in Figure 11.

Figure 11: Suitability index for rain-fed high input sugar cane, jatropha and soybean in Burkina Faso



Suitability index for rain-fed high input sugarcane

Score (%)
- >85: Very high
- >70: High
- >55: Good
- >40: Medium
- >25: Moderate
- >10: Marginal
- >0: Very marginal
- =0%: Not suitable

Suitability index for rain-fed high input Jatropha

Score (%)
- >85: Very high
- >70: High
- >55: Good
- >40: Medium
- >25: Moderate
- >10: Marginal
- >0: Very marginal
- =0%: Not suitable

Suitability index for rain-fed high input soybean

Score (%)
- >85: Very high
- >70: High
- >55: Good
- >40: Medium
- >25: Moderate
- >10: Marginal
- >0: Very marginal
- =0%: Not suitable

Source: IIASA/FAO, 2012; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: These maps are provided for illustration purposes only. Boundaries and names shown do not imply any endorsement or acceptance by IRENA.

In addition to the IRENA assessment, the ICAO performed a high-level assessment for fuel crops and produced high figures for the available harvest areas, leading to large energetic values, for several feedstock (ICAO, 2018) (Table 6). Those values should be taken with caution as the food-energy nexus is complex and requires a careful review of the potentialities, particularly in light of past experiences in the jatropha sector.

Table 6: Feedstock potentials for biofuels in Burkina Faso

Feedstock	Harvest area: current / potential (ha)	Energetic values: current / potential (barrels of oil equivalent)
Sugar cane	5 000 / 8 000	80 000 / 127 450
Sorghum	1 620 000 / yield increase +30%	– / 2 350 000
Rice husk and straw	172 000 / yield increase + 30 000 t	– / 113 300 (husk) 281 500 (straw)
Elephant grass	0 / 250 000	– / 12 450 000
Jatropha	3 000 to 8 000 / 100 000	– / 821 000
Cashew nuts	90 000 / +100%	120 000 / 240 000 (+90 000 with optimisation)

Based on: ICAO, 2018.

Note: The source does not address the water-food-energy nexus that could arise in Burkina Faso.

Solar PV

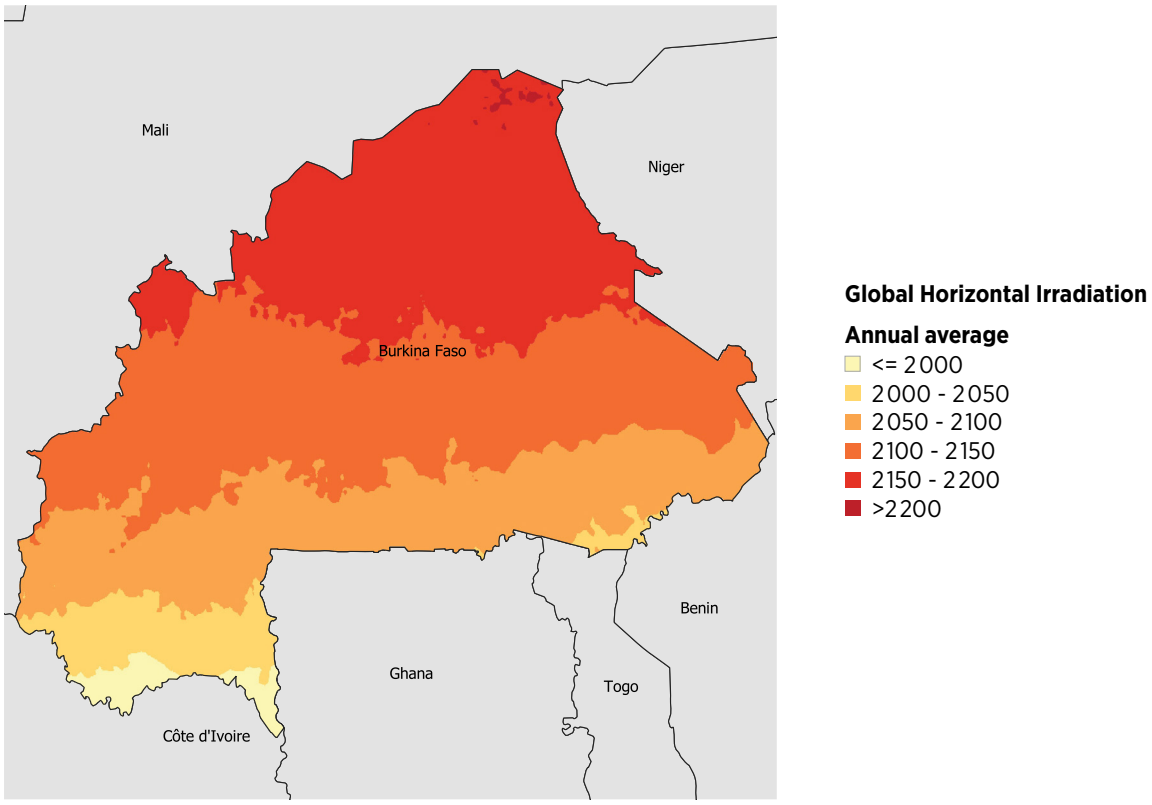
With an annual average of 3 000 to 3 500 peak sun hours and high irradiation rates, solar PV is a favourable renewable energy source for Burkina Faso (GoBF, 2015). The northern and Sahelian zones have the highest insolation values in the country, with annual average global horizontal irradiation (GHI) values reaching 2 200 kWh/m^2. The lowest annual average GHI values are found in the southernmost zone of the country towards the border with Côte d'Ivoire, with 2 000 kWh/m^2 (Figure 12). For direct normal irradiance (DNI), the highest annual average values are estimated at 1 650 kWh/m^2, with the lowest values at 1 250 kWh/m^2.

IRENA's suitability analysis for the country estimates that the technical potential of solar PV is 95.9 GW (IRENA, 2021a). This analysis considered major parameters that may influence the development of utility-scale solar PV plants, such as solar irradiation, population density, distance to transmission road networks, and other analytical parameters to locate the most suitable areas for successful prospecting, as shown in Figure 13.

Following this analysis, IRENA conducted site assessments for 18 solar PV sites across Burkina Faso (see Figure 13) that are all within the identified high-prospect areas. These sites have a high annual average specific energy yield of 1 745 kWh/kW peak (kWp) with an average levelised cost of energy of USD 0.081 / kWh. The assessment considers site-specific time-series resource data, country-reflective capital expenditure (CAPEX), operational expenditure (OPEX), discount rates and other fiscal parameters.

Despite this large available solar resource, local knowledge of the resource through ground measurements is very limited. To improve this knowledge, measurement campaigns are being prepared in the framework of the regional solar parks, and two locations in Burkina Faso will be studied (WAPP, 2019a).

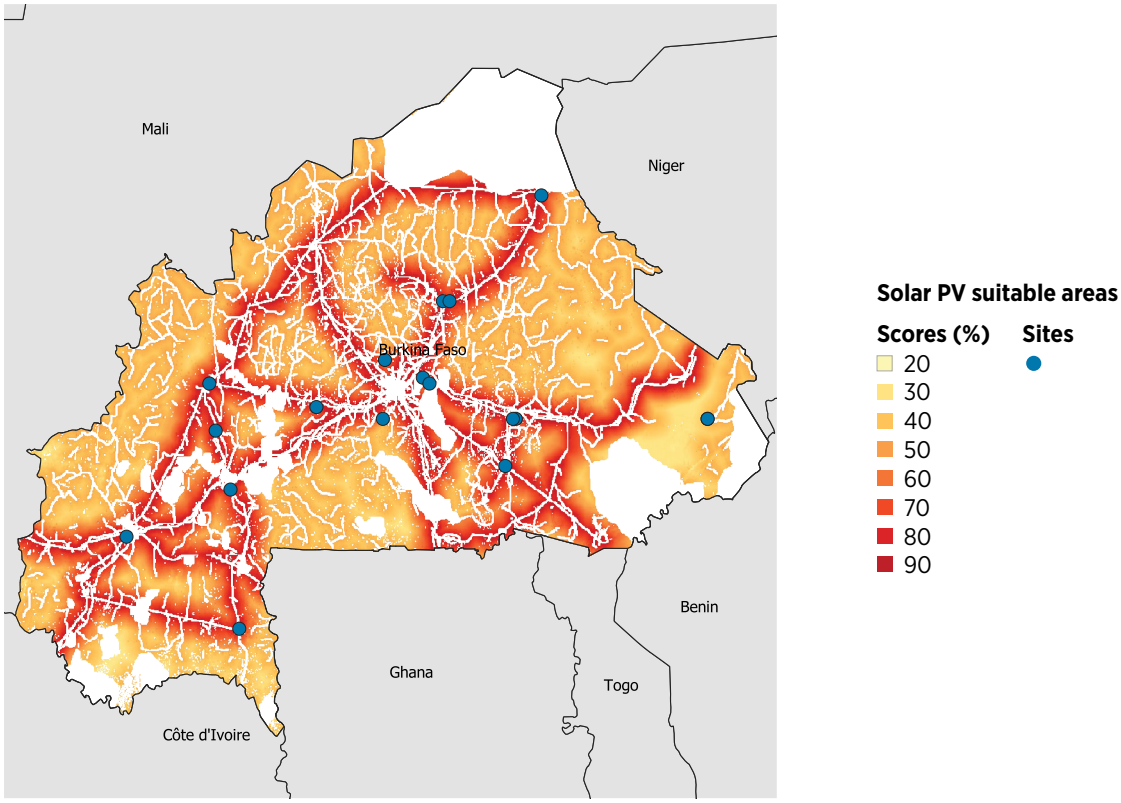
Figure 12: Annual average global horizontal irradiation in Burkina Faso



Source: ESMAP, 2019; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

Figure 13: Most suitable prospecting areas for utility-scale solar PV in Burkina Faso



Source: IRENA, 2021a; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

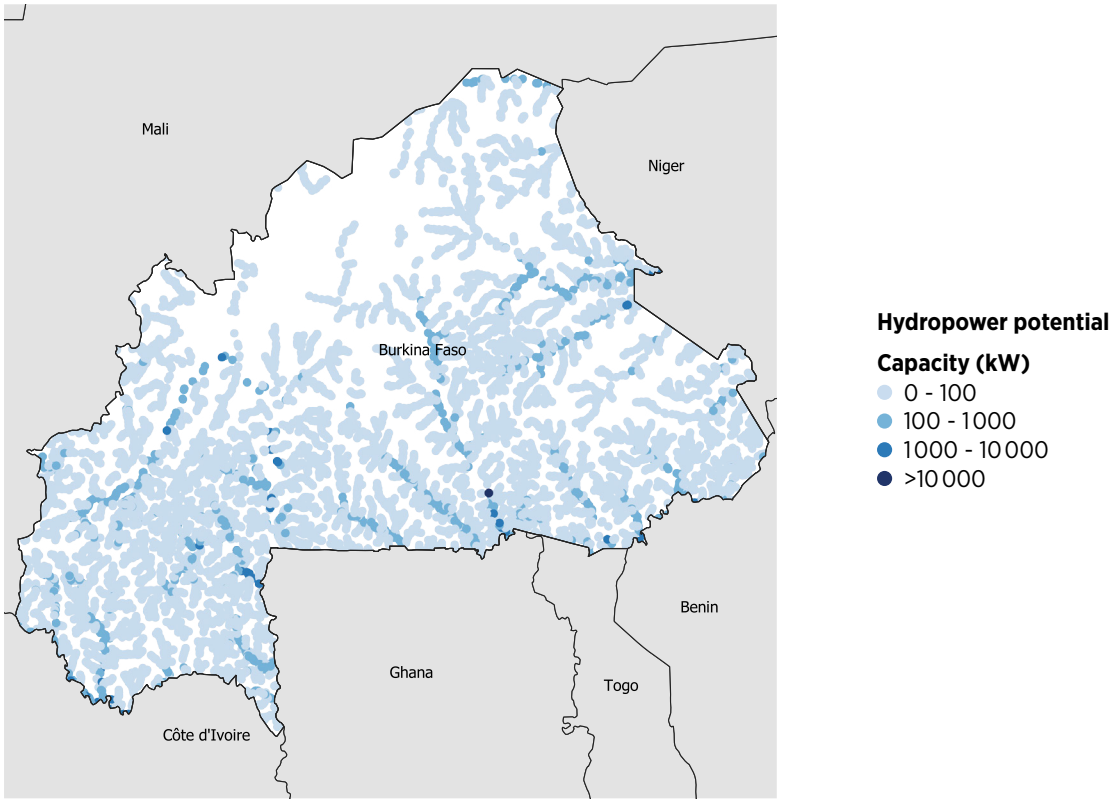
Hydropower

Burkina Faso has limited access to hydropower resources as a result of its climate and geographical location. The Delft University of Technology estimates that the average annual discharge of the country is 1.16 cubic metres per second (m^3/s) and that the hydropower technical potential is 512 MW (Hoes, 2014) (Figure 14). An analysis of the technical potential of 69 sites estimated an overall installed capacity of 113 MW, producing 875 GWh (GoBF, 2015), while the feasibility potential is 215 GWh per year (SEforALL, 2017). Further studies[14] identified 17 potential feasible sites, including the Ouessa, Bassiéri and Banwali dams (GoBF, 2015).

Although small and mini run-of-the-river hydropower sites have been identified in the south and south-west, the deployment of those remote installations for electricity access does not seem economically viable due to their distance from load centres (Moner-Girona *et al.*, 2016).

The effects of climate change in the region are expected to have an important impact on the hydrological resource. According to estimates, the average production declines for the Bagre and Kompienga dams are expected to reach 20% and 67% respectively by 2025, and 52% and 98% respectively by 2050 compared to 2000 (MoESD, 2014). The potential effects of climate change require constant analysis of the hydroelectric potential.

Figure 14: Hydropower potential in Burkina Faso



Source: Hoes, 2014; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

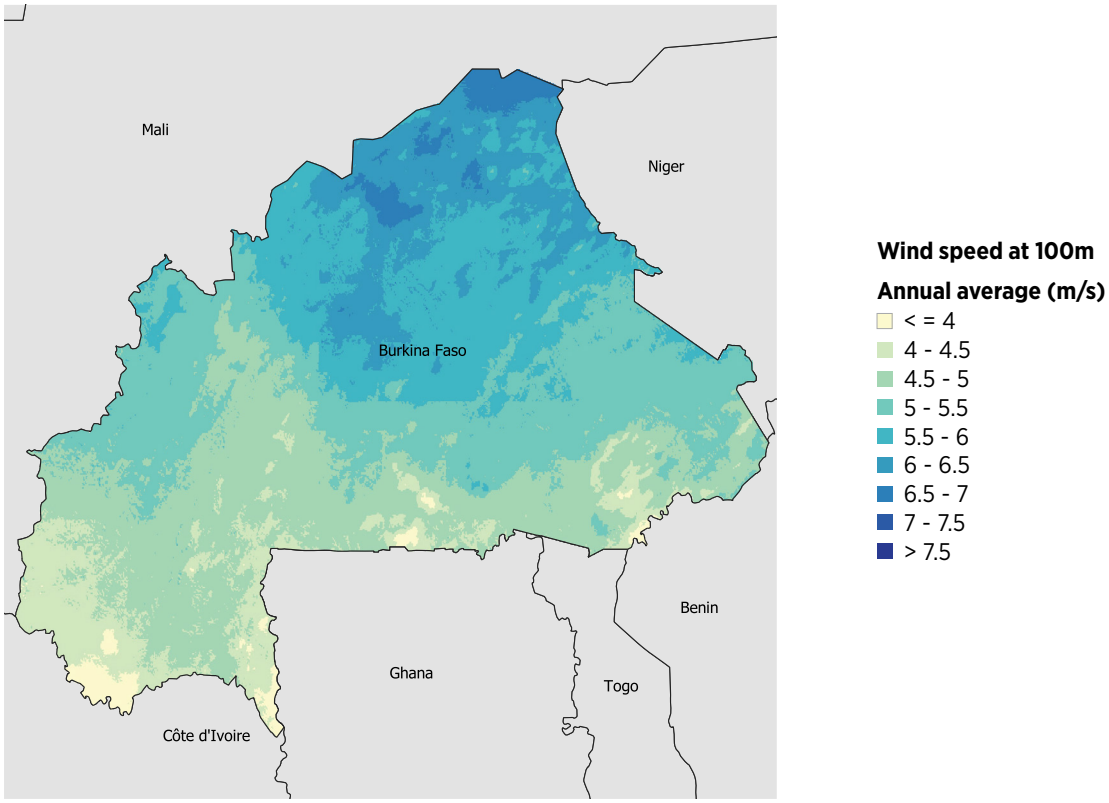
[14] A feasibility study and preliminary design are under way for Bagré (14 MW). Firms are being recruited to conduct feasibility studies for Folonzo (10.8 MW), Gongourou (5 MW) and Bontoli (5.1 MW). Appraisals are pending for Ouessa (21 MW) and Bon (7.8 MW). (Source: interviews.)

Wind

The wind resource in Burkina Faso is moderate, with the highest values reaching 6.7 metres per second (m/s) at a hub height of 100 m in the Sahelian region along the Malian border, and the lowest values at the same height dropping to 3 m/s in the southern region (Figure 15).

Overall, IRENA's suitability analysis estimates that the technical potential for wind energy is 1.96 GW (IRENA, 2021a). The analysis considered major parameters that may influence the ability to install utility-scale wind projects – such as wind speed, population density, distance to transmission and road networks, and other analytical parameters – to locate the most promising zones for successful prospecting, as shown in Figure 16.

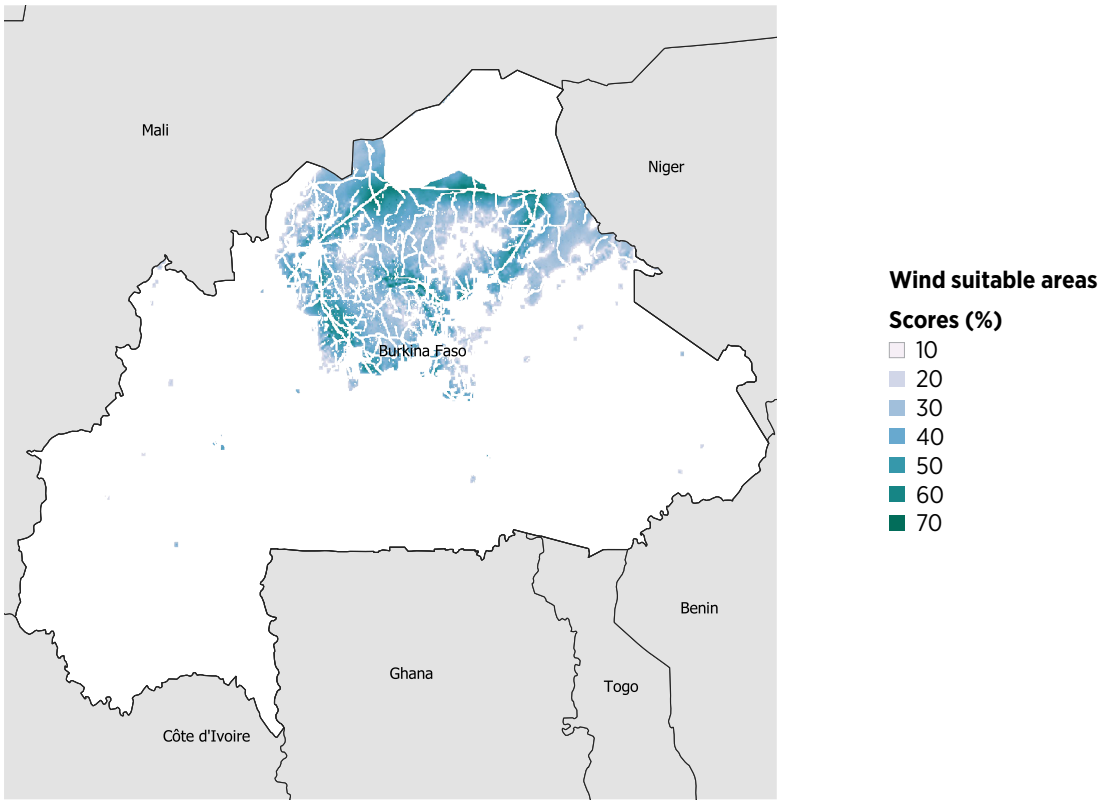
Figure 15: Annual average wind speed at 100-metre hub height in Burkina Faso



Source: DTU, 2015; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

Figure 16: Most suitable prospecting areas for utility-scale wind power in Burkina Faso



Source: IRENA, 2021a; Base map (UN Boundaries, 2021); also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

Collecting water in Poa, Burkina Faso

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Market day, Ouagadougou
© Luca Prestia/Shutterstock

3. KEY DRIVERS OF RENEWABLE ENERGY DEVELOPMENT IN BURKINA FASO

In light of the energy context described in the previous sections, several drivers exist to stimulate actors to support the deployment of renewable energy technologies in Burkina Faso. These drivers are spelled out in MoE (2018a) and are detailed in the following sub-sections.

3.1 Sustainable and affordable energy supply

Burkina Faso seeks to secure a sustainable energy supply at affordable and stable prices.

Economic development is linked to increased energy consumption. Rising energy demand is related to GDP growth and increased access to energy. With GDP growth of 5-6% per year since 2015, the energy matrix of Burkina Faso is increasingly under pressure. The country relies on imported electricity, imported oil and traditional biomass to sustain its energy demand.

- The country is structurally in deficit, with oil imports representing a large share of total imports. Without significant decarbonisation of the energy mix, oil imports would increase with rising energy demand, potentially causing the national economic balance to further deteriorate.

- Oil prices fluctuate with international market prices. To maintain stable electricity prices, a bridging mechanism was put in place, through the state-owned oil company SONABHY, which absorbs the oil price variations. The subsidy mechanism is creating a fiscal deficit, without achieving affordable prices for consumers.

- In the rural electrification sector, the COOPELs are facing significant challenges in operating diesel and hybrid-diesel systems, as the operating costs are difficult to recover without additional subsidies on the diesel price.

The solvency of the power sector, in particular, is an issue as it prevents national investments in new assets and compromises the maintenance and efficient operation of existing assets. This triggers a systematic recourse to the international community for funding national strategies and plans and could potentially create issues in phase of operations and for the maintenance of the new investments.

Non-power energy uses involve primarily cooking, which relies on traditional biomass. The country faces high demand for charcoal, which impacts the vegetation and leads to deforestation and can impact health. A clear priority is to move away from traditional biomass to modern energy services for cooking.

The current energy matrix is not scalable and is unsustainable, from an environmental and an economic standpoint. As discussed later, the country is currently deploying a strategy that could satisfy the growing needs of the economy and support the goal to reach universal energy access. To be successful, the strategy should build on solutions that deliver sustainable and affordable energy, with predictable prices.

From international experience, renewable energy technologies offer an array of options that provide targeted responses, by delivering scaled and appropriate energy services in each end-use segment. The competitive advantages of renewable energy technologies, summarised in brief, are as follows:

- Renewable energy projects concentrate the investment costs upfront and are operated at stable operating costs that are lower than those of fossil technologies. This procures a significant advantage in terms of price stability, as a stable price can be guaranteed for the lifetime of the asset.

- The costs of renewable energy technologies have fallen sharply in the last decade (Figure 17), and utility-scale renewable projects can now deliver power at lower levelised costs than large-scale fossil plants.

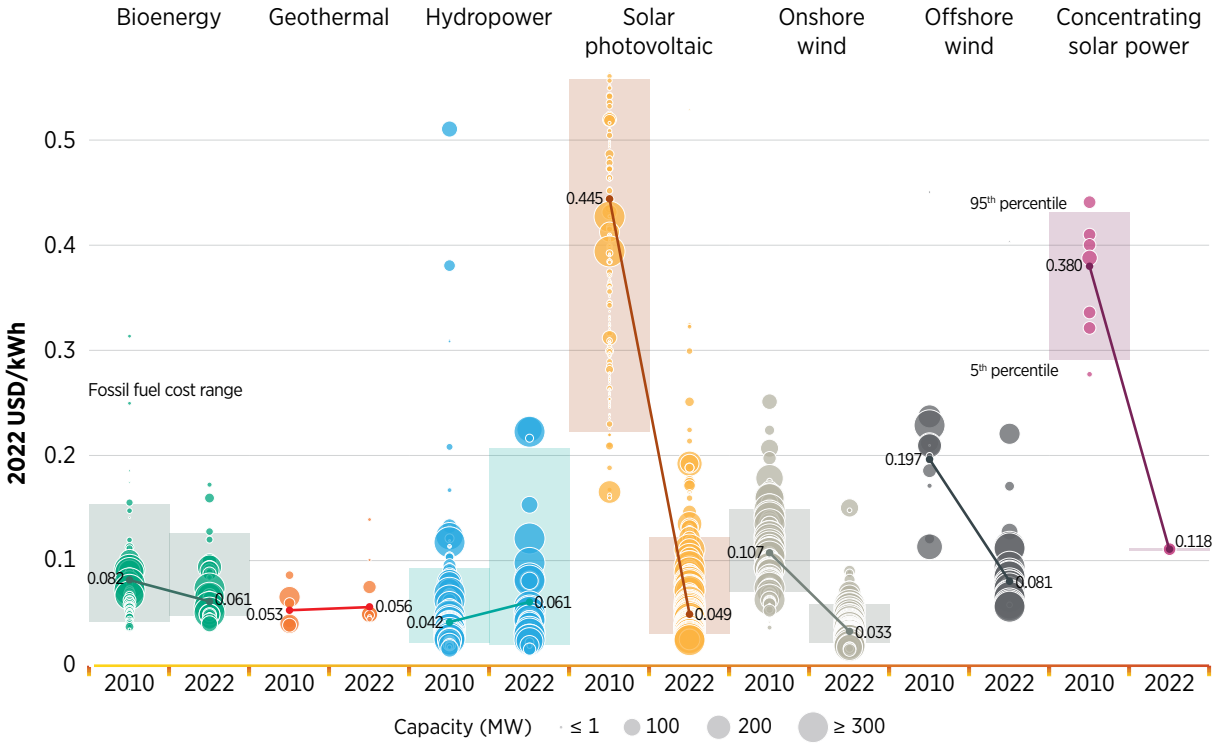
- Large-shares of renewable energy penetration in power systems are achievable – at all scales. The downward cost trend in variable renewable energy resources is accompanied by technologies and operational strategies that enable the predicting of production and demand, store excess power and balance power systems. This is achievable both at a utility scale and for rural communities (such as for mini grids) as well as down to the level of individual households with solar home systems.

- Renewable energy technologies can offer sustainable solutions for non-power uses, particularly for water heating and clean cooking (biogas, liquid biofuels, solar cooking, solar water heating); this can address the issues of deforestation and health effects from traditional biomass uses.

- To some extent, and with careful consideration of the water-food-energy nexus, renewable biofuels can be made available for transport. Significant experience was accumulated in Burkina Faso in the past.

Loudun Avenue mosque, Burkina Faso

Figure 17: Global levelised cost of electricity of newly commissioned, utility-scale power generation technologies, 2010-2021



Source: IRENA, 2023

In light of the energy context described in the previous sections, several drivers exist to stimulate actors to support the deployment of renewable energy technologies in Burkina Faso. These drivers are spelled out in MoE (2018a) and are detailed in the following sub-sections.

3.2 Energy access

Burkina Faso seeks to increase the resilience of rural communities through energy access.

In Burkina Faso, access to affordable sources of energy involves access to electricity services and to clean cooking, shifting away from traditional charcoal and wood-based biomass. The underlying drivers of the energy access objectives include social and economic development in rural communities. With the recent security threats and the COVID-19 pandemic, there is a reinforced need to boost the resilience of communities to external threats. For instance, health care services are impeded by the lack of reliable energy access to power facilities particularly in rural and remote areas. Decentralised renewable energy (DRE) offer cost-effective, quick, and scalable solutions for providing energy access to off-grid rural communities, creating jobs, increasing income, and improving livelihoods through better social services, like health and other public infrastructure. These are necessary to establish the link between the central government and remote localities.

Indeed, continuous energy supply during critical events is a requirement for sensitive building locations such as hospitals (see Box 1 for such a study), schools, telecommunications, and public buildings, as well as for remote communities in zones of high instability. In many locations, the availability of local renewable energy resources can supply local, affordable and reliable energy.

Box 2: Electrification with renewables: Enhancing healthcare delivery in Burkina Faso

Access to reliable energy is a prerequisite for the delivery of quality health services to all, whether that is to power incubators in maternity wards, lighting in delivery rooms and immunisation services, or basic diagnostics and administrative needs. In the context of countries and regions with high levels of poverty and an absence of reliable energy supply, decentralised renewable energy (DRE) can play a critical role in democratising essential services such as health and education. By strengthening primary healthcare infrastructure and building resilience of healthcare systems for the poor, sustainable energy can catalyse improvements in socio-economic and health indicators.

Burkina Faso has 2 330 healthcare facilities, of which 1 800 are primary healthcare facilities that serve mostly rural communities. As in other developing country contexts, these communities travel longer distances and incur out-of-pocket expenses to access reliable healthcare. The government of Burkina Faso is focused on addressing these challenges and providing more accessible healthcare to the poor in a reliable and resilient manner.

Today there is a clear opportunity to leapfrog the traditional grid and equip health facilities with DRE technologies to meet community needs in a sustainable manner. The implications are not only for service delivery and costs of healthcare provision and access, but also carbon dioxide emissions reduction and environmental considerations. IRENA and SELCO Foundation have partnered with the Health and Energy Ministries of Burkina Faso to assess the opportunities for integrating DRE and energy-efficient appliances to strengthen the healthcare sector of the country.

The recently published report* provides an overview of the approach that uses Sustainable Development Goal (SDG) 7 (or universal access to modern, reliable and affordable energy) as a catalyst to enable SDG3 (aimed at universal health coverage). It draws on primary data from health-energy assessments across 40 sample health facilities in Burkina Faso, across levels, key stakeholder consultations and meetings with health and energy experts from the government and outside.

In order to break away from silos and enable a more nuanced understanding of each sector for stakeholders from both sides – energy and healthcare sectors – there is a need to work closely together and bridge skill and knowledge gaps. The key steps and processes, as spelled out in the report, to enable better planning, design and implementation of energy-health nexus solutions are outlined below.

- Energy-health assessment: Clear understanding of the energy needs in the facility given the specific health situation, disease burden and human resource capacity.
- System design and costing: Developing customised DRE system designs, including efficient medical and electrical appliances, based on the assessments conducted and templatising these designs for different levels of healthcare and service provision. Based on this, cost estimations can be developed with local clean energy enterprises.
- Procurement and installation: Using procurement guidelines that incentivise quality and timely after-sales service and strengthen local entrepreneurship; installing energy solutions with efficient equipment based on energy system design.
- Ownership and maintenance: Establishing clear and customised financial and ownership models that ensure maintenance and proper utilisation of the energy system, including maintenance contracts with local energy enterprises.
- Capacity building and training: Equipping staff to utilise the medical appliances for service delivery and manage the energy system, including aspects of basic maintenance.

This process needs to be supported by improvements in the overall energy-health ecosystem across technology and innovation, financing, capacity building and skills, health service delivery, and policy. The report provides an effective approach for implementing an energy-health programme and building or strengthening the ecosystem to enable better integration of DRE solutions and energy efficiency for healthcare provision in Burkina Faso and ensure their long-term sustainability and operations.

* IRENA and SELCO Foundation (2022), Electrification with renewables: *Enhancing healthcare delivery in Burkina Faso,* International Renewable Energy Agency, Abu Dhabi.

3.3 Renewable energy potential

Burkina Faso has significant renewable energy potential, which can fulfil its energy demand.

Burkina Faso has sufficient renewable energy potential to meet its national targets. For the power sector, the country has abundant solar resource. The renewable energy projects currently identified in the pipeline are based primarily on solar PV, as it is affordable and scalable and can be deployed over short time frames.

Dependency on a single resource, however, implies the need to adjust to its availability and variability. The integration of a single source of variable renewable energy needs to be supported by additional investments in storage technologies and balancing on the regional grid.

Being well connected to its neighbours, Burkina Faso has the potential to balance out its electricity imports from the regional grid. Strong integration into a regional electricity market is also an efficient means to look towards high shares of renewable energy on the network, without having to increase the back-up capacity from fossil-based fuel plants – provided that the market can absorb excess production.

If other renewable energy resources could be harnessed, additional power system management strategies might be integrated, as the different resources (wind, hydropower) have different variability time frames. The "capacity credit" of renewables could be higher for a portfolio of technologies than for a single resource.

The country has had previous experience with biogas and biofuels, albeit for non-power uses and despite large uncertainties of the resource. This could be an asset in addressing the issue of inefficient cooking and deforestation.

3.4 Economic diversification and job creation

Burkina Faso seeks to diversify its economy and create qualified and sustainable jobs.

In 2020, an estimated 6.4% of the total labour force in Burkina Faso was unemployed (UNDP, 2021). Employment in the informal economy could lead to significant losses of national tax income. The informal sector currently employs an estimated 74% of the non-farming workforce and may contribute up to 25% of the GDP (Ouedraogo, 2021).

With 11.5 million jobs created worldwide in the renewable energy sector so far, renewables could be a catalyser for new employment opportunities. This is especially true in Burkina Faso, a country traditionally dominated by conventional sources of energy. With adequate policies, renewable energy may provide new avenues for technological innovation and the opening of new sectors for economic value creation. The same may be true for energy efficiency, where small entrepreneurs and companies can be involved in the adoption of energy-efficient appliances and appliances for energy self-generation.

3.5 International climate and health commitments

Burkina Faso has made international commitments to address climate and health impacts in the energy sector.

Greenhouse gas emissions from the energy sector increased four-fold between 1995 and 2015. Projections show that these emissions are expected to increase ten-fold between 1995 and 2030 (GoBF, 2021a).

The combustion of fossil fuels and traditional use of bioenergy are a major source of local air pollution. Some of the main pollutants are sulphur dioxide, nitric oxide and microparticles, which can cause adverse human health effects. These pollutants also can reduce agricultural yields, devastate forests and fisheries (acid rain), and damage buildings and infrastructure.

Renewables offer the most prominent low-carbon solution to meeting Burkina Faso's climate targets. In the 2021 revision of its Nationally Determined Contribution under the Paris Agreement, the country has committed to reducing its greenhouse gas emissions 29.42% by 2030 compared to the 1995 base year. The NDC already emphasises the use of alternative and renewable energy sources to achieve this target.

The Sindou peaks, Burkina Faso
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4. ENABLING FRAMEWORKS FOR RENEWABLE ENERGY DEPLOYMENT

Burkina Faso has taken significant action to improve its energy situation and is already implementing the drivers introduced in the previous section. The following sub-sections examine the regulatory frameworks and legislation currently in place, then identify potential shortcomings and formulate recommendations.

4.1 Strategic plans and targets

The energy sector in Burkina Faso has multiple policies and strategies (MoE, 2018a). Most of the strategies seem to overlap in scope and formulate targets that may not be aligned. However, as this section illustrates, those targets complement each other and expand over time. The current targets for renewable energy and energy efficiency are defined by the Energy Strategy 2019-2023, although some elements of the national renewable energy action plan (PANER) and the energy efficiency action plan (PANEE) may still be relevant.

The various plans and strategies present their own specificities and a number of key performance indicators. Except for the National Plan for Economic and Social Development (PNDES), which is centrally monitored, the monitoring of these numerous documents is complex. This creates uncertainties regarding the regulatory performance of the frameworks. The following paragraphs discuss the main features of the various strategic plans and targets, and when available, compare these to current achievements.

The identified strategies are described in Annex 3. There are:

- The Energy Sector Development Policy Letter (LPDSE), adopted in 2000
- The Energy Sector Policy 2014-2025 (POSEN), adopted in 2013;
- The Energy Sector Policy Letter 2016-2020 (LPSE), adopted in 2016;
- The Renewable Energy Action Plan (PANER), adopted in 2015;
- the National Energy Efficiency Action Plan 2015-2030 (PANEE), adopted in 2015;
- the National Plan for Economic and Social Development (PNDES), adopted in 2016;
- the Energy Strategy 2019-2023, adopted in 2018.

The LPSE acknowledges the need to address the financial stability of the energy sector, mostly through efficiency; however, it also proposes strengthening fossil-based fuel electricity production and ensuring the quality and quantity of hydrocarbons, which may counteract efforts to address the structural fiscal deficit of the power sector.

The objectives of the LPSE to be reached by 2020 include: increasing the electricity coverage rate in the country to 80%; doubling the number of electricity subscribers to 1 million; increasing the installed generation capacity from 300 MW to 1 000 MW; ensuring the continued availability of hydrocarbons throughout the country; and promoting the use of solar and bioenergy.

The LPSE text identifies specific actions to implement the strategy (GoBF, 2016a). The primary focus is to reinforce the fossil-based fuel baseload of the country, by adding more than 400 MW of fossil power plants. For renewable energy, the document announces a large number of utility-scale solar PV projects (104 MW and feasibility for another 80 MW), 39 MW of solar power in public buildings, 36 MW of hydropower, and 10 MW of biomass and waste power (which also can be found in the 2021 NDC submission).

The PANER addresses two main objectives: 1) ensure universal access to modern energy services, and 2) double the share of renewables in the energy mix.

The PANER details specific trajectories and objectives related to: capacities and energy produced by on-grid renewable energy; capacities for off-grid renewables; population and technology share for household cooking energy; share of solar heaters in public buildings, industries and hotels; and share of first-generation biofuels in oil consumption. The overarching targets are presented in Annex 3.

According to the PANER, the "doubling" of the share of renewable energy is understood as a doubling of installed capacity – from 15% in 2010 to 36% by 2030. However, the actual contribution of renewables to the electricity mix – including medium and large hydropower and excluding power imports from neighbouring countries – would vary from 21% in 2010 to 17% by 2020 and 27% by 2030. Including hydropower and excluding imports, however, the share is much more modest and actually decreases from 12% in 2010 to 9% by 2030.

Noticeably, the share of grid-connected renewable energy is defined in the target capacity, target share of total capacity, total power generated by renewables, and share of total power generation – with and without imports. Taken altogether, these targets thus not only specify the target for renewable energy, but also lock in targets for fossil fuel generation and imports – which might be too rigid an approach over the long term.

For end uses, clean cooking, and solar water heaters, the objectives are not formulated in terms of demand or level of service but in total numbers, which can create biases in achievements. Under the PANER, more than a quarter of the population should be supplied by off-grid systems by 2030; four out of five persons should use improved cookstoves; and half of the public buildings and a quarter of the industries and hotels should use solar water heaters. None of the targets specify the share of the end user covered by the different solutions, which can concern diverse tiers of access. For transport, the share of biofuel in petrol consumption is set at 10% for ethanol and 5% for biodiesel, both by 2030.

In parallel to the PANER, the PANEE, includes several initiatives addressing efficient lighting, standards and labelling, energy efficiency in buildings, energy efficiency in industry, high-performance electricity generation, and cross-cutting measures including improving energy efficiency in the public sector.

Similar to the PANER, the selected target indicators concern various dimensions. The efficient lighting targets are formulated in fixed annual savings (in GWh), which in turn could be converted into a number of devices. The grid losses are also very specific and are labelled both in share of losses (from 17% in 2010 to 10% in 2030) and in energy saved. However, the energy efficiency of buildings and industry is labelled in numbers (shares) of buildings with energy efficiency measures, which can lead to a vast array of interpretation and therefore impacts.

Adopted in 2016, the PNDES is a major planning document, fixing specific targets in all dimensions of the economy. The Plan aims to achieve economic growth through three lines of development: reduce poverty, build human capital and meet basic needs. In the PNDES, the energy component was expected to be covered under strategic objective 2.5, aiming to improve quality of life and to guarantee access to quality energy services and energy efficiency (GoBF, 2016b).

Table 7 presents a summary of the tracking indicators for the PNDES. Noticeably, these indicators do not match with the PANER but present more ambitious objectives regarding renewable energy. In an attempt to track progress, Table 7 presents a comparison of the latest available targets.

The trajectory towards these objectives is tracked by the Ministry of Energy, which publishes them in its annual report. In 2018, the achievements towards these aspirational targets were slightly under-realised, particularly regarding the electrification rate in rural areas and renewable energy capacity.

Table 7: Tracking indicators towards the achievement of the PNDES objectives for 2018

	2017 (A) (ARSE*)	2018 (B) (ARSE*)	2019	PNDES Targets		Difference/ PNDES 2018 (B-C)
				2018 (C)	2020	
National electricity coverage rate (%)	36.08	38.56	-	52.3	80	-13.74
Electrification rate (urban) (%)	65.76	68.69 (74.7)	-	69	75	-0.31
Electrification rate (rural) (%)	3.27	3.16 (32.2)	-	12.6	19	-9.44
National electrification rate (%)	20.63	21.44 (43.2)	-	30	45	-8.56
Renewable energy share in total generation (%)	12.55	16.87	-	19	30	-2.13
Total installed capacity (MW)	359.55	359.55	409	650	1000	-290.45

Source: GoBF, 2016b (Annex 3 of the report); PNDES objectives are compared with MoE (2019) and ARSE (2020).

Note: * Parentheses indicate the values provided in ARSE (2020), which are mentioned as "corrected from solar access".

Expanding on the PNDES, the Energy Strategy 2019-2023 embraces the issue of energy dependence and its cost to the economy. The Strategy, adopted in 2018, notes the lack of production capacity in the country and the decommissioning of plants scheduled from 2020 onwards. The Strategy seeks to ensure sustainable access to modern energy services, promote energy efficiency, and build on endogenous resources and regional co-operation. The aim of the Strategy is therefore to mobilise both external and domestic financial resources to achieve its targets. The Strategy defines precise targets for the energy mix and level of electrification (Table 8).

Compared to the PNDES, which targets the year 2020, the Strategy focuses on 2022 and raises the targets for grid coverage (increase from 80% to 90%), urban access (from 75% to 80%) and national access (from 45% to 60%). The share of renewables in total energy production is raised from 30% by 2020 in the PNDES to 55% by 2022 in the Energy Strategy.

The Strategy also aims to increase the total production capacity to 2 500 MW in 2022, by modernising and expanding the fleet of fossil-based fuel plants and recruiting independent power producers, implementing solar PV plants and hydropower, and promoting solar equipment and biomass. For biofuels, the Strategy mentions biodiesel from jatropha and indicates a target of 38 000 biodigesters by 2022.

For energy efficiency, the target is to reduce energy consumption 5% by 2020 and 10% by 2022. The focus is on building capacities and awareness of energy efficiency, reducing power losses, operationalising energy audits and using more efficient appliances (*e.g.* solar water heating, energy labelling, energy performance monitoring, performance labels on imported equipment, energy efficiency in education, awareness campaigns). Energy audits should be generalised for small and medium enterprises and large companies, and an energy efficiency code should be elaborated, including solar water heating and the use of efficient lightning for public buildings.

Importantly, the Strategy provides a monitoring framework (Table 8) that can be used to evaluate the progress and performance of government policies, such as MoE (2019), and to guide policy decisions. For the purpose of this review, in Table 8 the strategic targets are compared to actual achievements as of 2018. Significant gaps can be identified, including the low access in rural areas, the low share of renewable energy, the lack of installed capacity and the cost of electricity.

Table 8: Impact evaluation framework, comparing targets for 2019 and 2022 with actual levels for 2018

Impact	Indicators	2019 target	2022 target	2018 actual (ARSE*)
Accessible and affordable energy	National grid coverage (% of population)	52.30%	90%	38.56%
	National electrification rate	30%	60%	21.44% (43.2%)
	National electrification rate – urban	69%	80%	68.69% (74.7%)
	National electrification rate – rural	12.60%	19%	3.16% (32.2%)
	Share of renewables in total energy production	19%	55%	16.87%
	Installed capacity (MW)	650	2 500	359 (Table 7)
	Cost per kWh in XOF	55	50	70
Efficiency	Energy saved from efficient consumption (MW)	6 689	43 952	-
	Average cuts (hours)	140	80	-
	Overall distribution losses (technical and non-technical)	13.54%	11%	-

Source: MoE, 2018a.

Note: * Parentheses indicate the values provided in ARSE (2020), which are mentioned as "corrected from solar access".

4.2 Regulatory framework for the power sector

Among regulatory documents, Law 014-2017 (the Energy Law) covers the general regulation of the energy sector. It establishes a global framework for the management and regulation of both the energy sector and the electricity sub-sector, while provisioning for the establishment of the regional market. It has been further implemented through a number of decrees (see Annex 4). The aim of the Law was to open the production and distribution segments to competition across the entire country. It introduced specific elements promoting renewable energy and energy efficiency.

In 2018, SONABEL was established as a public company under private law. For large grid-connected renewable energy projects, under the monopoly regime for the transport network, access to the grid depends on feasibility agreement by SONABEL. SONABEL is also in charge of ensuring access and the electrification plans. The Energy Law did not unbundle the activities of the national utility, which remains vertically integrated.

The transmission grid does not extend fully across the country, and regulations allow for the establishment of additional concession zones for distribution grids with embedded generation. ARSE has a central role – although essentially consultative – for delivering generation and concession licences (Decree 2018-0569/PRES/PM/ME/MINEFID/MCIA/MATD of 10 July 2018 adopting specifications applicable to electricity distribution concessionaires in Burkina Faso) and establishing electricity tariffs.

In the generation segment, the various authorisation regimes are defined by Decree 2017-1011/PRES/PM/ME setting the power thresholds for generation operating licences and the coverage radius limits for distribution operating licences, which establishes distinct thresholds according to the generation source:

- Licence regime - fossil-based fuel: > 2 MW; renewable: 1 MW;
- Authorisation regime - fossil-based fuel 0.5 to 2 MW; renewable: 0.25 to 1 MW;
- Declaration regime - fossil-based fuel: < 0.5 MW; renewable: 0.25 MW; self-production: 0.5 to 1 MW;
- Exemption - fossil-based fuel: < 100 kW; renewable: 5 kW.

Competitive bidding (auctions) is the rule for generation above 5 MW (Decree 2017-1012/PRES/PM/ME/MCIA/MINEFID on the terms and conditions for granting licences or authorisations for the production of electrical energy). In this case, the regulator (ARSE) notifies the minister, who grants the licence for 25 years (15 years for an authorisation). To provide guarantees to investors, the auction should include the draft public-private partnership contract. The law (Decree 2017-1013/PRES/PM/ME/MINEFID/MCIA adopting specifications applicable to electricity producers in Burkina Faso) provides terms of reference for procuring generation capacity. In the absence of a grid code, the decree mentions a number of electrical requirements usually detailed in national grid codes.

For electricity transport, distribution, and retail, the tariffs methodology for a concession is established by Decree 2018-0568/PRES/PM/ME/MINEFID/MCIA of 10 July 2018 on remuneration for activities contributing to the supply of electricity and setting the methodologies and parameters for determining electricity transmission and distribution tariffs. Although ARSE provides guidance and recommendations based on benchmarks and best-practice revenue requirement methodologies, the tariffs are primarily set by the Ministry. The tariffs include a remuneration of the invested capital and the costs of sector expansion, in the form of a fixed part (redevance) and a variable part (per energy produced). The decree also establishes a social tariff for poorer customers, compensated by other client categories,[15] which might create challenges in recovering costs.

The distribution segment is in principle open to public and private competition, under a concession (if the network extends to more than 1 km) or an authorisation regime granted by ARSE (if the network extends to less than 1 km). The boundaries of the concession zone operated by SONABEL, and how the concession regimes are enforced outside this perimeter, are not addressed by the legislation.

ABER is in charge of supervising electrical co-operatives, associations and private structures delegated to provide public services in rural areas. The COOPELs are responsible for local electricity production, transmission, supply, maintenance and billing at the local level, per their concession contracts. In principle, the authorisation regimes carry performance requirements, which implies that licences can be revoked if those requirements are not fulfilled. This clause was recently triggered for some COOPELs (ARSE, 2020).

More recently, Burkina Faso opened the market for self-generation on the distribution segment (Decree 2019-0902/PRES/PM/ME/MINEFID/MCIA of 18 September 2019 on the terms and conditions of access by self-producers of renewable energy to the electricity grid and the conditions for buying back their surplus energy). Although requiring secondary legislation, this decree applies to all self-generators, including (but not exclusively) solar. The installed capacity should not exceed 30% of the total peak load (*e.g.* household). For under 500 kW, the installation is connected to the low-voltage network. Net metering and retail are authorised for installations over 100 kW under the authorisation regime. The purchase tariff is to be set by decree. The template purchase contract is to be developed by ARSE.

In terms of capacities, the 10-year indicative investment plan indicated by Law 014-2017 is potentially a strong lead for investment planning in the country. In rural areas, the plans formulated by ABER and the COOPELs should form the basis for investment in the coming years.

Under the responsibility of ANEREE, Decree 2017-1014 /PRES/PM/ME/MCIA/MINEFID of 26 October 2017 sets energy efficiency certifications for a large number of appliances, as well as the labelling of energy performance. This decree is supported by Interministerial Order 2020-033, which establishes a list of equipment to be exempt from value-added tax (VAT). The equipment should conform to the quality standards established by the Energy Ministry. The conformity agreement is delivered by ANEREE. This element is particularly relevant to limit the supply of sub-quality solar products under the VAT exemption regime.

The current policy and renewable energy "enabling" regulatory frameworks are summarised in Table 9.

[15] In Annex 2, the monophased tariff, 1 to 3 A between 0 and 75 kWh is set at XOF 70 per kWh (USD 0.12/kWh), which is below production costs. The grid charge cost is XOF 3 375, or USD 5.93.

Table 9: Summary of the current regulatory framework in Burkina Faso, based on IRENA classification

National policy		Regulatory instruments	
Renewable energy law / strategy	■	Auctions	■
Solar heating law / programme		Feed-in tariff	
Solar power law / programme		Premium	
Wind power law / programme		Quota certificate system	
Geothermal law / programme		Hybrid	
Biomass law / programme		Net metering	■
Biofuels law / programme		Ethanol blending mandate	■
Fiscal incentives		Biodiesel blending mandate	■
VAT exemption	■	Solar mandate	■
Fuel tax exemption		Registry	
Income tax exemption		**Finance**	
Import / Export fiscal benefit		Currency hedging	
National exemption of local taxes		Dedicated fund	
Carbon tax		Eligible fund	
Accelerated depreciation		Guarantees	
Other fiscal benefits		Pre-investment support	
Grid access		Direct funding	
Transmission discount / exemption		**Other**	
Priority / Dedicated transmission		Renewable energy in social housing	
Preferential dispatch		Renewable energy in rural access programmes	■
Other grid benefits		Renewable energy cookstove programme	
		Local content requirements	
		Special environmental regulations	
		Food / Bioenergy nexus	
		Social requirements	

Based on: Classification framework in IRENA, 2016.

4.3 Stakeholder mapping for the renewable energy sector

Institutional stakeholders

The stakeholder interaction map for the power sector In Burkina Faso is presented in Figure 18 and includes a broad array of institutions, as described below. For more details on the relevant laws and Decrees and their main highlights, see Annex 4.

The Ministry of Energy, Mines and Quarries governs the energy branch. Its duties include the preparation and application of policies and regulations for the sector; the control of the production, supply and distribution of energy; and the promotion of renewable energy and energy efficiency. The Ministry is organised in three directorates: conventional energy sources, energy efficiency and renewable energy. The structures affiliated with the Ministry are ABER, ANEREE and SONABEL.

The Ministry of the Environment, Water and Sanitation is responsible for reporting to the United Nations Framework Convention on Climate Change (UNFCCC) and is in charge of the co-ordination of mitigation and adaptation strategies for climate change. In partnership with the Ministry of Economy and Finance are working with the NDC Partnership, along with institutional partners, to develop a Partnership Plan for implementation of the countries Nationally Determined Contributions (NDCs) under the Paris Agreement.

The Société Nationale Electricité du Burkina (SONABEL), created in 1954, is a vertically integrated state-owned utility under private law. It is responsible for electricity production, transport, distribution and retail. SONABEL has the monopoly on transport, while an open market is allowed for generation and distribution segments (outside SONABEL's concession zones).

With the adoption of Decree 2018-0857, SONABEL is established as a public company under private law. The utility's objectives include: provision of electricity in "sufficient quantity"; improving access; and operation of the production, distribution, retail and transport of electricity. SONABEL has a monopoly over the electricity transport.

The Energy Regulatory Authority (ARSE) was operationalised by Decrees 2016-2017 and 2020-0278. The ARSE operates under the authority of the Prime Minister. It oversees the regulation of the sector, guaranteeing its economic and financial balance. In addition, the ARSE acts as arbitrator of disputes among operators and proposes to the government any tariffs applicable in the energy sector, including third-party access tariffs.

The National Hydrocarbon Company (SONAHBY) is the state-owned oil company. SONAHBY has a monopoly over all oil product imports and storage in the country. As its largest client, SONABEL is fully dependent on SONABHY's fuel supply, pricing and availability.

The National Agency for Renewable Energy and Efficiency (ANEREE) was created in 2016, as established in the POSEN. Its main objective is to monitor, promote and supervise renewable and energy efficiency markets, support and promote large-scale projects, federate partners in the sector, and foster research and innovation. Decrees 2016-1200 and 2016-1265 specify the roles of ANEREE, in order to:

- control, support and supervise the renewable energy and energy efficiency markets (labelling, test, technology centre, market supervision);
- establish a national energy efficiency strategy;
- support and promote flagship renewable and energy efficiency projects (assess potentials, promote ongoing actions, develop an energy information system, etc.);
- federate partners (private and public sectors, non-governmental organisation, etc.) in the renewable energy and energy efficiency sectors;
- initiate commercial services and public services related to renewable energy and energy efficiency;
- support research and education in both sectors.

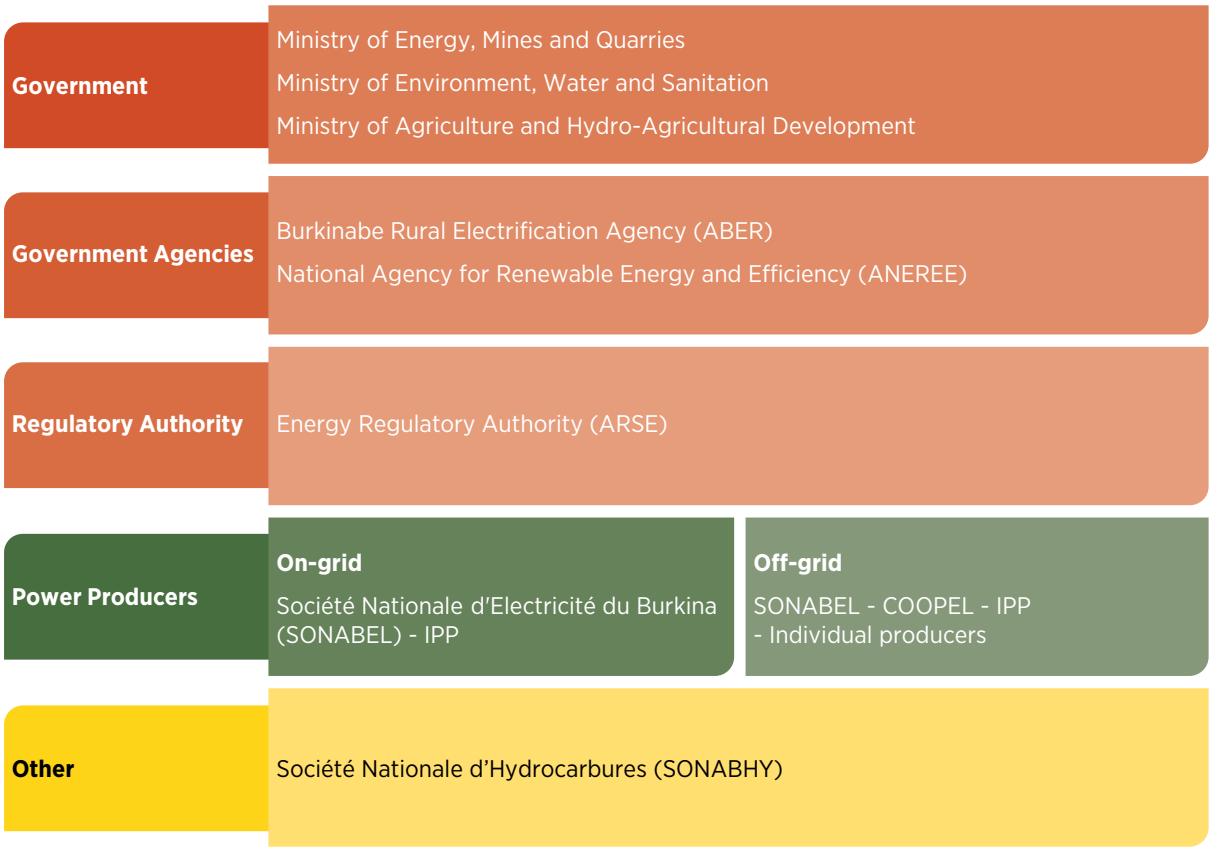
ANEREE is funded by multiple sources, including a fee on the renewable energy purchases from SONABEL, as per Decree No. 20161200/PRES/PM/MINEFID/MEMC, which established the National Agency for Renewable Energy and Energy Efficiency on 09 February 2017.

The Burkinabe Rural Electrification Agency (ABER), created in 2018, is in charge of promoting the rural electrification plan, assisting with the implementation of projects and facilitating access to electricity. The transformation of the Rural Electrification Fund (FDE) into ABER was considered by Law 014-2017. ABER was enacted a year later by Decree 2018-1160 adopting the statutes of ABER. ABER is also in charge of supervising electrical co-operatives and associations, as well as private structures delegated to provide public services in rural areas.

The Co-operative Electricity Companies of Burkina Faso (COOPELs) are local co-operatives established with the role of creating isolated mini-grids to manage and promote the use of electricity. The COOPELs act as the interface between the beneficiary populations and ABER.

The **Ministry of Agriculture and Hydro-Agricultural Development** is responsible for monitoring and evaluation of agricultural performance, enforcement of land tenure regulations, providing support to producers, and overseeing the management and use of the hydrological resource.

Figure 18: Power sector institutional stakeholders in Burkina Faso



Private sector

In Burkina Faso, the private sector is represented by 10% formal firms, with the rest comprising informal structures with low productivity (IFC, 2019).

International companies active in the country's renewable energy sector include *e.g.* Africa Energy Cooperation (AEC), GreenYellow, Qair International, Total Eren and Urbasolar. These companies are engaged in the development, financing, construction and operation of solar PV power plants. Other companies such as Engie have entered the market for the construction of projects, providing the know-how under international donor financing.

Local stakeholders are involved in the bioenergy and solar sectors. In the solar thermal sector, some local actors are involved in the manufacturing, assembling, import, retail and installation of solar water heaters (Table 10).

Table 10: Examples local companies involved in the renewable energy sector of Burkina Faso (non-exhaustive list)

Sector	Company	Activities
Bioenergy	FasoBiogaz	Energy and organic fertiliser production
Solar energy	Africa Energy Solaire (AES)	Installation and retail of solar PV mini plants, solar pumps and irrigation systems, solar street lighting
	ARESS Burkina Faso	Provider of SHS
	CB Energie	Design and installation of solar PV plants, solar PV pumps and irrigation systems, and solar lamps manufacture and retail
	DargaTech	Solar pumps for irrigation project
		Technical and financial study for three PV systems for a medical centre with surgical unit
		Technical and financial study of electrification for mini solar PV power plants and distribution network
	Farafina Eco Engineering	Implemented Yeleen cash project, training for water management and energy efficiency
	Faso Energy	Manufacturer of solar PV panels
	Salgatech	Production and installation of solar multifunctional cold rooms and ice machines
	Squall Group	Installation of solar traffic lights in Ouagadougou in partnership with ANEREE
	Sahelia solar	Kits solaires
	TERA Satisfaction Sarl	Installations of solar kits
	Solafrique	Installation of solar PV, solar PV pumps and irrigation systems
	Oolu	Off-grid solar with presence across Western Africa
	Microsow	Installation of solar PV and equipping rural facilities with solar powered equipments
Energy efficiency, solar energy	PPS Sarl	Installation of solar PV at a medical centre with surgical unit

International actors

The French Development Agency (AFD) funded the extension and densification of the distribution network within the Yeleen project and the development of solar PV mini-grids. In addition, AFD is co-financing with the African Development Bank (AfDB) the development of solar PV power plants. AFD is among the members supporting the Sahel Alliance initiative to assist the G5 Sahel countries (Burkina Faso, Chad, Mali, Mauritania and Niger) in their security and development challenges.

The AfDB has been involved in the Yeleen project by providing capacity building and technical assistance to ABER for raising private funds to deploy mini-grids for rural electrification. The Yeleen project was expected to lead to the installation of 100 mini-grids over a two-year period – powered by an estimated 11.4 MW peak (MWp) of total solar PV capacity – to connect 50 000 households in 100 localities, including 500 productive connections. Through the Yeleen project, the government of Burkina Faso also intends to increase the solar installed capacity by implementing 50 MW of solar PV production, divided into four PV power plants: Ouagadougou (42 MWp), Dori (6 MWp), Diapaga (2 MWp) and Gaoua (1 MWp). This latter segment is financed by the AFD and the European Union (EU).

The AfDB is also implementing the PEPU electrification project. In the area of energy policy, the AfDB supported the reform of the country's energy regulatory and management framework while increasing the attractiveness to private investors (AfDB, 2018). Burkina Faso is among the countries included in the AfDB's Desert to Power initiative, launched in 2019 to deploy 10 GW of solar energy across the Sahel by 2025.

IRENA and the Abu Dhabi Fund for Development (ADFD) collaborated in 2016 to develop a rural electrification project. Through the project, 12 000 local families were provided electricity access via 3.6 MW solar PV mini-grids and extending the grid (Box 2). The Islamic Development Bank has participated in Burkina Faso by funding fossil-based fuel generation reinforcement projects and decentralised solar PV rural electrification projects. In addition, ECREEE co-financed with ABER the Gori project, initiated by a local non-governmental organisation, to electrify a community with solar PV and diesel. In the solar thermal field, ECREEE supported the SOLtrain West Africa Programme.

The Millennium Challenge Corporation (MCC) has been involved in the country since 2008. In 2020, MCC approved a USD 450 million grant agreement with the government for the Burkina Faso Compact II programme (MCC, 2021). The programme includes three components: addressing electricity infrastructure improvement, enhancing grid development and access, and strengthening the effectiveness of the electricity sector by improving the legal, regulatory and institutional framework.

The World Bank has been involved in multiple projects in Burkina Faso. It funded the improvement in electricity access component of the PASEL project and a grid integration study for high penetration rates of solar PV. The Bank also supported the preparation of feasibility studies for the 150 MW peak regional solar park in Burkina Faso. In 2021, additional funds were approved for the Regional Off-Grid Electricity Access Project covering the 15 ECOWAS countries.

In 2016, IRENA, in collaboration with ECREEE, the West African Power Pool (WAPP), and the ECOWAS Regional Electricity Regulatory Authority (ERERA) initiated the West Africa Clean Energy Corridor (WACEC) initiative. Building on existing efforts in the region, including those of the West African Economic and Monetary Union (UEMOA), the AfDB, and other development partners such as Germany's GIZ and the US Agency for International Development (USAID), the WACEC promotes the development and integration of utility-scale renewable power in West African power systems. IRENA recently published revised solar and wind technical potentials for the country (IRENA, 2021a). IRENA, together with GIZ, EUEI Partnership Dialogue Facility (EUEI PDF) and the Austrian Development Agency (ADA) also supported ECREEE in the development of the regional market for Renewable Energy and Energy Efficiency services by establishing a regional scheme for certifying the skills of solar PV installers and other sustainable energy professionals.

Box 3: Rural electrification by solar PV/diesel and power-distribution mini-grids

This government priority project, benefitting from an ADFD loan of USD 10 million, involved the rural electrification of 42 localities in Burkina Faso with mini-grids, grid extensions and solar home system technologies. The project has been implemented by the government-led Burkina Rural Electrification Agency (Agence Burkinabé de l'Electrification Rurale, ABER; formerly the Development Fund for Electrification – Fonds de Développement de l'Electrification), together with Sahelia Solar and decentralised services company Nuon–Yéelen Kura S.A. The project followed a holistic approach, matching the most suitable and cost-effective technology with each end-user. In rural trading localities where populations are sufficiently dense, mini-grids will provide technical and economic competitive advantages over grid connections or individual solar kits. In sparsely populated areas, however, households will be most cost-effectively served by individual solar kits – which will be provided by the project.

* IRENA and ADFD (2020), Advancing renewables in developing countries: Progress of projects supported through the IRENA/ADFD Project Facility, Internatonal Renewable Energy Agency (IRENA) and Abu Dhabi Fund for Development (ADFD), Abu Dhabi.

Local research and training institutions

The Research Institute for Applied Sciences and Technologies (IRSAT/CNRST)[16] is involved in science and technology research. IRSAT aims to participate in research and studies on traditional and renewable energy, and biotechnologies. Its energy department is specifically in charge of research and development in the sector and evaluates its impact on the environment.

The Training Institute of Applied Solar Technologies (ITSA)[17] proposes training courses for professional graduates and engineers in solar technologies for the ECOWAS and UEMOA countries. ITSA also proposes six-month training courses for the design, management and maintenance of solar PV and thermal systems, as well as training courses for the design of biomass systems. In addition, two-week trainings are proposed for the installation and maintenance of solar PV and solar thermal, solar cookers and biodigesters.

The International Institute for Water and Environmental Engineering (2iE)[18] proposes several technical programmes for engineers and bachelor's degrees in relevant fields such as electricity, energy, infrastructure and service management, including hydro-agriculture. 2iE is very active in research, and a specific lab – Laboratoire Energies Renouvelables et Efficacité Energétique (LabEREE) – is dedicated to renewable energy and energy efficiency. LabEREE is mainly focused on biomass, solar energy and smart grids. Since 2010, it has been involved in several projects with renowned institutions – such as CSP4Africa, Flexy Energy, PRD-Bioraffinerie, SOLTRAIN, Switch Africa Green and UE-Biocarburant, among others. 2iE was also involved in the solar thermal market study in Burkina Faso in 2015.

The University of Ouagadougou[19] was involved in the preparation of the Wind Atlas in 2011. The physics department has knowledge applicable to the technical aspects of renewable energy; however, there are no specific courses dedicated to technical or administrative matters related to the energy sector. The University of Ouaga II offers Bachelor of Economy programmes with specialisations in development management and environment and sustainable development.

16 www.cnrst.bf/irsat

17 www.institut-tsa.org/

18 www.2ie-edu.org/

19 www.univ-ouaga2.gov.bf/accueil

Nabou, a gurunsi village in Southwest Burkina Faso
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5. FINANCING THE ENERGY TRANSITION

5.1 Introduction

During the last decade, the government of Burkina Faso has demonstrated strong political will to develop renewable energy and has implemented significant reforms (an independent power producer framework and tenders, tax incentives, etc.) to strengthen the financing framework of renewables in the country. This has led to positive assessments on the state of public finances and on the stability of the public utility (SONABEL) and has boosted investor confidence.

In addition to government initiatives, international financial institutions are attracted to investing in Burkina Faso, as the Sahel region is considered a strategic investment location for many development finance institutions. Consequently, these institutions target infrastructure investments in Burkina Faso, especially in the renewable energy sector, to support local economic development.

There is vast potential in the country's renewable energy sector, particularly in the off-grid sub-sector, with an estimated market size of USD 117.1 million in 2017 (ECREEE and World Bank, 2019). This increasing need for financing is an opportunity for international financiers, but also for the local financial and insurance market to be integrated into the renewable energy financing space.

In general, access to financial services has increased in Burkina Faso, driven by digital services. According to the World Bank's Global Findex report, the share of adults with an account at a financial institution, or with a mobile money provider, increased from 14.4% in 2014 to 43.2% in 2017. Nevertheless, access to credit remains a key issue for renewable energy small and medium enterprises in the country, while financial infrastructure and regional capital markets are in need of further development.

5.2 Renewable energy financing landscape

In 2014, Decree 2014-636 established a "hybrid" single-buyer model for the centralised grid in Burkina Faso, complemented by an open market on the secondary segment (non-SONABEL). Three years later, Law 014-2017/AN consolidated the liberalisation of the sector by establishing the opening of electricity production and distribution to competition. Liberalisation of the sector also covered rural electrification.

Renewable energy projects developed by the private sector are financed under different schemes, depending on their size, the technology type and the concession framework. Large solar PV projects were granted the right in 2018 for private development. Some of these projects have already signed financing agreements, with the share of debt varying between 70% and 80%. Nevertheless, to finance the start of construction, some developers prefer to finance fully with equity and then to refinance a large part of the equity at commissioning.

However, according to several investors, lenders, and project developers, the public-private partnership framework needs to be strengthened. Although the National Development Plan (NDP) intends to fund more than 50 infrastructure projects through such partnerships (including in the energy sector), private investors can still be deterred by a sometimes lengthy, cumbersome and heavily centralised competitive tendering process. Consequently, the sector suffered from the cancelation of several open-tender processes (IFC, 2019).

The Ministry of Energy is handling competitive procurement procedures. After a developer has been awarded a project, it has to go through a discussion with the government to define a competitive structure ("dialogue compétitif") before submitting a final proposal. Then, the project has to be approved by the Council of Ministers to receive an Award letter. After this, various authorisations, permits and contracts have to be obtained and signed with the public authorities, such as the: permitting procedures with the public administration, public-private partnership contract, producer guarantee, land lease agreement with the state, public-private partnership contract and grid connection contract with SONABEL.

Several major constraints impede the development and financing of public-private partnerships in the country. First, sometimes insufficient planning has caused non-priority projects to be developed and sub-optimal technological choices to be made. Second, the limited ability of the grid to accommodate more renewable electricity can restrain investment in additional generation capacities. Finally, the centralised procurement process may cause significant delays in processes for project development (IFC, 2019).

In 2017, the regulatory reform initiated a more favourable mini-grid and off-grid licensing and concession framework for rural electrification, by allowing the licensing of off-grid projects to both private developers and rural co-operatives. All these initiatives are relevant for the sector, but they could be strengthened by better co-ordination with private players to be more effective.

Large-scale projects have limited access to local debt financing. Development finance institutions offer very competitive lending conditions, in terms of both maturity and cost of debt. As in many other countries in the West African region, large-scale renewable energy projects in Burkina Faso are usually financed by international lenders, and mostly by development finance institutions such as AFD, the AfDB, the Islamic Development Bank and the World Bank. These players are equipped to manage the due diligence processes required for such projects, a task that may challenge local or regional lenders.

Burkina Faso's local financial market is dominated by the banking sector, which accounts for 84% of total assets and includes 14 commercial banks that are mainly subsidiaries of foreign groups (French, Moroccan and Pan-African banks). The local banking sector is mostly private (although the state is present in the capital structure of many banks) and is highly concentrated, as five banks control three-quarters of total assets (ECREEE and World Bank, 2019). The three main lenders – Coris Bank, Ecobank and Bank of Africa – are pan-African lenders.

In 2017, loans to customers amounted to XOF 1.8 trillion (USD 3 billion). This underscores the lack of participation of commercial banks in the financing of the Burkinabe economy, especially for key sectors such as renewable energy. The amount of loans to customers dedicated to renewable energy financing is unknown. Although the credit market is dominated by banks, small and medium enterprises also have access to credit through other financial institutions, such as microfinance institutions.

In Burkina Faso, the microfinance sector plays a critical role. It provides a source of financing to the rural population and to individuals and businesses that are unable to obtain appropriate funding from commercial banks. Considering the need for rural electrification, microfinance is critical to facilitate the development of small-scale renewable energy solutions, especially in isolated off-grid areas. The credits allocated in 2017 by these institutions amounted to XOF 140 billion (USD 242 million) (ECREEE and World Bank, 2019). However, while large multilateral microfinance institutions appear to be in good financial health, a majority of small- and medium-scale institutions struggle to operate, with some having negative returns.

Alongside the banking sector and microfinance, local equity and capital market financing are still poorly developed in the country. Thus, renewable energy projects and companies face difficulties accessing local equity financing, and renewable energy developers must leverage international equity financing to finance their projects, especially in the off-grid sector. Several investment funds are focusing on the development of renewable energy projects in West Africa, including Burkina Faso.

5.3 International and regional financial instruments and programmes to promote renewable energy investments

Financial institutions offer a wide range of financial products in the region for renewable energy projects. Private investment funds, family offices, development finance institutions and strategic investors (independent power producers, industries) can offer equity and quasi-equity financing depending on the project's size and main characteristics. On the debt side, development finance institutions offer competitive debt conditions (sometimes concessional debt) for large-scale projects and can support commercial banks when investing in small and mid-scale projects. Commercial banks can provide short-term commercial credits for inventory purchases and working capital. Trade finance solutions (export credit agencies, private trade funders) can also be leveraged, and some projects are able to leverage grants and subsidies from development finance institutions and foundations, often on a results-based financing basis.

Development finance institutions show a strong interest in financing the renewable energy sector in Burkina Faso. International actors are particularly attracted to the country due to their perception of the government's strong commitment to the deployment of renewables. International investors and development institutions are interested in supporting the development and stability of the Sahel region, which is a priority region for foreign investments.

Burkina Faso is involved in several programmes to support, especially financially, the development of renewables. ECREEE assisted in the implementation of the PANER, Burkina Faso joined the SEforALL initiative, and solar parks are expected to be developed in the country as part of the 2019-2033 ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure. For the off-grid sector, the ROGEAP aims to improve access to electricity in 19 West African countries, including Burkina Faso, through solar home system deployment using, in particular, financial tools. Some of these programmes have already been mentioned above, and some are described below.

AfDB's Sustainable Energy Fund for Africa (SEFA)

SEFA is a multi-donor trust fund established in 2011 and administered by the African Development Bank. Its objective is to support the private sector in leading economic growth in African countries through the efficient use of clean energy resources. Meanwhile, it aims to support the development of small and medium-scale renewable energy projects (Ecofin, 2020). To unlock private investment from these projects, SEFA operates through three financing components:

- grants to facilitate the preparation of bankable projects
- equity to bridge the financing gap and build management capacity
- public sector support to create an enabling environment for private investment.

Through a USD 983 million grant, SEFA initiated the AfDB's engagement in mini-grids through the Green Mini Grid Market Development Program, aimed at supporting the scale-up of investments in commercially viable green mini-grid projects by creating an enabling environment (recommendations on energy sector policy). Through this initiative, SEFA has paved the way for the AfDB to finance its first scale-up green energy programme in Burkina Faso (AfDB, 2017a; 2017b).

World Bank's Regional Off-Grid Electricity Access Project (ROGEAP)

ROGEAP was implemented by ECREEE and financed by the World Bank through its Lighting Africa programme (ECREEE and World Bank, 2019). The project it is expected to benefit around 1.7 million people in the broader region, as well as businesses and public institutions. For Burkina Faso, ROGEAP delivered a geospatial analysis of least cost electrification options in 2023 and 2030, through on grid, minigrid and offgrid systems, with some 1.3 million households suitable for stand-alone off grid solutions in 2023, deceasing to 613 000 households in 2030, as the grid expands.

ROGEAP pursues two main financial objectives:

1. **Support regional market acceleration by promoting private investment in electricity service provision.** ROGEAP aims to increase the capacity building of banks and financial institutions that are reluctant to lend to solar off-grid developers due to perceived credit risk, insufficient collateral, small deal sizes and lack of understanding of the solar sector. ROGEAP also supports entrepreneurship by providing grants and matching grants for companies that are eligible to receive capital from private equity and debt funds. In addition, ROGEAP assists in risk mitigation by supporting a guarantee mechanism that will share risks with lenders to leverage donor support and debt financing.

2. **Promote better access to finance by supporting both the supply and demand sides of the market.** On the supply side, ROGEAP aims to provide working capital to solar equipment importers and distributors to meet their debt financing needs. On the demand side, it aims to provide short- and medium-term debt to small and medium enterprises that are end users of off-grid solar equipment, and to households via microfinance institutions.

Power Africa's Beyond the Grid Fund for Africa (BGFA)

The BGFA, as part of the Power Africa initiative, aims to enable the development of the region's off-grid sector using financial mechanisms. It is being implemented over the period 2019-2025 with the goal of benefiting 5-15 million rural and peri-urban people. Assuming that the markets in which solar home systems and mini-grid companies operate are still viewed as risky by investors, the BGFA helps businesses access finance to scale up. Thus, it is offering EUR 50 million (USD 50 million to qualified private off-grid energy service providers, with an expected contract size per applicant of between EUR 1 million and EUR 4 million (USD 1 million to USD 4 million).

More than just implementing a financing mechanism to create viable conditions for private projects to emerge, the BGFA also wants to improve local market conditions through capacity building and technical assistance to local authorities and private actors. The local adaptation of BGFA in Burkina Faso is YiiteFaso, which aims to bring clean and affordable energy to more than 3.5 million people in peri-urban and rural areas. Selected projects were expected to be contracted and in 2022, agreement have been signed with ARESS Burkina Faso to scale up access, benefitting up to 116 000 people in remote areas (ESI, 2022).

WAEMU's Regional Program for the Development of Renewable Energy and Energy Efficiency (PRODERE)

The first phase of PRODERE is fully financed by WAEMU's own funds (around XOF 10 billion or USD 15 million). The programme is in line with WAEMU's objective of increasing the share of renewable energy produced in the WAEMU zone to 80% of the energy mix by 2030. Between 2013 and 2015, the first phase of PRODERE led to the installation of 7 500 solar PV streetlights and 6 mini solar PV power plants in rural areas, and to the distribution of 4 500 solar kits to rural populations in the WAEMU zone.

In Burkina Faso, the project has allowed the installation of four mini power plants in four regional hospitals and has contributed to the electrification of public and community structures and to the installation of more than 1 000 solar streetlamps across the country, for a total cost of XOF 2.25 billion (USD 3.5 million).

The second phase of the project has been running since 2016 and focuses on the development of larger solar PV plants for a total amount of 200 MW (25 MW per country). To finance this phase, WAEMU and state members have set up a fund called the Regional Facility for Access to Sustainable Energy (FRAED).

AfDB's Desert to Power initiative

AfDB launched the Desert to Power initiative in 2019, aiming to deploy 10 GW of solar energy across 11 countries of the Sahel (including Burkina Faso) by 2025 and provide 250 million people with electricity. The initiative is financed by the Desert to Power G5 Sahel Financing Facility, financed by the Green Climate Fund up to USD 150 million (October 2021) and by the AfDB up to USD 379.6 million (since February 2022). In total, the Facility is expected to mobilise USD 966 million over a seven-year period.

In Burkina Faso, this initiative applies to the Yeleen grid project (4 solar PV plants for a total of 51 MW) and the Yeleen rural electrification project (100 solar mini-grids and 100 000 solar kits for rural households). The PEDECEL (Electrification and Electricity Connection Development Project) is also part of the Desert to Power initiative and aims to expand the country's distribution network to increase access to quality electric power in several peri-urban and rural localities (more than 218 000 targeted households).

Funds and financial facilities of other development finance institutions

Recent developments show that lenders and investors are seriously considering investment and lending opportunities in Burkina Faso. The main financing instruments that renewable energy projects benefit from in the country are debt instruments, grants from development finance institutions, and, to a lesser extent, grants from regional and local banks. For example, BICIAB bank (BNP Paribas Group, now Vista Bank) provided the loan to Total Eren for the installation of a solar PV generation unit at the Essakane mine (Total Eren, 2017).

Energy sector investments in Burkina Faso are financed largely by foreign resources. In 2016, financing of the development project portfolio and programmes in the country was divided as follows: 6.74% from government financing, 6.28% from SONABEL and ABER (former FDE) financing, and 87.58% from external financing (MoE, 2018a).

Between 2005 and 2015, Burkina Faso received a total of USD 121 million in funds from development finance institutions, with an average deal size of USD 7.5 million. The funding total accounted for 2% of the total investment of development finance institutions across West Africa over this period. The main programmes and financing from these institutions for the energy sector in Burkina Faso are summarised in Annex 6. However, despite the strong will from international financial institutions to invest in the country's renewable energy sector, investments are sometimes hindered by the lack of performing companies to invest in, especially in the off-grid sector.

Development finance institutions offer concessional financing specifically for renewable energy projects. For instance, the West African Development Bank (BOAD) has an agreement with the Green Climate Fund (GCF) that sets out the terms and conditions for the use of GCF resources. Under precise eligibility conditions, BOAD can provide long-term debt financing at a reduced cost (approximately under 4% all-in margin, up to 18 years of maturity). International lenders are also starting to finance medium- and small-scale projects, such as off-grid projects.

The Facility for Energy Inclusion (FEI) Is a USD 500 million Pan-African debt facility founded in 2008, sponsored by the AfDB and managed by Lion's Head Global Partners. The FEI aims to provide debt capital to solar home system companies, small independent power producers and mini-grid developers. It targets segments of the sector that are underserved by international investors and domestic lenders. In total, Burkina Faso received around USD 100 million in energy access financing from the AfDB during the 2014-2017 period (European Union, 2020). The FEI is divided into two organisations:

- FEI on-grid provides long-term debt financing to renewable energy small-scale independent power producers, mini-grids and captive power projects with a capacity below 25 MW.
- The FEI off-grid energy access fund (FEI-OGEF) offers flexible short-term debt financing to off-grid companies. Its aim is to engage with the local market by attracting local investors to guarantee access to long-term, local currency funding. In Burkina Faso, FEI-OGEF financed off-grid developers such as Qotto (EUR 2 million or USD 2 million debt financing for geographic expansion).

Moreover, some projects developed by the state can benefit from grants and subsidies, as well as from external concessional financing from development finance institutions. For instance, in 2014 the Zagtouli project received EUR 22.5 million (USD 22.5 million) in concessional financing from AFD. Consequently, the project paved the way for the further development of large-scale and state-owned renewable energy projects. Development finance institutions commonly use concessional debt, mainly for state-owned renewable energy projects but also sometimes for independent power producer projects, in order to:

- create a pulling effect and pave the way for further development of the sector,
- maintain the financial equilibrium of the sector,
- participate in the development of an innovation that would involve an additional charge but that would also participate in further development of the sector (*e.g.* storage solutions).

Hybrid financing (quasi-equity instruments) is not commonly used in renewable energy projects in Burkina Faso, although it is necessary to develop a tailored financing offer in the country.

Several guarantees can be leveraged in Burkina Faso to strengthen the financial structuring of renewable energy projects. Developers can benefit from guarantees that provide coverage against political and security risks. These guarantees are mostly offered by development finance institutions and are detailed in Annex 8. Nevertheless, not all guarantees available have been used yet in the country, especially for renewable energy projects.

A few examples of guarantees being used for the renewable energy sector are elaborated below. For example, Burkina Faso has already benefited from guarantees from the Multilateral Investment Guarantee Agency (MIGA).

In October 2020, the European Investment Bank pledged EUR 60 million (USD 60 million) in financing to support four countries, including Burkina Faso, in their membership or share capital increase in the African Trade Insurance Agency (ATI). Burkina Faso is in the process of becoming a member of the ATI. This will enable it to benefit from the ATI's guarantee mechanism (the Regional Liquidity Support Facility or RLSF), thereby enhancing access to foreign direct investment for the renewable energy sector and especially the private sector. Membership will also enable the country to be eligible for the AEGF guarantee provided by the EIB.

Sovereign counter-guarantee instruments (the World Bank's and AfDB's Partial Risk Guarantee, the AFD's Green Public Procurement, etc.) have not been required by lenders for renewable energy projects in Burkina Faso, considering the soundness of SONABEL.

Overall, the share of investment from development finance institutions allocated to the deployment of renewable energy is substantial. For instance:

- In 2019, the AFD group invested a total of EUR 2.8 billion (USD 2.8 billion) in the energy transition sector, representing 23% of its total commitments (EUR 12.1 billion or USD 12.1 billion) (AFD, 2021a).
- In 2021, the World Bank lent USD 11.5 billion in Western and Central Africa and USD 15.6 billion in Eastern and Southern Africa, with 17% and 12% of these amounts allocated to energy and extractives respectively (World Bank, 2021f).
- In 2019, the total AfDB approvals amounted to UC[20] 7 300 million (USD 10 512 million), with 23.5% of this allocated to the renewable energy sector (UC 1 717 million or USD 2 472 million) (AfDB, 2021a).
- In 2019, the Dutch Development Bank's (FMO) green-labelled new investments (including renewable energy, agriculture and green credit lines) averaged EUR 861 million (USD 861 million), representing 25% of FMO's new investments (FMO, 2020).

International senior debt is available for large-scale projects and provides attractive financing conditions (up to 18-20 years of debt maturity for an all-in rate of around 4.5-5%). For most development finance institutions, the renewable energy sector is a priority sector to invest in. This fosters competition in Burkina Faso among these institutions, which are constantly improving their lending conditions.

A main issue surrounding international senior debt is the payment mechanism that often follows a results-based financing scheme: developers receive financing only after agreed-upon results are achieved and verified. This leads to a financing gap before any result has been achieved. This is particularly detrimental for small and medium-sized players that are willing to develop small-scale renewable energy projects in the country and are looking for financial players ready to take development risk to initiate their projects.

Political risk insurance policies are often required by lenders and investors for renewable energy projects seeking financing in Burkina Faso, especially on the equity financing of the projects. The main political risk insurance used for renewable energy projects is the political risk insurance policy from MIGA. For example, the Nagreongo solar PV project developed by GreenYellow (30 MW peak) benefited from a EUR 4.5 million (USD 4.5 million) MIGA guarantee for a 20-year period. MIGA also approved three other solar PV projects, for a total capacity of 102 MW peak (MIGA, 2021). Other political risk insurance instruments could be leveraged in Burkina Faso, such as the ATI's RLSF, even if there is no track record identified so far.

With regard to international equity financing, there are two main kinds of players. Some of these are engaged in large-scale projects or in off-grid projects, such as the Africa Enterprise Challenge Fund (AECF), or Bamboo Capital Partners and its Bloc Smart Africa Fund. Development finance institutions also provide equity financing to some renewable energy projects. As mentioned previously, results-based financing mechanisms are burdensome for the development of early-stage projects. Eventually, most equity financing for renewable energy projects is provided by project developers.

5.4 National financial instruments and programmes to promote renewable energy investments

Over the past decade, the government of Burkina Faso has adopted many policies and strategies to develop, structure and regulate the renewable energy sector. These highlight the commitment of the public authorities to this sector, which is perceived as a key rationale by developers and investors for entering the Burkinabè market. The main policies and strategies implemented to facilitate renewable energy financing in Burkina Faso are elaborated in the following text (MoE, 2018a).

Energy Strategy 2019-2023

As part of its aim to mobilise both external and domestic financial resources to strengthen energy supply and to improve energy efficiency in Burkina Faso, the Energy Strategy targets three main sources of financing. These are: national financing (state, banking system and financial system), external bilateral and multilateral aid in the form of grants and concessional loans, and foreign private capital through public-private partnerships.

PACAO-BF (2018-2022)

Established in 2008, the PACAO-BF aims to contribute to the structural transformation of the economy through the production of competitive goods and services to ensure growth, in particular in the solar energy sector. This project led to the elaboration of the Cluster Solaire to favour synergies among different actors in the sector. The objective of the project is to provide financial support to the actors by setting up financing mechanisms favouring the mobilisation

[20] UC, or "unités de compte" (units of account [U.A.]), in the AfDB is equivalent to special drawing rights at the International Monetary Fund. In June 2021, UC 1 = USD 1.44. See: www.afdb.org/fr/documents/june-2021-exchange-rates.

of equity, external subsidies and enabling technical and financial partners financing. The project also aims to facilitate financing through the setting up of a new fund serving as a support guarantee for solar companies (Chamber of Commerce and Industry, 2020).

Moreover, the Cluster Solaire aims to foster the participation of local commercial banks in the financing of renewable energy projects. The objective is to enable local renewable energy companies to be eligible for loans with preferential rates of 5% with a maturity of 15 years. The Cluster Solaire programme also aims to implement a fund that would serve as a financing guarantee to facilitate access to credit for renewable energy companies (PACAO-BF, 2021). Such projects could send positive signals to local banks to participate in the development of the renewable energy sector.

Burkina Faso Compact II (2021-2026)

This programme will be implemented through three main projects (see Annex 3) that benefit the financing ecosystem of renewable energy projects in Burkina Faso:

- PREDEL (Projet de renforcement de l'efficacité du domaine de l'électricité) supports the membership of Burkina Faso in the ATI to facilitate access to guarantee and insurance products designed to mitigate liquidity issues and concerns about the creditworthiness of SONABEL (Regional Liquidity Support Facility, RLSF).
- PADOEL (Projet d'accroissement de l'offre d'électricité moins coûteuse) aims to facilitate independent power producer transactions by reinforcing the structuring of the tender programme.
- PRAEL (Projet réseaux et accès à l'electricité) establishes a Connections Fund and a Productive Use of Electricity Fund to provide access to lower-income consumers to purchase electrical equipment.

The Burkina Faso Compact II, and particularly its PADOEL project, aim to facilitate new solar independent power producer transactions by providing transaction advisory services to prepare feasibility studies, to structure the tender programme and to bring transactions to financial close.

For the off-grid sector, in 2019 the government of Burkina Faso launched the Back Up Solaire Project, implemented by the ANEREE. The ambition was to facilitate the installation of solar home systems in off-grid areas through three-year zero-interest subsidies to individuals. The first phase of the project led to the installation of 850 solar home systems, and the second phase aims to install between 3 000 and 3 500 solar home systems.

Other national financial instruments

Local equity financing appears scarce in Burkina Faso, and information on potential local equity investors is sparse. Most utility-scale projects are designed in the country under a public-private partnership scheme. These schemes are defined by a concession agreement, and electricity sales are regulated by a power purchase agreement signed between the sponsor of the project and SONABEL. For now, the state is committed in the concession agreement to pay the electricity delivered by the sponsor if SONABEL defaults on its payments as stated in the power purchase agreement.

Additionally, SONABEL usually commits to set up a guarantee mechanism in the power purchase agreement, usually by taking a letter of credit from a commercial bank. If required by a lender, a project sponsor could benefit from a public counter-guarantee mechanism, such as the Partial Risk Guarantee offered by the World Bank or the AfDB, or the Public Payment Guarantee offered by AFD.

So far, no public counter-guarantee mechanism has been requested for renewable energy projects in Burkina Faso. Nevertheless, considering that the state could stop providing public guarantees on utility-scale projects and that a few development finance institutions are concerned about the long-term financial soundness of SONABEL, additional guarantee mechanisms could be necessary to set up large-scale renewable energy projects in the near future.

Today, the state backs the power purchase agreement and is therefore engaged to pay the electricity purchase if SONABEL defaults on payment. Meanwhile, a payment guarantee is taken by SONABEL. The other insurance policies contracted by project sponsors depend largely on the technology used, the project size and its structure. Although the development of the local insurance ecosystem is promising, many project sponsors must obtain insurance policies from international insurers, as the ratings of local insurers are often considered insufficient by lenders.

Looking ahead, several solar projects are under development in Burkina Faso and might seek financing for implementation and construction in the coming years. These could be potential opportunities for lenders, investors and service providers. The projects are the Matourkou, Kalzi, Kaya, Koupela and Ouaga, and Bobo and Balé solar PV projects (see Annex 7). Additionally, several hydropower projects are under development, some of which could seek financing from development finance institutions, even if they are owned and partly financed by the government and developed by SONABEL. These projects are the Ouessa, Gongourou, Folozon, Bontioli and Bagré hydropower expansion projects (see Annex 7).

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6. KEY CHALLENGES AND RECOMMENDATIONS

The key institutional and regulatory challenges and recommendations presented are the outcome of the stakeholder consultation process organised by IRENA. The summary of the consultation is presented in Annex 5 in the form of a SWOT (strengths, weaknesses, opportunities and threats) analysis.

6.1 Reinforce the institutional framework

Challenge 1.1: The regulatory frameworks are not performing up to standards.

Despite a long history of plans and targets, legislation on renewable energy and energy efficiency in Burkina Faso has been adopted but lacks implementation. The country is not yet on the trajectory to meet the objectives set by the revised Energy Strategy.

Several pieces of legislation are outdated (LPDSE, POSEN, LPSE) and are perceived as overlapping. The PANER and PANEE should be updated to reflect the revised Energy Strategy. While the targets of the PANER are expected to be achieved, some programmes have not been kick-started, specifically those related to decentralised electricity access and biofuels.

The regulatory documents have focused primarily on establishing a level playing field for competition in the generation and distribution segments, through the establishment of dedicated governance institutions, tariff-setting methodologies and a mechanism to award licences and concessions. However, the liberalisation of the electricity sector is not yet effective, as the legislation does not seem to be implemented fully. Specifically:

- The separation of accounts of SONABEL is not in place, which suggests that the tariffs are not on track to becoming cost-reflective.
- Grid codes have not been adopted. Potentially, the technical elements are regulated through power purchase agreements, which may complicate the future evolution of grid management and integration into the regional power pool.

In line with the partial enforcement of the adopted regulations, preliminary findings suggest that the reinforcement of institutional capacities needs prioritisation to foster operationalisation.

In addition to ARSE's aforementioned challenges,[21] ANEREE is facing challenges in staffing and competences to fulfil its mission. For instance, the agency oversees testing equipment and assessing its compliance with quality standards. ANEREE should deliver a compliance certificate to importers. Currently, the agency does not have the materials and capabilities to fulfil this role. The budget dedicated to ANEREE is insufficient and does not cover all activities. Punctual support is provided by donors.

As a consequence, a major issue for local industries is that the market is flooded with imports of low-cost, low-performance devices (*e.g.* solar devices, biodigesters). Due to the lack of control over imported product quality, local companies are competing on price rather than on quality and service.

Recommendation 1.1: Reinforce the institutional framework

The institutional framework in Burkina Faso is well developed, with each actor having a clear mandate. However, a gap lies in enforcement of the existing mandates and regulations. There is an urgent need to fund the organisations to meet expectations and to build the internal capacities of the institutions.

Those organisations should be in a position (skills, budget, infrastructures) to develop, implement and monitor the plans and strategies for Burkina Faso. Key competences should be internalised. Technical assistance programmes should ensure knowledge transfer.

There is an urgent need to develop testing, certification and labelling of products. ANEREE should be equipped to perform tests and to deliver certificates to both imported and locally manufactured products. VAT exemptions, or any government and donor subsidies, should be conditioned to labelling. To address asymmetric competition from imported products, ANEREE should be able to deliver compliance certificates and import authorisation in order to regulate the market for renewable energy and energy efficiency devices.

On the regulatory side, a key feature of operationalising the ARSE is to implement the mechanisms to guarantee a sustainable (and independent) budget over time, also providing a degree of political independence and capacity to hold the utilities accountable for their operational and financial performance – which is the purpose of a regulator. In the interim period, pressing issues that need to be addressed include:

- the ability to develop and enforce a tariff methodology, based on cost recovery, with elements of performance management;
- the ability to deliver concession licences for a large number of mini-grids, as this sector is set to expand rapidly with the support of large donors;
- pursue the ongoing development of grid codes and their adoption;
- building the ability to review procurement processes for independent power producers, including reviewing the environmental impacts of the project and reviewing the cost implications of the power purchase agreement.

6.2 Develop and update an Integrated Resource Plan

Challenge 2.1: The country lacks integrated planning and clear investment plans in on-grid capacities.

The two primary energy sources of Burkina Faso are unsustainable biomass and imported oil. Even at current energy access levels, which are among the lowest in the region, the country is facing a shortage of capacity, lacks electricity access and faces high power prices despite significant subsidies to the power sector. Current programmes are targeted at filling the current capacity gap with solar PV (mainly) and improving access primarily through grid extension; both issues of clean cooking and energy efficiency lack attention.

Portfolios of the current committed and planned generation plants are complex to compile and are available through a variety of sources. However, the portfolio still includes new oil capacity to be built, which will increase the fiscal deficit. The economic potential of solar, wind and hydropower projects should be reviewed, and more reliable estimates are needed on the country's sustainable bioenergy potential.

The capacity shortage is the main driver for investment decisions. However, the planning of future investment lacks appropriate demand forecast modelling and optimisation of the energy supply in order to meet peak demand in the medium to long term. Economically feasible renewable energy project locations are not being used as inputs to plan for grid expansions, to prioritise future mini-grid projects and to establish access strategies in rural areas.

[21] ABER could not be interviewed in the process but was reported to be facing capacity challenges.

Box 4: Opportunities for connecting mines to the main grid

Discussions are ongoing* with the mining sector to investigate grid connection for facilities that meet certain selection criteria – for example, the size of the mine, expected lifetime and distance to the grid. The corresponding demand is currently not established but could lead to a peak capacity of 715 MW, to be met by additional solar capacity, imports and potentially LNG.

The IRP should build on realistic estimates of the demand. The integration of mines to the main grid would create additional demand for baseload capacity. Considering that some mines have already invested in self-generation or hybrid systems, solutions are sought to amortise existing assets, for example through net billing.

Dynamic power studies would need to consider the behaviour of the network when the mining load centres are added to the grid – potentially in remote locations, in conjunction with the dispatch of large solar capacities, as these industries would require stable power supply across the year. The outcome should drive the investment plans for infrastructure, generation and flexibility capacities.

Studies should also provide evidence of the business opportunity to connect mines to the main grid, in terms of service and costs. Eventually, the regulated tariffs should be cost reflective and transparent.

* Information collected through the RRA validation process.

Recommendation 2.1: Develop and iteratively update an Integrated Resource Plan

A regularly updated Integrated Resource Plan (IRP) is needed to clarify future investments moving forward and to address the structural fiscal deficit of the power sector. This implies developing a strategy based on projected demand scenarios, and a specification of the capacity investments according to the levelised cost of energy (per MWh), rather than a CAPEX-oriented strategy (per MW).

Flexibility in the integration and dispatch of variable supply to the grid should be based on storage and regional integration. For instance, on a regionally integrated grid, Burkina Faso's solar power potential could be well-complemented by hydropower from southern neighbours (*e.g.* Ghana) and by wind power from Sahelian neighbours (Mali, Niger). The commercial potential of baseload renewables (bioenergy, hydropower) requires some clarity, as well as the potential of the rooftop solar market (grid connected). The capacity of mines to be connected to the grid is an open discussion (Box 3).

An IRP needs to build on grid stability studies of the power system, in order to assess the true penetration potential of renewable energy – including grid reinforcement and storage on a cost-efficiency basis. In addition, grid codes prioritising access to the grid for electricity generated from renewables, and dispatch based on marginal cost, should be developed to govern all current and future electricity generators. The studies should include the role of renewable energy generators and storage technologies to help system operation remain reliable and secure, where they would specify the ancillary services that variable renewable energy and enabling solutions can offer, which may be financially remunerated.

This provides transparency for project implementation by independent power producers and offers flexibility for integration to the regional grid.

Challenge 2.2: Investments in grid capacity and electricity storage are lagging.

The national electricity network has been improved steadily in recent decades. Nevertheless, many areas of Burkina Faso still are not reached by the grid, and the instability of the network puts a strain on the country's energy development. The electricity transmission network faces key challenges, such as overloading of network infrastructure, low maintenance capacity and low network automation. Several lenders and investors are therefore concerned that the network in its current state may not be able to absorb the expected long-term electricity generation.

A study from the World Bank (2019) on the stability of the grid confirmed that all the renewable energy projects under development would generate extra capacities that could be absorbed by the grid. However, it also highlighted the need to develop storage solutions and to reinforce the grid. Thus, financing from international and local investors and lenders is necessary to improve the electricity network. Development finance institutions have already invested in grid expansion (see Annex 10). However, it appears necessary to attract further international partners to support grid maintenance and expansion and storage solutions in the long run.

Recommendation 2.2: Reinforce the grid to reassure investors and redirect investments to strategic needs of the country

The on-grid sector is facing an issue of grid robustness, which is a major concern for many investors and lenders. Recent reinforcements of the national grid should be extended to be able to absorb all the additional renewable energy generation capacity expected. This is especially true near major urban centres, where the grid is overloaded due to the concentration of projects in those areas.

To tackle this issue, it would be necessary to redirect local and foreign investments to the management and reinforcement of the grid, in order to support the state's investments in grid expansion and strengthening. Development finance institutions could support the government by providing concessional financing to that end. It would also be necessary for investors and lenders to favour investments in storage solutions to complement new generation capacity.

6.3 Develop business models for rural electrification, including off-grid and mini-grid solutions

Challenge 3.1: Rural access to electricity relies on a failed business model for COOPELs.

In the early 2000s, the FDE was put in place to support rural electrification under the form of loans to co-operatives that were in charge of supervising and operating rural (diesel) mini-grids (*e.g.* 40% as loans, 60% as grants). The co-operatives were assigned a concession, with the right to charge customers for the electricity consumed, at a regulated tariff.

The co-operative model, which is highly subsidised, is falling short to scale up electricity access through diesel mini-grids across the country, and alternative business models should be sought. Several co-operatives have faced challenges in maintaining efficient management of the systems and delivering quality service to customers, in part because the tariff did not cover the operation and maintenance costs, and also because the collection of revenues can be challenging in rural communities where income is scarce and impacted by agricultural outputs. In some cases, the concession was withdrawn and transferred back to SONABEL.

Rural electrification projects face difficulties attracting private investment. The rural electrification sector is primarily dependent on foreign aid and technical assistance. Rural electrification is mainly funded by: the electricity development tax, government investment and international financial partners such as the World Bank, the Islamic Development Bank, the EU, the Abu Dhabi Fund for Development and the AfDB. International partner contributions represent about 75% in any given year. This effort to attract the private sector is coupled with institutional reforms to create a more favourable investment environment. ABER raised around EUR 20 million (USD 20 million) in debt from local banks to accelerate the pace of electrification.

In the near future, donor-funded projects may trigger a further acceleration of the mini-grid segment.[22] Because part of the investment is expected to come from the private sector, this implies an extra effort needed to accelerate the readiness to attract private investments (Box 4).

[22] The Solar Energy and Access Project includes USD 50 million under component 1.3 "Green Mini-Grids Leveraging Private Investments" regarding the construction contracts (engineering, procurement and construction, EPC), associated technical, environment and safety, and socio-economic studies for preparation, and owner engineering services for bidding documents and construction oversight.

Box 5: Spatial planning for rural electrification

For Togo, the Togolese Renewable Energy and Energy Efficiency Agency (AT2ER), supported by the EU and the International Finance Corporation (IFC), commissioned a full assessment of the viability of mini-grid business plans for 318 villages across the country. Based on ground-collected socio-economic data (household surveys), the study established the load profile, capacity and willingness to pay for each village, including the possibility to expand productive uses.

The study then performed a technical dimensioning (using projected demand profiles in a four-year horizon and the HOMER software) and financial analysis of each potential system, based on the most recent investment cost estimates. This study, and the data collected, including GIS-based mini-grid designs, are shared with potential bidders, thus improving the chances of success of the national rural electrification programme.*

In the case of Burkina Faso, such background information is not yet available to support the rural electrification scheme. This creates uncertainty on the dimensioning and risk pricing for these investments. Potentially, some geospatial analysis** could be deployed to identify and prioritise locations for future ground surveys.

The collected information was used, in particular, to create business plans per village and to develop clusters of villages that can mitigate risks for investors. The study assumed that a small part of the investment would be supplied by private investors, which would operate the system. The study looked into the case of fixed regulated tariffs and sought to establish the level of grants and concessional financing required to meet the target tariff, while maintaining a level of internal rate of return (IRR) (ranging from 3% to 18%) for a private share of equity.

Furthermore, to bridge this gap in some countries in West Africa including Burkina Faso, IRENA has recently developed high level geo-spatial assessment of pathways to achieve universal access in Burkina Faso considering twenty scenarios based on different demand targets, cost and grid expansion outlook. This analysis shows the synergy between the grid expansion and off-grid, investments and competitive advantage of hybrid solar over diesel-based systems. A platform has been developed where the results can be explored extensively. https://irena.gep.kartoza.com/

This analysis can help to optimise resource for detailed studies for country programme development.

* Based on this work, the call for tender for private sector investors for 317 villages was issued in 2019.

** See, for example: the Energy Access Explorer (World Resources Institute); Village Data Analytics (ESA Space Solutions); the OpeN Source Spatial Electrification Toolkit (KTH); GEOSIM (Innovation Energy Development).

Recommendation 3.1: Develop business models for rural electrification that are attractive to private investors

Due to the falling costs of solar PV and energy storage, renewable-based mini-grids have a strong potential to address the issue of operation costs for mini-grids in Burkina Faso.

However, in rural areas, the potential electricity demand and capacity to pay of customers is limited, which limits the attractiveness to the private sector to recoup investment. One possibility is to identify potential productive uses within a community and to invest in productive applications that can increase power demand and agricultural output, which in turn increases the revenues of the community.

Unfortunately, the high level of risk involved puts pressure on the cost of private loans and equity, which would translate into high electricity costs. Under the leadership of ABER, this situation requires the public sector to provide financial support in the form of grants (either CAPEX-based or results-based) and concessional lending, with an optional minority stake for the private sector.

The electricity tariff might also need to be adapted to better reflect the cost of service and the limitations of consumers' ability to pay; smart meters and prepaid are mandatory to secure revenue collection. The private sector could be involved under a public-private partnership as a build-own-operate (BOO) model or as simple operations and maintenance under a performance contract, under the supervision of the regulator. Notably, suitably structured public financing will play a central role in tackling the affordability gap and ensuring that no one is left behind.

Challenge 3.2: The regulation around self-generation hinders project development.

Several investors, lenders and project developers highlight recent regulatory improvements and insist on the need to keep reinforcing and consolidating the regulation specific to renewable energy project financing and the enforcement of the existing regulation. The regulation for self-generation projects establishes an energy fee that developers pay to the authorisation holder of electric power distribution. The calculation of this energy fee can be complex and confusing, and, according to several players, its level hinders the development of self-generation projects (fixed amount paid per installed kilowatt per month that depends on the total installed capacity) (Decree 2020-1053).

Recommendation 3.2: Reinforce the framework around self-generation to accelerate the development of new projects for large industries and mines

According to several players (mostly industries such as mines, and renewable energy developers), the recent regulatory framework for self-generation projects needs to be enhanced to make large generation projects more profitable for large industries and mines. In particular, it is key to assess and reduce the costs incurred to those projects (tax burden, energy fee, etc.) to facilitate their development and financing. For example, the current regulation thwarts commercial and industrial electricity production due to the costly energy fee that self-developers are required to pay (depending on their level of production and consumption of electricity) to the authorisation holder of power distribution (Decree 2020-1053). Development finance institutions could further support the authorities in reinforcement of the regulation.

For example, one of the objectives of MCC Compact II is to strengthen the policies and regulations governing the electricity sector of Burkina Faso and to support the implementation of key institutional and regulatory reforms to further support the development of renewables in the country. This support can be manifested through capacity building on energy computation and planning tools or the assessment of projects' financial sustainability, by support in the power purchase agreement and concession and tendering processes.

Challenge 3.3: Project developers are reluctant to operate mini-grids due to the difficulty in collecting revenue from users.

For mini-grid solutions in the country, the cost of generating electricity in rural areas is particularly high in comparison to the electricity tariffs set by SONABEL. Consequently, even though many mini-grids have already been built (in particular as part of the Yeleen project), project operators are reluctant to operate these systems due to the difficulty in collecting revenue from users, and especially in identifying productive users. The profitability of these projects is often too low to attract project developers.

Recommendation 3.3: Improve mini-grid profitability through better planning and identification of productive users.

To tackle this issue, two main solutions could be envisaged:

1. Development finance institutions could assist authorities in the identification of users (and especially productive users) to strengthen mini-grid revenues and to facilitate mini-grid development and co-ordination with other off-grid technologies through better planning.[23]

2. To improve the profitability of existing mini-grids, it would be key to implement a subsidy mechanism that would enable improved profitability alongside a reduced electricity tariff. Appropriate grant and subsidy schemes, which require private funding matches and are predictable and not overly bureaucratic, should be introduced, for instance by development finance institutions or through the Rural Electrification Fund (FDE). Grants or bonuses could be provided to mini-grid developers for any new connections, and tariff top-ups could be implemented.

For instance, the Green Mini-Grid programme developed by the Sustainable Energy Fund for Africa (SEFA) provides market intelligence, business development support, policy and regulatory support, quality insurance and access to finance for mini-grid projects in several countries.

[23] This refers to the Togolese case evoked in Box 4 in section 6.3 of this report.

Box 6: Opportunities for hybridisation in the mining sector

In 2018, the 15 MW Essakane hybrid (solar PV and fuel) power plant started powering the IAMGOLD mine. The plant has reduced the mine's oil consumption by 6 million litres and its annual CO_2 emissions by 18 500 t. The project was realised by Finland-based Wärtsilä as an engineering, procurement and construction (EPC) contract, and a power purchase agreement was established between Total Eren and IAMGOLD. This model of "corporate sourcing" could, in the future, reduce the carbon footprint of mining across Africa (Bird&Bird, 2020)

The cost of electricity generation in a mining project is between 10% and 35% of the project cost. The sector faces a permanent risk of blackouts and relies primarily on fossil-based self-generation to increase resilience. In addition to providing power, the creation of mini-grids for the mining industry is a potential source of local content and job creation, as their operation may require the use of local and qualified labour.

In addition, the creation of mining mini-grids could make it possible to channel a certain volume of electricity production to the local population, as mining operations are located in rural areas, generally off the national electricity grid. This, however, requires regulating the tariffs charged to consumers, as the power price charged to populations would be impacted by the investments and operations of the mine. A lack of such regulations can create local tensions.

6.4 Reinforce financing capacities and strengthen insurance and tax ecosystems

Challenge 4.1: The framework of renewable energy project finance is weak.

The weakness of the renewable energy finance ecosystem in Burkina Faso puts a strain on the development of renewable energy projects.

First, the political situation makes it necessary to facilitate the granting of existing guarantees such as those provided by MIGA and to develop additional guarantee and insurance mechanisms to have specific mitigation products for each technology type, especially for small and mid-scale projects. Currently, there are very limited local financial services related to local rated insurers, making it costly for a project to get insurance that meets the investors' and lenders' criteria, according to interviews with regional and international lenders.

Second, local financial institutions lack sufficient internal capacity and credit appetite to invest in renewable energy sectors. This comes mainly from their risk perception of the renewable energy market, due to their limited knowledge of technologies, market characteristics and historical data on companies' credit performance in the sector. This prevents them from developing strategies and financial products to target this market. The renewable energy sector is complex due to high transaction costs, and the regulatory environment needs to be strengthened to reassure financial players to support projects. Local banks need to be reassured by the government and by international financial institutions about the solidity of the sector and its actors.

Project development costs also put a strain on the development of projects, increasing their complexity; other challenges include the length of the development phase, the cost of studies, occasionally the lack of local knowledge, and the administrative burden to acquire the necessary authorisations and licences. For solar PV projects such as mini-grids or commercial and industrial installations, taxation (custom duties, permits and authorisations) can weigh heavily on construction costs and on profitability during the project's operation. For example, duties and other taxes affect the profitability of solar home system companies. There is therefore a need for stricter application of the existing legislation and contracts. Some project developers stated that while the government does implement relevant exemptions (for example, from duties and VAT), developers sometimes struggle to benefit from these due to burdensome processes and stringent eligibility requirements.

Mini-grid developers and solar home system companies can also suffer from insufficient fiscal incentives, either due to inadequate application of existing incentives or to the fact that developers are too small to benefit from the existing privileged tax regimes. Law 038/2018 establishes five privileged regimes enabling companies to benefit from VAT, customs and other tax exemptions provided that they meet certain investment thresholds (see Annex 9). Those thresholds are reduced for some companies, in particular those operating in the renewable energy sector, but remain too high for mini-grid and solar home system companies, according to several players.

Recommendation 4.1: Develop blended finance, local insurance systems and an oversight scheme for the implementation of tax exemptions

Hybrid financing instruments (mezzanine) are not commonly used in renewable energy projects in Burkina Faso, although it would be key to develop a tailored financing offer in the country. Some assets in renewable energy projects (storage solutions, grid connection works, etc.) require different financing mechanisms due to the different temporality and financing amounts required. Because hybrid financing instruments offer more flexibility than traditional debt or equity instruments, this could be a unique opportunity to advance financing for the energy transition in the country.

Additionally, blended finance, particularly using concessional financing, can increase available resources. For now, no use of blended finance has been observed for renewable energy projects in Burkina Faso. It might be relevant for the government to analyse subsidies or exemptions for non-renewable energy sources that provide an unfair advantage to fossil fuels and to develop policies that encourage the development and use of local insurance.

Burkina Faso is key and even attractive for development finance institutions considering its development needs; however, as mentioned earlier, international lenders and investors are focusing more on on-grid projects and offer very competitive financing conditions that could change the renewable energy market specificities. Thus, financing from development finance institutions should be combined with local financing in support of programmes, in order to prevent the crowding out of local financial institutions and avoid hampering sustainable local market development.

In that perspective, it would be key to learn from the participation of BICIAB (USD 16.5 million) (now Vista Bank) in the 15 MW solar plant project. To complement those learnings, it would be essential to develop capacity building for regional and local banks to aid their understanding of the risks and potential returns linked to investments in the renewable energy sector. This is to assist in designing appropriate lending solutions to allow participation alongside development finance institutions in financing renewable energy in Burkina Faso.

Developing the local insurance ecosystem is key to reducing risks and insurance costs for projects. Well capacitated and diversified insurance products would strengthen the financial ecosystem. In particular, it is key for renewable energy projects to access specific insurance policies for the different phases of a project's life. Such an insurance ecosystem would require a strengthened regulatory framework, with a well-capacitated authority in charge of certification and regulation.

It could be relevant to set up a task force to oversee the implementation of tax exemptions and to mitigate potential difficulties that developers may have when requesting tax exemptions (IFC, 2019). To tackle this issue, it would be key to consolidate the existing regulatory and fiscal framework in Burkina Faso – by reinforcing framework agreements (guarantee mechanisms in particular), smoothing the application of existing fiscal incentives and developing additional financial incentives. Increasing tax exemptions for grid-connected projects during both construction and operation will highly reduce project costs and eventually would increase their profitability. As stated in the ROGEAP, the government could expand existing financial incentives to cover the entire off-grid stand-alone solar product supply chain, including batteries, inverters and other system components to provide necessary support to the industry.

Challenge 4.2: Access to debt financing from local banks is difficult, especially for small-scale projects.

The main issue for the off-grid sector is the financing gap faced by small and mid-scale project developers but also by companies distributing renewable energy devices (such as solar home systems). To date, international lenders and investors are focusing more on on-grid projects, for several reasons. First, there is insufficient planning from the authorities, especially regarding the distinction between areas that should be electrified by the national grid and areas where off-grid solutions should prevail. Second, the fact that the off-grid market is nascent and unproven explains the lack of appetite from international lenders towards the sector. Consequently, off-grid developers struggle to find financing solutions, especially debt financing from local banks, while developing off-grid solutions remains very costly in Burkina Faso.

Two main factors are limiting the access to bank financing for renewable energy solutions in the country. First, the deposit structure of Burkinabè banks represents an obstacle in the process of granting loans and financing the economy. The instruments used in maturity structures do not have a contractual maturity date and offer the depositor the option to withdraw or increase assets without notice or penalty. There is therefore a prevalence of short-term deposits. This limits the ability of banks to grant long-term loans, which is particularly detrimental to renewable energy projects that require such loans. Second, the lack of available credit information about the borrower and poor judicial processes regarding collateral registry and recovery compel banks to require high amounts of collateral to mitigate consumer credit risk.

Recommendation 4.2: Reinforce local financing capacities to diversify and improve the financing products offered in Burkina Faso for renewable energy projects

To scale off-grid electrification, companies will need to access large volumes of commercial debt financing. It is therefore essential to reinforce local financing through capacity building (solar PV vocational training and technical certification programmes) to address unfamiliarity and insecurity of lenders towards the off-grid solar sector. This way, local banks could be more inclined to participate in the financing of off-grid developers, and end consumers become willing to buy the energy produced. To facilitate such local financing, it would also be key to implement guarantee mechanisms on credits allocated by local banks to off-grid projects. The borrowers' credit risk could be reduced, and local banks would eventually be less demanding in terms of collateral registry.

Reinforcing local financing can also be achieved through the mobilisation of microfinance to enable debt raising from small and medium enterprises and end users to finance off-grid devices. Microfinance solutions can be integrated into the business models of off-grid players (as is already done by several solar home system providers). Eventually, local lenders could be supported by setting up dedicated credit lines for rural electrification. For instance, the SUNREF programme, Implemented by AFD, developed credit lines totalling EUR 30 million (USD 30 million) with local banks in West Africa to finance energy efficiency programmes.

6.5 Operationalise rooftop solar and net metering

Challenge 5.1: Despite potential advantages to support distribution grids, self-generation and net metering are not available.

Public infrastructure is necessary to establish the link between the central government and remote localities. The COVID-19 pandemic, and other recent events in Burkina Faso, show how essential the local resilience of communities is. Continuous energy supply during critical events is a requirement for sensitive building locations such as hospitals, schools, telecommunications, and public buildings, and for remote communities in zones of high instability. In off-grid areas and in areas facing power shortages, the availability of local renewable energy resources can supply local, affordable and reliable energy.

Decree 2019-0902 sets the premises for self-generation and for the retail of excess power through net metering. The decree is designed primarily for large installations, above 100 kW. Various provisions apply, which limit the scale of development, such as:

- the installation is limited to 30% of the subscribed capacity;
- net metering is available only to installations above 100 kW. The tariff is to be set by the regulator in a separate decree.

The current version of the decree could target medium-sized installations in the commercial and industrial sector but is not addressing net metering in the household segment. In the household segment, the quality of the electricity service at the distribution level is problematic, with high prices and frequent power outages. The country features a large number of importers of generator sets, which are used to compensate for the quality of service and the lack of access to the grid. Due to the 30% capacity limitation featured by the decree, household solar installations may not be available to replace generator sets.

According to stakeholders, rooftop solar PV suffers from a lack of awareness of the technology and a lack of clarity on product performance and durability. Despite the decreasing costs of energy storage (IRENA, 2022b) and solar panels, the sector is not currently part of the national energy strategy.

Recommendation 5.1: Operationalise on-grid rooftop solar, net metering and prosumers

The vast majority of households would be limited to small-scale installations for self-consumption, which might be limiting the market potential for such installations.

The installation of rooftop solar PV in areas where the grid is weak could help reduce the load and reinforce the quality of service. Due to the high cost of fossil fuels, part of the opportunity could lie in switching existing diesel generator sets in urban and peri-urban areas to rooftop solar. The reduction in storage costs could be an alternative to the variability of supply and improve the adequacy with the peak demand.

The actual market size and power cost incurred by households using a diesel generator set for reliable supply should be established to assess the level of incentives needed for switching to solar. Mapping of the rooftop PV potential in major cities of Burkina Faso can help to accelerate the deployment of rooftop PV systems (Box 6). Connection rules and net metering should be operationalised.

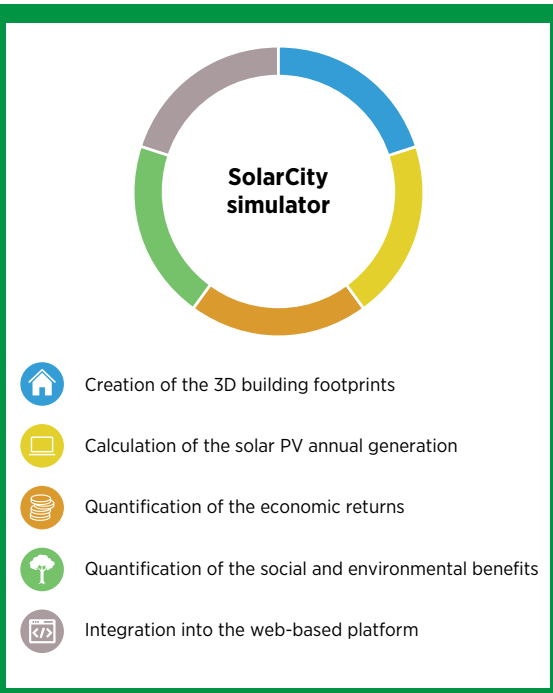
Box 7: The SolarCity Simulator

The SolarCity Simulator, developed by IRENA, is an innovative tool designed to support member countries in assessing their potentials for rooftop solar PV installations by testing different policy instruments, incentive schemes, and installation scenarios that could lead to potential economic savings and social-environmental benefits.

The methodology relies on a robust power generation model to calculate the annual energy production based on a city's solar resource profile and three-dimensional building footprints, and a simplified financial model to establish a range of economic indicators, such as payback, equity internal rate of return, and investment cash flow.

All these indicators are employed to further identify the suitable rooftops for solar PV installations in a city and assess their technical and economic potentials.

To learn more, see IRENA, 2019c.



Awareness, financing, net metering, and certification of installations and materials should support the emergence of rooftop solar, in both the commercial and industrial and the household segments. The local value chain could be stimulated through the mandatory certification of installers and materials. Cross-cutting activities involving awareness, entrepreneurship and small-scale finance should be supported.

6.6 Regulate the solar home systems market

Challenge 6.1: Access is currently reached through an unregulated market for solar home systems.

In 2020, Burkina Faso accounted for almost 10% of the solar home systems sold in West Africa. The majority of these purchases include a cash system, but the pay-as-you-go (PAYGo) segment is increasing over time (Table 11 and Figure 19). The products are of variable prices and quality, and their diffusion is now reaching thousands of consumers, which would call for a level of supervision from the regulator to safeguard consumers while providing an enabling ecosystem for continuing innovation in the sector.

Amid the COVID-19 pandemic, the government of Burkina Faso introduced a reduction of 50% in the cost of solar kits for vulnerable households. In addition, the United Nations Capital Development Fund (UNCDF) started the Fonds des Energies Renouvelables pour la Résilience du Burkina Faso (FERR-BF) to support PAYGo companies. Despite having benefitted from support, this market is out of scope of the current regulations, and there are no synergies with mini-grid deployment plans.

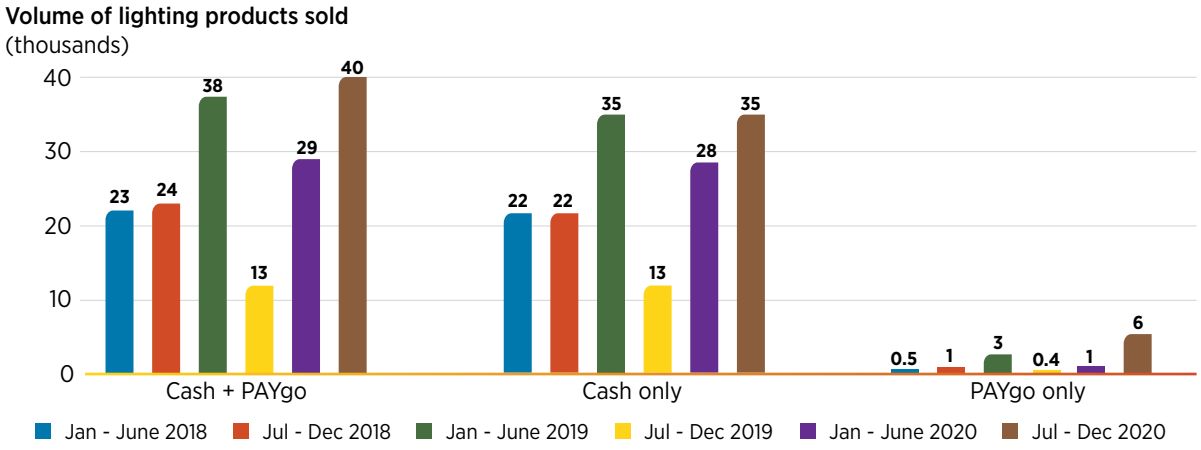
In principle, ANEREE is in charge of certifying the performance of solar products, which it is not in a position to deliver due to a shortage of capacities. As a consequence, the market is flooded with materials of variable costs and quality, and local entrepreneurs compete on costs rather than on quality and service.

Table 11: Solar home system sales in West Africa and Burkina Faso, June to December 2020

	Sales June to December 2020	Cash	PAYGo
	Volume of lighting products sold		
West Africa	434 390	192 814	241 576
Burkina Faso	40 298	34 773	5 525

Source: GOGLA, 2020.

Figure 19: Imports of solar home systems in Burkina Faso, 2018-2020



Source: GOGLA, 2020.

Note: Products are classified as 'cash' when sold in a single transaction (including products purchased via tenders), or as 'PAYgo', when the customer pays for the product in instalments over time or pays for the use of the product as a service.

Recommendation 6.1(a): Consider and regulate the solar home system market as a sizeable market segment for access

Initiatives supporting accelerated access through solar home systems are flourishing across Africa. These systems have proved to be low cost compared to other options (grid extension and mini-grids) in cases where the population density and demand are low. In some cases, the solar home systems market segment may be the most effective solution for remote off-grid households. Considerable breakthroughs have been reached in the development of mobile PAYGo technologies, which optimise the billing costs (Box 7).

For the promotion of a viable solar home system and electricity access value chain, it is recommended that the government of Burkina Faso look into:

- testing, certification, import, using local certification competences and establishing quality standards;
- organisation of the payment scheme such as leasing, upfront payment or loan involving financial institutions;
- distribution, installation and maintenance requirements of the devices in remote areas;
- collection of payments, through PAYGo platforms or in cash;
- gender equality in the energy sector; and
- a demand-side subsidy to cover the affordability gap from poorer off-grid households.

There is an opportunity to develop competences for maintaining or repairing solar home system equipment in case of failures, as in remote areas there is a severe lack of training or availability of trained personnel. Private sector engagement in the management of such facilities can be enabled through public-private partnerships for off-grid systems and mini-grids.

Stakeholders also indicated potential for engagement in basic research, certifications, policy development and review, regulatory assessment or market surveys, and acceptance of the technology at large. The assessment of the opportunities for solar rooftops, mini-grids and solar home systems, including those with battery storage, would greatly benefit from the mobilisation of local capacities, and the inclusion of women.

Recommendation 6.1(b): Support solar home systems and off-grid companies by enabling mobile money innovative business models

Many off-grid players use mobile money platforms to scale their businesses, as this enables them to offer electrification services to low-income and isolated customers through innovative business models such as PAYGo solutions. Off-grid players are thus limited by the penetration of these players in Burkina Faso. As has been demonstrated in East Africa during the last decade, the proliferation of mobile money platforms can facilitate energy access (World Bank, 2021g). Financial institutions, supported by public authorities, could take action by bringing together the main off-grid players and the main telecommunication and mobile money players to take advantage of the growing internet usage in Burkina Faso.

Box 8: Best practices for PAYGo solar

PAYGo solar is a breakthrough business model that combines low-cost, high-quality solar equipment with prepaid financing and low-cost operations anchored in mobile money payments. The system typically includes three lights and phone charging, which can be sourced for USD 40-60 depending on the order quantity. Interest rates on top payments that are as low as USD 10 per month are possible depending on the terms offered.

The PAYGo model has achieved rapid growth in Africa based on offering ownership of solar energy systems for payments close to the average household budget of rural households. The prerequisites for the model are matching the local energy budget, widespread use of mobile money, very low operating costs, effective last-mile distribution and low blended cost of financing. This translates to a model that only works at a large scale, with a customer portfolio of 200 000 and above.

The key elements of a sustainable rural PV market include customer satisfaction, affordability, dealer profitability, and effective supply and service chains. Considering these elements, it is recommended that projects pursue six basic actions:

1. Pilot private sector and non-governmental organisation delivery models: These could be either: 1) a dealer-sales model where the dealer purchases systems or components from manufacturers and sells them directly to households, usually as an installed system, and sometimes on credit; or 2) an energy service company (ESCO) model where the ESCO owns the system, charges a monthly fee to the household and is responsible for service.

2. Pilot consumer credit delivery mechanisms: Dealer sales of solar home systems must overcome their high initial cost relative to conventional alternatives and provide a means whereby households can continue to pay amounts roughly equivalent to their conventional energy purchases. Long-term consumer credit is one means to make monthly payments more comparable to conventional energy expenditures.

3. Pay first-cost subsidies and offer affordable systems: Subsidies are intended to reduce the initial payment and/or the monthly payments that households have to make, with the objective of making monthly payments equivalent to current monthly payments for conventional energy. Certification of installation is done either by the project or by commercial financiers.

4. Support policy development and capacity:
   - For projects using the ESCO concession model, technical assistance to national regulatory agencies is also included for concession bidding and contracting, training of agency staff, and monitoring and regulation of concessions.
   - Projects indirectly or directly influence government planning and policy related to rural electrification. Unrealistic political promises and uncoordinated grid extension harm the market for solar home systems.
   - Reduced import duties on PV components can remove market distortions and make solar home systems more affordable for rural households.

5. Enact codes and standards and establish certification, testing and enforcement institutions: Reasons for failure of solar home systems projects have included poor-quality products, poor installation and maintenance, and systems being "oversold" (marketing claims that raise expectations higher than the technology can deliver). Codes, standards and certification (and marketing restraint) are important elements to address these issues, and to reduce commercial risks.

6. Conduct consumer awareness and marketing programmes: Most projects conduct some type of consumer awareness and marketing programme. Such programmes are usually preceded by a market survey conducted as part of project preparation activities.

(Text courtesy of Kevin Kennedy, Sapere Aude Consulting Ltd.)

6.7 Support local industries and entrepreneurship

Challenge 7.1: Local entrepreneurship is underdeveloped due to asymmetric competition.

Burkina Faso demonstrates skills in several renewable energy sectors, such as solar panel assembly, assembly of solar devices, biodigesters and hydropower. It also has a local competence centre, which has the capability to train young professionals and women in the sector.

For example, PNB Phase II achieved 10 000 biodigesters in 2014, and PNB Phase III (2022-2026) is seeking to deploy 26 000 biodigesters by 2025. The programme targets 38 000 digesters by 2030. According to input collected through the RRA validation process, the programme supported the creation of 19 companies and 500 jobs, for a turnover of XOF 1.8 billion (around USD 2.5 million). PNB Phase III addresses capacity building, access to finance for households and companies, and the development of enabling investment frameworks.

However, the country still faces an absence of entrepreneurship in the renewable energy sector. Entrepreneurship lacks a strategy and an ecosystem to flourish. The lack of certification of devices is a missed opportunity for local companies, which currently must compete on cost with low-quality products.

Recommendation 7.1: Develop a strategy to position local industries across renewable energy value chains

Sourcing local competences and people is a must for implementing a renewable energy strategy. First, there is a need for talent to design and implement energy strategies. This is from the state capacity side. Then, some parts of the value chains can be localised, so as to maximise the spill over of investments. In economic terms, the objective is to increase the *multiplier effect* of public investments.

As each auction is carried outside an Integrated Resource Plan (as previously mentioned), the private sector is currently not able to schedule investments in the local value chain and human capacities that would initiate a thriving renewable energy sector. However, the potential for socio-economic benefits – jobs, research, education – can be testified by the presence of industry associations and research infrastructure despite modest activity in the renewable energy sector. Auctions can adapt to address issues around a just and inclusive energy transition. Specific design elements should include small and new players, foster the development of local industries, create local jobs, contribute to sub-national development and engage communities (IRENA, 2019d).

According to IRENA, auctions can be made compatible with local development through systematic auction schemes – a commitment to a longer auctioning schedule. Under such an approach, a steady stream (rather than an aperiodic flux) of auctions helps market agents to better adjust their expectations and plan for the long term, and helps the government to promote the local industry (IRENA and CEM, 2015).

To bring certainty to the nascent renewable energy market, South Africa initiated auctions as capacity pipelines, determined initially under the country's Integrated Resource Plan and further elaborated under the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP). In terms of job creation, the REIPPP has generated a total of 40 134 job-years (equivalent to full-time employment for one year) for South African citizens, of which 33 019 job-years were in construction (101% above planned) and 7 115 job-years were in operations (IRENA, 2019c).

Despite demonstrated skills in several renewable energy sectors, and the existence of a local competence centre, Burkina Faso must take further steps to advance local value chains and job creation for renewables. To move forward, the country's objectives and targets need to be consistent, stable and clearly communicated. A clear long-term policy framework and incentives need to be put in place, and the private sector and civil society should be mobilised.

The mandatory certification of installers would create skilled jobs and guarantee the quality of service to end consumers. Small companies and entrepreneurs should be supported to supply components and services to various segments of the supply chain.

IRENA (2013) underlines the need for standards and quality assurance mechanisms to ensure that products perform according to specifications and are reliable, safe and durable. This is particularly important in rural areas, where consumers have limited room to select their supplier. By referring to appropriate standards in the legislation, and ensuring compliance, one outcome is to create competitive markets for renewable energy technologies based on quality and safe products and services, which can create a competitive level playing field for local small and medium enterprises currently struggling to emerge on a market supplied by low-cost imported products.

6.8 Assess the bioenergy potential

Challenge 8.1: Despite its potential, the bioenergy sector lacks strategy.

On bioenergy, and despite an urgent need to move away from unsustainable uses of traditional biomass, there is a lack of competences in bioenergy technology, standards, deployment and maintenance of bioenergy products. Due to the small scale of the projects, and to the low purchasing power of consumers, there is a deficit of attention from the private sector to invest, and limited capacities to initiate projects.

Agri-food systems are one of the main productive use sectors where there are significant opportunities to deploy renewable energy solutions. On the other hand, the business case for renewable energy suppliers is likely to be enhanced by the improvement of the business case of food chain actors. If, thanks to better access to energy, food chain actors can reduce food losses and sell more and better-quality food products, they would be more able to pay the right energy tariffs to cover the operational costs of energy suppliers.

This synergy between the business case of energy suppliers and that of food chain actors is currently overlooked. One reason is the lack of co-ordination among stakeholders from the food and energy sectors, including among relevant ministries. Another reason is a lack of information and data to help de-risk and optimise investments in renewable energy for food chains.

However, the country does not have a national bioenergy strategy in line with its agricultural strategy. Bioenergy projects and initiatives are initiated on a case-by-case basis, when donor funding is available. These (sometimes significant) projects and programmes face challenges to become institutionalised and to scale up.

Several sources of bioenergy are identified (waste, cotton processing residues, sugar cane). However, the scale of the bioenergy potential from residues and waste has not been assessed in detail, and the scalability of existing demonstration projects and the market potential should be clarified.

Contributors to the bioenergy sector are well identified (Ministry of Energy. Mines and Quarries, Ministry of Finance, Ministry of Environment, Water and Sanitation, MRAH, 2IE, IRSAT, ABNORM (standardisation agency), ARSE, COOPELs). However, this scattered co-ordination of the sector dilutes responsibilities, and greater synergies are needed to define the priorities for the sector.

Plans to address the use of traditional biomass and the transition to sustainable biomass are scattered, and a shared and unified framework that consolidates existing plans and strategies is missing. This uncertain situation has prevented the sector from scaling up and prevented building the necessary capacities to evaluate the resource, initiate bankable projects, and operate and maintain bioenergy plants.

Box 9: Green Hydrogen Programme on Solar PV Power Plants in West Africa

The West African Science Centre on Climate Change and Adapted Land Use (WASCAL), in partnership with the German Federal Ministry of Education and Research (BMBF), launched the Project "Optimizing Solar PV for Green Hydrogen Production in West Africa (PV2H)", coupled with the BIO2H and bioenergy feasibility studies in Burkina Faso, as part of strategies to contribute to the promotion of the development of green hydrogen for an effective fight against climate change.

Funded by BMBF to the tune of almost EUR 3 million, the PV2H project aims at providing a concrete technical response to the negative impact of dust on solar PV power plants and to propose ways to optimise the production of green hydrogen from solar PV systems under the specific climatic conditions of the Sahelian region in West Africa. The 24-month project is led by WASCAL and Forschungszentrum Jülich, with other partners, including, University Joseph KI-ZERBO, University Abdou Moumouni, SONABEL, and the Ministry of Environment, Energy, Water and Sanitation and Ministry of Higher Education, Research, and Innovation of Burkina Faso.

Adopted from https://wascal.org/bmbf-funds-3-million-euro-green-hydrogen-programme-on-solar-pv-power-plants-in-west-africa/

Recommendation 8.1: Assess the bioenergy potential for power generation, transport sector and clean cooking

The bioenergy potential from residues and waste should be assessed in detail, and the scalability of existing demonstration projects and their market potential should be clarified in order to identify promising avenues and to discard prototypes that do not have scalability potential. The lack of assessment concerns not only bioenergy residues from agriculture but also the potential for sustainable bioenergy from all available feedstocks.

One recommendation would be to use the Bioenergy and Food Security Rapid Appraisal (BEFS-RA) methodology of the Food and Agriculture Organization of the United Nations (FAO) to undertake a robust and comprehensive assessment of the potential to develop sustainable bioenergy at the national and, if need be, sub-national level. Such analysis has been undertaken in several countries, including Egypt, Turkey and Zambia. Alongside the potential, the whole supply chain for feedstock collection and transport should be studied. This assessment should be the basis for selecting pilot initiatives and developing a national strategy on sustainable bioenergy (FAO, 2021).

A national bioenergy strategy would require a co-ordination mechanism involving the agricultural and animal resources sectors and other involved actors. The potential of each sub-sector needs validation from an environmental, economic and social perspective. The outcome strategy needs to guide future engagement of technical assistance programmes and donors in this sector. Awareness, capacity building, entrepreneurship and financing would support the national strategy, as was done for Kenya (Republic of Kenya, 2020).

There are two complementary ways to address the lack of information and to de-risk and optimise renewable energy in agri-food chains:

1. Map the best locations to install renewable energy systems. This can be achieved for sustainable bioenergy at the country level – potentially with an emphasis on biogas, as undertaken by the FAO through the use of the BEFS-RA methodology in Egypt, Turkey, and Zambia, among others.

2. Assess the feasibility of renewable energy investments in selected food chains, using a three-step approach: 1) food chain situation analysis; 2) mapping the best renewable energy opportunities; and 3) complementing the mapping exercise with a comprehensive cost-benefit analysis of renewable energy investments in agri-food chains. The FAO carried this out through the INVESTA cost-benefit for three food chains (milk, vegetables and rice) in four countries (Kenya, the Philippines, Tanzania and Tunisia).

6.9 Review the hydropower potential

Challenge 9.1: Estimates of the hydropower potential are outdated.

The hydropower potential was estimated in the period 2012/13 with the support of technical assistance. At that juncture, several sites were identified, but further studies concluded that the investment cost would be too significant for the resource available. Currently, the potential for refurbishment of existing hydropower capacities and the opportunity for additional locations appear to conflict in the different information sources.

The current capacities are ageing and may require refurbishment, and plans and strategies to revive the hydropower resource appear to be outdated. This is related to a lack of capacities to assess the bankability and impact on the energy matrix of the refurbishment, repowering and development of hydropower sites. Awareness of new technologies and operations and maintenance was reported.

Recommendation 9.1: Review the hydropower potential and current project proposals

Burkina Faso has a tradition of hydropower projects as well as historic competences in the sector. Considering that hydropower contributed around 15% of the electricity generated nationally in 2019, a review of the hydropower potential is advisable, taking into account the long-term climate impact.

Technical support would be needed to review past studies and assess the bankability of the hydropower potential in terms of refurbishment, repowering and new sites. If operated flexibly, hydropower might provide baseload capacity or support to the integration of variable renewable sources. Clarity on the actual potential, investment opportunities and needs would help the international community to onboard hydropower in their plans.

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Annex 1: List of planned, committed and recent generation plants

Table 12: List of planned, committed and recent generation plants in Burkina Faso

Name of station	Plant type	Plant capacity (MW)	Earliest year	Status
Bougouriba	Hydro	12	2025	Planned
Noumbiel	Hydro	60	2025	Planned
Aval	Hydro	14	2023	Committed
Bontioli	Hydro	5.1	2022	Committed
Folonzo	Hydro	10.8	2022	Committed
Gongourou	Hydro	5	2022	Committed
Samendeni	Hydro	2.6	2019	Commissioned
Komsilga (extension)	Oil	50	Ongoing	Committed
Kossod (extension)	Oil	50	Ongoing	Committed
Diapaga	Oil	0.46	2020	Planned
Donsin	Oil	100	2020	Planned
Gorom-Gorom	Oil	0.3	2020	Planned
Ouaga Est	Oil	108	2020	Planned
PIE Thermique	Oil	100	2020	Planned
Fada	Oil	7.5	2020	Commissioned
Ouahigouya	Oil	30	2019	Planned
Aggreko	Oil	50	2019	Commissioned
Ouagadougou	Biomass waste	10	–	Conditional (NDC)
Kalzi	Solar PV	30	–	Conditional (NDC)
Kaya 1 and Koupela 1 and 2	Solar PV	300	–	Conditional (potentially World Bank SEAP) (NDC)
50 000 solar home systems	Solar PV	3	–	Conditional (NDC)
Ouaga Solaire / Ouaga Nord Ouest	Solar PV	30 (43 by NDC)	2024	Committed (NDC)
Dori, Diapaga, Gaoua	Solar PV	9	2024	Tendered 2020 (Yeleen) (NDC)
Zagtouli extension	Solar PV	17	2024	Committed (EIB) (NDC)
Matourkou	Solar PV	30	2025	Tendered 2020 (KfW) (NDC)
Kodeni	Solar PV	38 MWc	2023	Committed
Donsin	Solar PV	25 MWc	2023	
Dedougou	Solar PV	18	–	Conditional (NDC)
Souri	Solar PV	18	2023	Committed
Nagréongo	Solar PV	30	2022	Commissioned
Zano	Solar PV	24	2023	Under construction (NDC conditional)
Pâ	Solar PV	33	2023	Under construction (NDC conditional)
Koudougou	Solar PV	30	2025	Committed (NDC)
Mana (SEMAFO)	Solar PV	20	2018	Committed
PPP/PIE Solaire EMOA	Solar PV	18.18	2018	Committed
Zina	Solar PV	22.6	2023	Work in progress
Essakane off-grid	Solar PV	15	2018	Commissioned (NDC)
PPP/PIE Solaire BID	Solar PV	12.73	2017	Committed
PPP/PIE Solaire Pa'te "Oie	Solar PV	5.82	2017	Committed
Zagtouli	Solar PV	33	2017	Commissioned
Ziga	Solar PV	1.1	2017	Commissioned
PPP/PIE Solaire AFD	Solar PV	2.86	2016	Committed

Based on: IRENA, 2018; GoBF, 2021a; local interviews.

Note: Earliest year and statuses could not always be actualised. PPP = public-private partnership.

Annex 2: SONABEL's electricity tariffs as of March 2021

Table 13: SONABEL's electricity tariffs as of March 2021

TENSION		Catégories et tranches tarifaires	FACTURATION DES CONSOMMATIONS (en FCFA)					FRAIS D'ABONNEMENT (en FCFA)				
			Tarifs du kWh			Redevance	PRIME FIXE	Avance sur Consom-mation	Frais ETS police et de pose	Timbres	Liasses	TOTAL Abonne-ment
BASSE TENSION BT	MONOPHASE 2 FILS	I) USAGE DOMESTIQUE PARTICULIERS ET ADMINISTRATION										
		Tarif type A (monophasé)	Tranche 1	Tranche 2	Tranche 3							
			0 à 75 kWh	76 à 100 kWh	plus de 100 kWh							
		1 à 3A	75	128	138	1 132	0	3 375	691	400	108	4 574
		Tarif type B (monophasé)	Tranche 1	Tranche 2	Tranche 3							
			à 50 kWh	51 à 200 kWh	plus de 200 kWh							
		5A	96	102	109	457	1 774	8 175	691	400	108	9 374
		10A	96	102	109	457	3 548	16 350	691	400	108	17 549
		15A	96	102	109	457	5 322	24 525	691	400	108	25 724
		20A	96	102	109	764	7 096	32 700	691	400	108	33 899
		25A	96	102	109	764	8 870	40 875	691	400	108	42 074
		30A	96	102	109	764	10 644	49 050	691	400	108	50 249
	TRIPHASE 4FILS	II) USAGE DOMESTIQUE ET FORCE MOTRICE PARTICULIERS ET ADMINISTRATION	Tranche 1	Tranche 2	Tranche 3							
		Tarif type C (triphasé)	à 50 kWh	51 à 200 kWh	plus de 200 kWh							
		10A	96	108	114	1 226	10 613	51 300	1 380	400	108	53 188
		15A	96	108	114	1 226	15 918	76 950	1 380	400	108	78 838
		20A	96	108	114	1 373	21 224	102 600	1 380	400	108	104 488
		25A	96	108	114	1 373	26 531	128 250	1 380	400	108	130 138
		30A	96	108	114	1 373	31 837	153 900	1 380	400	108	155 788
	DOUBLE TARIF	III) B.T. / TARIFS HORAIRES PARTICULIERS ET ADMINISTRATION	Heures de pointe (10h à 14 h et 16h à 19h)		Heures pleines (0h à 10h, 14h à 16h et 19h à 0h)							
		Tarif type D1 Non industriel	165		88	8 538	34 582 FCFA par kW par an	PS X 100 X 165	1 380	4 000	108	
		Tarif type D2 Industriel	140		75	7 115	28 818 FCFA par kW par an	PS X 100 X 140	1 380	4 000	108	
MOYENNE TENSION (MT)		IV) M.T. / TARIFS HORAIRES PARTICULIERS ET ADMINISTRATION	Heures de pointe (10h à 14 h et 16h à 19h)		Heures pleines (0h à 10h, 14h à 16h et 19h à 0h)							
		Tarif type E1 Non industriel	139		64	8 538	70 826 FCFA par kW par an	PS X 100 X 139	1 380	4 000	108	
		Tarif type E2 Industriel	118		54	7 115	64 387 FCFA par kW par an	PS X 100 X 118	1 380	4 000	108	
INDUSTRIES EXTRACTIVES ET HAUTE TENSION (HT)		V) H.T. / TARIFS HORAIRES PARTICULIERS	Heures de pointe (10h à 24 h)		Heures pleines (0h à 10h)							
		Tarif type G	140		70	7 115	64 387 FCFA par kW par an	PS X 100 X 118	1 380	4 000	108	
ECLAIRAGE PUBLIC Tarif type F		5A - 15A mono	122			381	- PS = Puissance Souscrite - Pour la BT double tarif, la MT et la HT : Pénalisation si Cos phi < 0,8 et Bonification si Cos phi > 0,9 - L'administration est dispensée du versement de l'avance sur consommation - Pour la BT double tarif, la MT et la HT : les frais de timbres sont de 400 FCFA par jeu de page en double du contrat soit au total 4000 FCFA					
		20A et plus mono	122			637						
		10A - 15A triphasé	122			1 022						
		20A et plus triphasé	122			1 144						

Source: SONABEL, 2022.

Annex 3: Measures and targets of the different plans and strategies

The **Energy Sector Development Policy Letter (LPDSE)**, adopted in 2000, was among the first initiatives to identify energy sector improvements and measures. Its goal was to provide guidance to define specific policies for each form of energy.

Energy Sector Policy 2014-2025 (POSEN)

The **Energy Sector Policy 2014-2025 (POSEN)**, adopted in 2013, aims to define a framework to implement energy sector reforms – policy law on renewable energy – and creates the National Agency for Renewable Energy and Efficiency (ANEREE). It also organises the energy sector by defining three sub-sectors: electricity, hydrocarbons and renewable energy (with the latter further subdivided into wind energy, solar energy, biomass, biogas and energy efficiency). POSEN aims to increase the share of renewables in the energy mix to 50% by 2025 (GoBF, 2015). In the achievements targeted by POSEN, the country's interests lean towards biofuels, solar energy, the sustainable production of wood energy and efficient cooking.

The achievements targeted by the POSEN are:

- Establishment of biennial international meetings on biofuels and solar energy,
- Participatory management of forests for the sustainable production of wood energy,
- Exemption from customs duty and VAT on solar energy equipment for five years from the 2013 finance law,
- Capacity building of the Institute of Applied Sciences and Technologies (IRSAT) for the certification of improved stoves and solar equipment,
- Organisation of the wood-energy sector (producers, transporters, retailers) and capacity strengthening,
- Dissemination of 5 000 improved cookstoves,
- Promotion of alternative energy sources (butane gas, briquettes) to wood energy,
- Capacity building of producers of domestic energy equipment,
- Creation of rural wood-energy markets.

Renewable Energy Action Plan (PANER)

Table 14: Targets for renewable energy generation and use under PANER, 2010, 2020 and 2030

	Objectives	2010	2020	2030
On-grid renewables	Installed capacity (MW)	32	150	318
	Share in electricity mix (%)	15	24	36
	Energy produced (GWh)	117	306	685
Off-grid renewables	Share or rural population supplied by renewable off-grid systems (%)	0.5	12.8	26.9
Clean cooking	Share of the population using efficient cookstoves (%)	9	32	79
	Share of the population using clean fuels for cooking (butane gas) (%)	11	22	32
Solar water heaters	Share of public buildings using solar water heaters (%)	5	25	50
	Share of industries and hotels using solar water heaters (%)	5	15	25
Biofuels	Share of ethanol in petrol consumption (%)	0	0	10
	Share of biodiesel in diesel and distillate diesel oil consumption (%)	0	1	5

Source: GoBF, 2015.

National Energy Efficiency Action Plan 2015-2030 (PANEE)

Table 15: Targets for energy efficiency under PANEE, 2010, 2020 and 2030

	Objectives	2010	2020	2030
Efficient lighting	On-grid lighting savings (GWh/year)	0	67	334
	Off-grid lighting savings (GWh/year)	0	1.9	5.2
Grid losses	Loss share (%)	17	14.5	10
	Energy savings (GWh/year)	0	61	447
ECOWAS energy efficiency standards and labelling	Total number of energy efficiency standards in force in the country	0	1	5
	Total number of energy efficiency labels in force	0	1	5
Energy efficiency in buildings	Share of new large private/public buildings designed with energy efficiency measures (%)	0	10	90
	Share of private/public buildings renovated with energy efficiency measures (%)	0	10	90
Energy efficiency in Industry	Share of industries with energy efficiency measures (%)	0	5	50
	Share of energy savings (%)	0	20	20

Source: MoME, 2015.

Burkina Faso Compact II

The Burkina Faso Compact II programme has a detailed action plan to upgrade the whole electricity sector. The programme includes:

- Project 1: Increasing the efficiency of the electricity sector – Renforcement de l'efficacité du domaine de l'électricité (PREDEL)
- Project 2: Increasing the supply of cheaper electricity – Accroissement de l'offre d'électricité moins coûteuse (PADOEL)
- Project 3: Networks and access to electricity – Réseaux et accès à l'électricité (PRAEL)

The levers constituting the Compact II programme include:

1. Optimising the policy, legal and institutional framework
2. Strengthening the capacity and efficiency of government institutions and agencies
3. Planning the deployment of infrastructure and mobilising the corresponding financing
4. Strengthening the capacity and efficiency of SONABEL
5. Increasing private sector participation in production and accelerating regional integration
6. Re-organisation of the electricity market
7. Increased private sector participation in access to electricity
8. Increasing energy efficiency
9. Rationalisation of subsidies and tariffs

These levers are detailed in 102 actions. Levers 5, 7 and 8 are directly related to renewable energy as they include actions corresponding to the development of solar independent power producers, the development of stand-alone solar products, and energy management and efficiency.

Energy Sector Policy Letter 2016-2020 (LPSE)

The **Energy Sector Policy Letter 2016-2020 (LPSE)**, adopted in 2016, aims to make energy accessible and available through several measures (see Annex 3), including the promotion of energy efficiency. The LPSE addresses several of the drivers to the adoption of renewables as presented in the previous section – for example, it relies on energy production from renewable sources, increases access to modern energy services and promotes regional energy co-operation.

Table 16: Actions to develop energy production from renewable sources and to promote energy efficiency under LPSE 2016

Develop energy production from renewable sources
Preparing the energy code
Adopting fiscal incentives for PV material
Develop a new law on general energy regulation
Construct five solar PV power plants under public-private partnership schemes
Extend Zagtouli power plant to 50 MW
Construct a solar PV power plant in Mana by Zina Solaire (20 MW)
Programme of solar installations on public buildings, schools, hospitals (39 MW)
Install seven solar and hybrid power plants of 15 MW each with injection into the SONABEL grid
Carry out feasibility studies and build a 20 MW hydroelectric plant in Ouessa
Build a 16 MW hydroelectric power plant in Bagré Aval
Construct mini hydroelectric power stations at Folonzo, Bontioli and Gongourou
Carry out the feasibility study for the construction of the Arly hydroelectric dam
Build a 10 MW biomass-waste thermal power plant
Carry out feasibility studies and launch the construction of 80 MW solar power plants in five regions
Reform the institutional framework to better consider renewable energy and energy efficiency
Set up a national agency for renewable energy and energy efficiency
Set up a quality control centre for solar components
Set up two factories for the manufacture and assembly of solar equipment, one of which is located in the technology park
Build and equip a showroom for the sale of solar kits within the Technopole
Light 200 kilometres with solar PV street lamps
Build two vocational high schools in energy technology and renewable energy
Set up an energy technology centre
Promote energy efficiency
Implement incentive policies for the use of solar water heaters and cookers with the installation before 2020 of, 5 000 solar water heaters and 5 000 solar cookers among identified public buildings
Install multifunctional biodiesel production platforms
Audit interconnection lines
Carry out a study on the implementation of thermal and energy regulations in buildings
Acquire and install 1 500 000 LED lamps to replace fluorescent lamps in households
Automate the operation of appliances such as air conditioners and lamps
Audit 100 high-powered public administration buildings
Install thermal and acoustic insulation of 100 public administration buildings
Install 2 000 square metres of reflective film
Install 10 000 kVAr of capacitor banks in high-reactive power installations
Implement measures to encourage the use of local building materials and take energy efficiency into account in the architectural design of homes and buildings
Install 1 million low-energy lamps
Monitor and control the monthly consumption of households and public and private buildings

Source: GoBF, 2016a.

Annex 4: Key regulations – references and summary

Table 17: Key regulations – references and summary

Regulation	Date	Key points
Decree 2014-636 on the conditions for concluding contracts for the delegation of public services, issuance of licences, authorisations and submission to the obligation to declare an installation in the electricity sub-sector in Burkina Faso	2014	• Currently out of date, this text was superseded by a series of reforms actualised in 2017. • The document refers to a "hybrid" single-buyer model for the centralised grid, complemented by an open market on the second segment (non-SONABEL), where SONABEL was established as the single buyer for Burkina Faso, with a monopoly over the transmission and distribution networks. Power generation is open to competition. • A "second segment" (*i.e.* not on SONABEL-operated networks) is open to competition for production and distribution. For over 25 kW, a concession agreement is delivered by the Minister; an authorisation regime applies in the range of 10-25 kW; below 10 kW, a declaration regime applies.
Law 014-2017 on the general regulation of the energy sector	2017	• The Law establishes a global framework for the management and regulation of the sector, and consolidation of the electricity sub-sector, while considering the provision for the establishment of the regional market. • The Law established the opening of the production and distribution sectors to competition. It allowed the opening of the generation segment to competition over the entire territory, and withdrew the single buyer. It introduced specific elements promoting renewable energy and energy efficiency. • The Law establishes the main actors of the electricity sector, as follows (see corresponding decrees in the following sections): o The national electricity regulator (ARSE); important for the mandate of the utility, the Law establishes the production, distribution and transport to be separated accounts – also applicable to agents acting in multiple segments. o The utility SONABEL, in charge of the supply of electricity, transport, distribution, retail import and export of electricity; also in charge of ensuring access and the electrification plans. o The Rural Electrification Agency (ABER), which promotes the rural electrification plan, contributes to its implementation, facilitates access, and co-ordinates activities in rural areas. o The Renewable Energy Agency (ANEREE) (see following sections). • Electricity production is open to the private sector under a licensing regime granted by the Ministry. A 10-year indicative investment plan is to be established. • Under the monopoly regime for the transport network, access to the grid is pending feasibility agreement by SONABEL. • The distribution segment is open to public and private competition, under a concession and authorisation regime granted by ARSE. • For rural electrification, a production and distribution concession is delivered by the local community with simple advice from ARSE. In this framework, the local communities ('communautés territoriales') validate the electrification plans, are involved in the master planning and can grant concessions.

Regulation	Date	Key points
Decree 2016-1200 relating to the creation of the National Agency for Renewable Energy and Energy Efficiency (ANEREE) Decree 2016-1265 adopting the statutes of the National Agency for Renewable Energy and Energy Efficiency (ANEREE)	2016	• The decree establishes the renewable energy and energy efficiency Agency (ANEREE), with six roles: o Control, support and supervise the renewable energy and energy efficiency markets (labelling, test, technology centre, market supervision); o Establish a national energy efficiency strategy; o Support and promote flagship renewable and energy efficiency projects (assess potentials, promote ongoing actions, develop an energy information system, etc.); o Federate partners (private and public sectors, non-governmental organisation, etc.) in the renewable energy and energy efficiency sectors; o initiate commercial services and public services related to renewable energy and energy efficiency; o support research and education in both sectors. • ANEREE is to be funded by multiple sources, including by a fee on the renewable energy purchases from SONABEL.
Order 17/118 laying down the technical rules for the production of electrical energy	2017	• The document relates mostly to existing law and decrees, without establishing links with enforced laws and decrees. • The issues listed include: environmental protection, control authorities, technical/electrical/installation rules, technical standards, control services, metering, waste management, risks and security. • This document might contain gaps, despite being potentially highly relevant.
Decree 2016-2017 on the attributions, organisation and functioning of the Regulatory Authority of the energy sector. Decree 2020-0278 on the attributions, organisation and functioning of the Regulatory Authority for the energy sector	2017 (2020)	• The decree establishes the electricity regulator, ARSE, as an independent entity, financially and structurally independent, under the supervision of the Prime Minister's Cabinet. • Two identical versions of this text were adopted
Decree 2017-1011 setting the capacity thresholds relating to generation permits and the coverage radius limits of distribution permits.	2017	• The decree is fundamental to establishing the capacity thresholds for the various type of authorisation on electricity production and distribution. • Regarding electricity generation, it establishes: o Licence regime - fossil-based fuel: > 2 MW; renewable: 1 MW; o Authorisation regime - fossil-based fuel 0.5-2 MW; renewable: 0.25-1 MW; o Declaration regime - fossil-based fuel: < 0.5 MW; renewable: 0.25 MW; o self-production: 0.5 to 1 MW; o Exemption - fossil-based fuel: < 100 kW; renewable: 5 kW. • Regarding electricity distribution: o Concession regime if extents > 1 km o Authorisation if extends < 1 km o Authorisation regime for solar PV systems
Decree 2017-1012 on the terms and conditions for granting licences or authorisations for electricity production	2017	• The decree establishes detailed procedures for granting production licences and authorisations; competitive bidding should be the rule, without exceptions above 5 MW. • ARSE notifies the Minister, who grants the licence for 25 years (15 years for an authorisation). • The auction should include the draft public-private partnership contract.
Decree 2017-1013 adopting specifications applicable to electricity producers in Burkina Faso	2017	• The text provides terms of reference for procuring generation capacity. • The document mentions a number of electrical requirements usually detailed in national grid codes.

Regulation	Date	Key points
Decree 2017-1014 establishing the energy efficiency standards and requirements applying to appliances and equipment as well as their implementation methods.	2017	• The decree sets energy efficiency certifications for a large number of appliances, as well as the labelling of energy performance. • The testing and exclusion processes do not seem to appear in this text.
Decree 2018-0568 on remuneration for activities contributing to the supply of electricity and setting of methodologies and parameters for determining electricity transmission and distribution tariffs.	2018	• The decree establishes the tariff methodology for a concession. • The tariffs include a remuneration of the invested capital and the costs of sector expansion, under the form of a fixed part (redevance) and a variable part (per energy produced). However, bilateral agreements are possible. o Production: prices are set by the energy ministry, with agreement of ARSE; o Transport: prices are set by ARSE, based on the revenue requirement methodology; ARSE establishes the adequate incentives for reducing losses; under the agreed performance levels, the additional costs are covered by the network operator; o Distribution: revenues are fixed by the Ministry of Energy on the basis of benchmarks supplied by ARSE; o Non-eligible clients: a social tariff is granted to poor customers, and the income gap is compensated by other client categories. • The tariffs are reviewed every five years.
Decree 2018-0569 adopting specifications applicable electricity distribution in concession zones	2018	• The decree establishes the conditions to apply for an exclusive right to distribute electricity over a concession zone. • Performance criteria are to be set by ARSE. • The revenues are fixed according to the legislation (Decree 2018-0568).
Law 033-2007/AN establishing the Finance Law for the execution of the State Budget – Management 2008	2008	See Official Journal of Burkina Faso (2018)
Decree 2014-636 PRES/PM/MME/MEF on the conditions for the conclusion of public service delegation contracts, the issuance of licences, authorisations and submissions to the obligation to declare installation in the electricity sub-sector in Burkina Faso	2014	See GoBF (2014)
Law 058-2017/AN supporting the general code of taxation of Burkina Faso	2017	See GoBF (2017)
Decree 2018-0857 PRES/PM/ME/MINEFID of October 2, 2018 approving the statutes of the National Electricity Company of Burkina (SONABEL)	2018	• SONABEL is established as a public company under private law. • The goals of SONABEL include: o provision of electricity in 'sufficient quantity'; o improving access; o operation over production, distribution, retail and transport of electricity. • SONABEL has a monopoly over the transport of electricity.
Decree 2018-1160 PRES/PM/ME/ MINEFID of December 19, 2018 adopting the statutes of the Burkina Faso Rural Electricity Agency (ABER)	2018	• The transformation of the FDE into the ABER was considered by Law 014-2017. • The Burkinabe Rural Electrification Agency (ABER) was enacted a year later by Decree 2018-1160 adopting the statutes of ABER. • The decree specifies the missions and attributions of ABER.

Regulation	Date	Key points
Decree 2019-0902 on grid access modalities for renewable energy self-generators and net metering	2019	• The decree applies to all self-generators, including (but not exclusively, through solar). • The installed capacity should not exceed 30% of the total capacity (*e.g.* household). • Under 500 kW, the installation is connected to the low-voltage network. • Net metering and retail is authorised for installations over 100 kW. • The purchase tariff should be set by decree. • The template purchase contract is to be developed by ARSE.
Interministerial Order 2020-033 relating to the conditions of eligibility and modalities for VAT exemption on imports and sales of solar equipment	2020	• The VAT and import taxes exemptions for solar equipment were first adopted in 2013 for a five-year period, through Law 051-2012 and extended by Law 058-2017. • In 2020, the Interministerial Order 2020-033 redefined the conditions of eligibility and the terms and conditions of use. • The text establishes a list of equipment exempted from VAT. • The equipment should conform to the quality standards established by the energy ministry. • •The conformity agreement is delivered by ANEREE.
Decree 2020-1053 PRES/PM/ME/ MINEFID/MCIA on the conditions for the self-production of electricity in Burkina Faso	2020	• The decree sets out the conditions for self-generation of electrical energy in Burkina Faso. • It does not apply to emergency power generation facilities or to facilities relating to State security and national defence. • It sets out certain requirements for self-producers depending on their access to the public electricity distribution or transmission network, as well as the taxation and fees they are subject to. The tariffs are determined based on the amount of installed capacity.

Annex 5: Strengths, weaknesses, opportunities and threats (SWOT) for the for the on-grid, rural and productive energy sectors based on stakeholder workshop and interviews

Table 18: Strengths, weaknesses, opportunities and threats (SWOT) for the on-grid energy sector in Burkina Faso

Strengths (internal)	Weaknesses (internal)
General • A set of actors exists with a clear mandate, set by law (ARSE, ABER, ANEREE, Ministry, SONABEL). • A strong planning framework is in place (PANER, PNDES), and a new National Development Framework is under elaboration. • Law 014/2017 opens possibilities to involve independent power producers as well as new distribution operators, including with embedded generation (mini-grids). • The sector saw a number of independent power producers successfully developed. • Renewable energy resources can cover the demand. • Mobilisation of capacities is ongoing. • Renewable energy investments above XOF 100 million (USD 180 000) could be eligible for a reduced VAT and partial tax exemption / tax break under the Investment Code of Burkina Faso (Law 038-2018).	**General** • The cost of electricity is among the highest in the region, and subsidies increased 34% during 2016-2019. • Despite ongoing diversification, oil remains a primary focus in future investments. • Regulatory challenges remain, with gaps in regulation enforcement. • Plans and strategies are perceived as overlapping. • The economic potential of solar and wind projects is outdated and is not yet used as an input to planning grid expansion versus rural electrification (Integrated Resource Plan plus rural electrification planning). • Institutional capacities demonstrate gaps, such as in quality monitoring for ANEREE. • The regulator is partially funded and is not equipped to play its role. • Positioning in the value chain needs to be strengthened.
Bioenergy • Contributors to the sector are well identified (MEMC; MINEFID; environment ministry; animal resources ministry; 2IE; IRSAT; ABNORM; ARSE; COOPELS). • Several sources of bioenergy are identified (waste, cotton processing residues, sugar cane). • Large companies are involved in valorisation of bioenergy waste at a small scale (SOSUCO – sugar; FASOBIO – mango; BELWET – jatropha/biodiesel). • Small-scale demonstrators are operating (0.75 MW biogas is reported by IRENA). • The co-generation plant operated by FasoBiogaz could reach up to 0.5 MW (power), and new demonstrations are encouraged (*e.g.* Ouagadougou slaughterhouse; wastewater treatment plant).	**Bioenergy** • Plans to address the use of traditional biomass and the transition to sustainable biomass are scattered. • A shared and unified framework that consolidates existing plans and strategies is missing. • The co-ordination of the bioenergy sector falls under several ministries, and better co-ordination is needed. • The sector lacks a specific regulatory framework, not available as of today, according to stakeholders. • The scale of the bioenergy potential from residues and waste is not detailed, and the scalability of existing demonstration projects and the market potential should be clarified. • The technology appears complex. • Gaps are reported in capacities to evaluate the resource, initiate bankable projects, and operate and maintain bioenergy plants.
Hydropower • With 34.5 MW in operation, the technology is well implemented in Burkina Faso, and trained capacities are available. • Several other projects were identified*, although the final list is to be consolidated, as some areas are protected under the Ramsar Convention on Wetlands of International Importance. • Hydropower is connected to productive uses (agriculture, fishing), potentially increasing revenues of local populations.	**Hydropower** • Plans and strategies related to hydropower are outdated. • Current installations are ageing and would require refurbishment (silting; spare parts). • A lack of access to investment and a lack of capacities to propose bankable projects were reported. • The technical capacities lack training on new technologies and operations and maintenance.

Strengths (internal)	Weaknesses (internal)
Solar • The political vision puts solar in focus. • A number of large-scale independent power producer projects are operational (62 MW reported by IRENA), with more in the pipeline**. • A demonstration project for the mining sector (15 MW peak) is potentially replicable and could form the basis for access in remote areas. • Local manufacturing capabilities are in place (*e.g.* Faso Energy). • Awareness among the population is high.	**Utility-scale solar** • Enhanced planning in project implementation is needed. • PANER does not yet include current and planned solar project capacity. • Several organisations are in charge of certification, which creates a need to reinforce co-ordination (ANEREE, ABNORM, IRSAT). • There is a need to consolidate and transfer knowledge from existing facilities. • Positioning of the local supply chain versus imported products (price / quality / distribution networks) should be evaluated.
	Small-scale on-grid solar • Application decrees are still under development, and net metering is not in force yet. • The quality of solar products is highly variable. • The VAT exemption on solar products is related to testing by ANEREE; however, the lack of capacities limits the capability to perform actual testing, hence certificates are delivered based on claimed performance rather than actual. • The distributors lack awareness on product performance and quality. • Capacities for assessing the bankability of small-scale solar projects are lacking. • The local supply chain is in competition with imported products (price / quality / distribution networks).
Opportunities (external)	**Threats (external)**
General • Regional integration is an asset to be exploited to accelerate variable renewable energy on-grid. • Demand forecasts on which future capacity investments are foreseen are uncertain, which can open opportunities for a revision of the investment pipeline. • Costs of renewable energy and storage fell sharply over the last decade, making renewable electricity competitive with oil on-grid.	**General** • Volatile and increasing oil prices do not guarantee predictable and stable electricity prices to support development. • The security of installations and populations is compromised in several regions. • The COVID-19 pandemic demonstrated the need for increased resilience of public infrastructure.
Solar • International donors and technical assistance partners have a strong focus on large-scale solar in Burkina Faso, with access to concessional financing at a large scale. • Large-scale solar, coupled with storage and regional integration, has the potential to address the lack of generation capacity.	**Bioenergy** • The capability to exploit residues is impacted by the export prices of raw materials, which influences production.
Bioenergy, hydropower • The opportunity to mobilise financial partners and climate finance for (non-solar) renewable energy plants (bioenergy, hydropower) may be explored. Environmental and social impacts assessments will be a key decision factor for such investments. • There is potential to use the FAO Bioenergy and Food Security Rapid Appraisal (BEFS-RA) methodology to undertake a robust and comprehensive assessment of the potential to develop sustainable bioenergy at the national and, if need be, sub-national level.	**Hydropower** • The technical potential is reduced due to the topography and the variability of the water resource. • The technical and financial community is not mobilised for hydropower.
	Solar • Large-scale solar integration at high penetration rates may depend on the capability of the regional electricity market to balance variable generation.

*Bontiolli, Bougouriba, Gongourou, Noumbiel and Samendeni.

** Actual pipeline to be reviewed with stakeholders.

Table 19: Strengths, weaknesses, opportunities and threats (SWOT) for rural access in Burkina Faso

Strengths (internal)	Weaknesses (internal)
Strengths (internal) • A specific regulatory framework for off-grid rural electrification is under development (SEFA/AfDB). • Law 014/2017 opens possibilities to involve independent power producers as well as new distribution operators, including with embedded generation (mini-grids). • 40 mini-grids have been built, and more than 50 000 solar home systems have been distributed. • A pilot Electrified Activity Zone is ongoing. • Burkina Faso represents 10% of the solar home system market in West Africa. Most systems are cash, and 8-10% are PAYGo. • The solar resource is intense, in particular in off-grid areas. • Professional curricula on rural electrification are available.	**Weaknesses (internal)** • The involved actors require co-ordination and clarification of their roles and responsibilities – including MEMC (DGERE, ANEREE), universities and institutes (IRSAT, 2IE), professional associations (APER/BF, ABAPEE, CNPDER), ARSE and ABNORM. • Planning and co-ordination of on-grid versus off-grid electrification is not yet co-ordinated (rural electrification plan or equivalent), including: o grid extensions (short, medium and long term); o mini-grids, considering productive uses; o priority access projects for public infrastructures (social, schools, public facilities and hospitals); o oriority zones for solar home systems (low density). • The mini-grid segment is dependent on institutional support, and its scalability is limited by access to grants. • Business models for sustainable green mini-grids are needed to attract private capital. • Current installations are facing challenges with operations and maintenance, and collecting payments. • A gap exists in the regulatory framework for mini-grids for the establishment of public-private partnerships (although two examples of private mini-grids were mentioned). • In the mini-grid segment, the electricity retail price is based on the grid tariffs (not cost reflective). • A specific tariff for solar systems is lacking, and there are insufficient incentives to mitigate private investment risk. • The solar home system market is sizeable in numbers and impacts a large number of consumers, but is unregulated at the moment. • The imported materials are of variable quality. • The sectors lack human and financial resources. • ANEREE lacks the development of a certification for PV panels and storage. • Local technical capacities should be developed to deploy mini-grids.
Opportunities (external)	**Threats (external)**
Opportunities (external) • The "Solar Energy and Access Project" component 1 (Sustainable Rural Electrification) will be implemented by ABER. It involves the deployment of green mini-grids (41 000 households) based on viable business models for public-private partnerships. • The costs of solar PV and storage have reduced the levelised cost of electricity for mini-grids and solar home systems. • For mini-grids, international experience shows that coupling with the development of productive uses has a beneficial impact on community income and further reduces the cost of electricity by maximising the system use. • Smart payment systems increased revenue collection for operators and secure investment. • For solar home systems, innovative business models have been demonstrated across the globe for rapid upscale of access to basic electricity services.	**Threats (external)** • Aggressive prices on solar components (production, storage) are sometimes detrimental to performance; this spreads misperceptions on the capabilities and reliability of solar installations among the population. • This puts high emphasis on the need for certification of imported products and systems.

Table 20: Strengths, weaknesses, opportunities and threats (SWOT) for productive uses in Burkina Faso

Strengths (internal)	Weaknesses (internal)
Solar • Local manufacturing expertise exists, and there is high consumer adhesion to the manufacturing of solar water heaters and solar cookers and the assembly of small solar-powered equipment (*e.g.* hair dressers, laundry, cooling, pumping, welding). • The increase in demand for productive applications drives the demand for self-powered equipment in the absence of electricity access.	**General** • There is a lack of promotion of local manufacturing and competition with low-cost imported equipment. • The purchasing power of consumers is limited, which puts price (beyond quality) as a driver for sales. • There is a need for reinforced capacities for technology development, manufacturing, quality and entrepreneurship. • There is a need to support local micro and small entrepreneurs.
Bioenergy • Local biodigester manufacturing and installation exist. • There is a national biodigester programme (PNB-Burkina Faso). • A quality evaluation framework is available for biodigesters. • A small-scale jatropha demonstration plant exists. • Efficient cookstoves are available (ANEREE/CNRST).	**Solar** • The quality of imported equipment is un-assessed. • Consumers lack awareness of the quality of solar products.
	Bioenergy • No specific regulatory framework applies to bioenergy for productive uses. • Competences are lacking in bioenergy technology, standards, deployment, maintenance. • Financial resources are insufficient. • Interest from the private sector is limited. • Capabilities to initiate projects are limited. • For crop-based bioenergy, land availability (due to insecurity in desert territories) and competition with food are potential issues.
Opportunities (external)	**Threats (external)**
Solar • The supply of cheap, imported small-scale equipment provides an opportunity for entrepreneurs to propose locally manufactured / locally assembled equipment.	**Solar** • The market is flooded with imported products of variable quality, which compete with higher-priced (yet potentially better-quality) local manufactured products.
Bioenergy • There is urgency to move away from unsustainable bioenergy to sustainable uses.	

Annex 6: Main programmes and financing of bilateral and multilateral development finance institutions for the energy sector

Table 21: Bilateral energy investments of development finance institutions in Burkina Faso

Institution	Project (Year)	Financing instrument and amount	Project description
AFD	Zagtouli I (2017) (Alliance Sahel, 2020)	Loan (EUR 22.5 million)	33 MWp solar PV plant
	Yeleen (2018) (AFD, n.d.)	Loan, subsidy (EUR 75 million)	4 solar PV plants (Dori, Ouagadougou, Diapaga and Gaoua) for a total of 51 MWp
Proparco	Dedougou (COD: 2023) (MIGA, 2020)	N/A	18 MWp solar PV plant
	Tenkodogo (COD: 2022) (FMO, 2021)	Loan (EUR 9.1 million, 18 years)	24 MWp solar PV plant
FMO	Tenkodogo (COD: 2022)	Loan (EUR 11 million, 18 years)	24 MWp solar PV plant
	Dédougou (COD: 2023)	Loan (EUR 7.8 million)	18 MWp solar PV plant
	Nagreongo (COD: 2021)	Loan (EUR 13 million, 14 years)	30 MWp solar PV plant
	Kodeni Solar (COD: 2022)	Loan (EUR 21 million, 14.5 years)	38 MWp solar PV plant
KfW	Beyond the Grid Fund for Africa (BGFA) (2020)	EUR 7.5 million	Aims to offer affordable and clean energy access to people living in rural and peri-urban areas (5 - 15 million people in five African countries including Burkina Faso through the local initiative called YiiteFaso)
		N/A	14 MWp solar PV project (and storage)
Swedish International Development Cooperation Agency (SIDA)	BGFA (2020)	EUR 60 million	See description above
	SEFA (2011) (AfDB, 2020d)	EUR 898 million	Fund hosted and managed by the AfDB that provides financing to unlock private sector investment in renewable energy and energy efficiency
Nordic Development Fund (Norfund)	SEFA (2011)	USD 10.65 million	See description above
	Facility for Energy Inclusion (FEI) (2016) (Norfund, 2020)	USD 20 million equity USD 3 million junior equity	Financing platform to catalyse financial support (from USD 5 million to USD 20 million per project) for innovative energy access solutions developed by small-scale independent power producers in Africa
MCC	Burkina Faso Compact II (2020) (Ministry of Mines and Quarries, 2021)	USD 450 million	• Strengthening Electricity Sector Effectiveness Project • Cost-Effective and Reliable Electricity Supply Project • Grid Development and Access Project
Africa Enterprise Challenge Fund (AECF)	REACT EEP (2018) (AECF, n.d.)	USD 5 million	Aims to finance private companies to improve the efficiency of electrification and access to clean and reliable electricity supply for households and small businesses in urban and peri-urban near Ouagadougou through stand-alone solar PV installations
CDC Group	Zina Solaire (COD: 2022) (CDC Group, n.d.)	N/A	26 MWp solar PV plant
Power Africa	BGFA (2020)	EUR 4 million	See description above
Ministry of Foreign Affairs of Denmark	BGFA (2020)	EUR 5 million	See description above
German government	SEFA (2011)	EUR 150 million (AfDB, 2021b)	See description above

Note: MWp = megawatt peak; N/A = data not available.

Table 22: Multilateral energy investments of development finance institutions in Burkina Faso

Institution	Project (Year)	Financing instrument and amount	Project description
African Development Bank (AfDB)	SEFA (2011)	Hosting	See description in Table 21
	FEI (2016) (AfDB, 2016)	USD 20 million*	See description in Table 21
	PARSE (2018) (AfDB, 2018)	USD 21.2 million**	Creates the conditions for inclusive access to energy in Burkina Faso by increasing public and private capital in the sector. Includes four components: 1. Improve the sector's equal and institutional framework 2. Strengthen the governance of the sector's key structures 3. Establish a framework conducive to public and private investments 4. Increase investments in rural areas
	Yeleen (2018) (AfDB, 2019b)	EUR 48.82 million	Aims to develop an innovative rural electrification model through mini-grids that do not require recurrent public subsidies and allow productive use of electricity: installation of 100 mini-grids over two years, powered by an estimated total solar PV capacity of 11.4 MWp, to connect 50 000 households in 100 localities.
World Bank	PASEL (2013) (World Bank, 2019)	IDA credit (USD 165 million)	• Since 2017: Installation of on-grid solar power plants (20 MW in Koudougou and 10 MW in Kaya), realisation of inter-city connections and capacity building for key energy sector actors.
	SOLEER (2021 (GoBF, 2021c)	USD 75 million (IDA) USD 93 million (Clean Technology Fund)	• Increase access to solar energy and mobilise private financing to increase access to electricity. • Support the electrification of 300 localities in rural areas and the connection of 120 000 households, small and medium enterprises, and community infrastructure. • Key investments to strengthen the grid and enable the integration of solar generation and its dispatch during peak demand. • Launch of a competitive tender for 325 MWp of solar with 335 megawatt-hours (MWh) of battery storage to be developed in several phases, with the first phase of 120 MWp with 120 MWh of battery storage to be launched mid-2021.
	ROGEAP (2017) (World Bank, 2021f)	USD 172.5 million credits and grants (IDA) USD 67.2 million grant (Clean Technology Fund)	Improving access to electricity in 19 West African countries through the deployment of solar home systems
	Zina Solaire (COD: 2022) (World Bank, 2017)	EUR 12 million IFC A loan; EUR 10 million IFC senior concessional loan	26 MWp solar PV plant
European Union	ACP-EU Energy Facility (since 2004)	N/A	Support to institutions in the regulation of the energy sector and project financing (20 projects in Burkina Faso: rural electrification)
	Yeleen (2018) (European Commission, 2019)	EUR 6.3 million	Four solar PV plants (Dori, Ouagadougou, Diapaga and Gaoua) for a total of 51 MWp
	Zagtouli (2017)	EUR 22.5 million grant (European Development Fund)	33 MWp solar PV plant
	Zagtouli II (COD: 2024) (Alliance Sahel, 2020)	EUR 23.0 million loan (EIB)	17 MWp solar PV plant
	PACAO-BF (2018) (Chamber of Commerce and Industry, 2020)	EUR 6.0 million	Led to the implementation of the Cluster Solaire to favour synergies among the different actors of the sector in Burkina Faso

Note: N/A = data not available;

* Equivalent to U.A. 14.1 (Exchange rate: 1.41538 – November 2021);

** Equivalent to U.A. 15 (Exchange rate : 1.41538 – November 2021)

Annex 7: Investment opportunities and types

Table 23: Investment opportunities and types – solar projects

Project name and developer	Technical information	Project timeline	Contracting and financing
Matourkou SONABEL	Solar on-grid 14 MW (+ 4 MW storage)	COD in 2024 Recruitment of a consultant to prepare the engineering, procurement and construction (EPC) tender launched in February 2021	KfW identified as the financial partner. There might be a need for co-financing. EPC opportunity.
Kalzi NAANGE	Solar on-grid 38 MW	COD in 2023 Finalisation of the development ongoing. Construction expected to start in the second quarter of 2022.	Build-own-operate-transfer (BOOT) concession agreement, 25-year power purchase agreement
Kaya and Koupela Independent power producer – project not attributed yet	Solar on-grid (120 MW) and storage (120 MWh)	COD expected in 2024. The authorities are currently designing the tender process.	Expected to benefit from financial support from the WAPP and the World Bank
Koupela (2) Independent power producer – project not attributed yet	Solar on-grid (180 MW) and storage (180 MWh)	COD expected in 2026. Feasibility studies by the authorities have started.	Expected to benefit from financial support from the WAPP and SONABEL
Ouaga, Bobo and Balé SONABEL	Solar on-grid (60 MW) and storage (70 MWh)	COD expected in 2027. Ongoing complementary studies (development phase).	Expected financing from SONABEL and the MCC

Table 24: Investment opportunities and types – hydropower projects

Project name and developer	Technical information	Project timeline	Contracting and financing
Ouessa SONABEL	Hydro on-grid 20 MW	COD in 2030. Feasibility study finalised and available.	Expected financing from SONABEL and the Ministry of Water and Sanitation
Gongourou SONABEL	Hydro on-grid 5 MW	Feasibility study finalised and available.	Expected financing from SONABEL
Folozon SONABEL	Hydro on-grid 11 MW	Feasibility study finalised and available.	Expected financing from SONABEL
Bontioli SONABEL	Hydro on-grid 5 MW	Feasibility study finalised and available.	Expected financing from SONABEL.
Bagré Hydro expansion SONABEL / Independent power producer	Hydro on-grid 14 MW	Feasibility study for expansion of the existing Bagré project is expected, with support from the European Union.	Expected financing from SONABEL. Could be developed by an independent power producer. Could receive financing from the government.

Annex 8: Guarantees offered by development finance institutions towards the renewable energy sector

Table 24: Guarantees offered by development finance institutions towards the renewable energy sector in Burkina Faso

Project name and developer	Technical information	Contracting and financing
MIGA (World Bank) (World Bank, 2016b	Political Risk Insurance (PRI)	• Protection for equity sponsors/lenders from political risks (currency inconvertibility and transfer restrictions, expropriation, war and civil disturbance, breach of contract) (MIGA, 2015). • MIGA provides PRI for up to 95% of debt investments and up to 90% of equity for a period of up to 15 years (20 years in special circumstances). • Its pricing is a function of country and project risks and administrative costs associated with the guarantee.
	Non-Honouring of Financial Obligations (NHFO)	MIGA provides credit enhancement solutions by covering the risks of non-honouring of sovereign financial obligations by a host government, state-owned enterprises or public authorities.
IBRD-IDA (World Bank)	Project-based guarantees	• Provided in the context of specific investment projects where governments wish to attract private financing (equity or debt). Can be granted to public or private sector projects. Two types of project-based guarantees exist: 1. Loan guarantee: can be granted to public or private sector projects: it protects private sector lenders/bond investors from debt service default by public sector borrowers or by project companies (due to the failure of a public entity to meet its contractual obligations). 2. Payment guarantee: covers payment defaults of non-loan-related government payment obligations to private entities (recurring payments under a power purchase agreement or termination payments under a concession agreement) via a direct payment guarantee or a World Bank-supported Letter of Credit. • The obligations of the IBRD/IDA are backed by a counter-guarantee and an indemnity from the host government, requiring reimbursement to the IBRD/IDA by the host government if the guarantee is called by the guaranteed party. • IBRD/IDA guarantees only directly cover debt instruments.
AfDB (AfDB, 2022b)	Partial Credit Guarantee (PCG)	• Guarantees partially the debt service obligations of low-income countries and well-performing state-owned enterprises in low-income countries. • African Development Fund (ADF) countries are eligible for PCGs only if they are classified as countries with low risk of debt distress. • The ADF PCG also requires a counter-indemnity from the beneficiary member country in which the country agrees to reimburse the Fund for any amount paid under the guarantee.
	Partial Risk Guarantee	• Protects lenders against specific political risks related to the failure of a government or a government-related entity to honour its commitments. • It consumes a fraction of the country's Performance Based Allocation (PBA) and requires a counter-indemnity from the beneficiary member country, in which the country agrees to reimburse the Fund for any amount paid under the guarantee (AfDB, 2022b).
AFD	Public Payment Guarantee	• Guarantee of payment of the public utility's commitments: issued by AFD to the commercial bank that emitted the letter of credit (available in case of default payment from the public partner). • It covers the entire letter of credit in the event of default by the public partner on the on the repayment contract. • The project company bears the cost of the Public Payment Guarantee (AFD, 2021b).

Project name and developer	Technical information	Contracting and financing
ATI	RLSF	• Mitigates the liquidity risk: ATI selects a bank that issues stand-by letters of credit to independent power producers with the backing of the RLSF. • The amount will enable the independent power producer to continue to operate for at least six months in the event of off-taker default. • The RLSF has two components: 1. Cash collateral 2. An on-demand guarantee (if the cash collateral is exhausted) (ATI, n.d.).
EIB	AEGF (ATI, 2020)	Covers against sovereign or sub-sovereign non-payment under a power purchase agreement, expropriation and breach of contract, currency inconvertibility, war, civil unrest and arbitration award default.

Annex 9: Five privileged regimes (Investment Code, Law 038-2018/AN)

Table 25: Definition of the five privileged regimes

	Investment amount (excl. VAT and working capital)	Permanent positions created	Share of production for export
Regime A	Between XOF 100 million and XOF 500 million	More than 20	N/A
Regime B	Between XOF 500 million and XOF 2 billion	More than 30	N/A
Regime C	Between XOF 2 billion and XOF 25 billion	More than 40	N/A
Regime D	More than XOF 1 billion	More than 30	More than 80%
Regime E	More than XOF 25 billion	More than 100	N/A

Source: Burkina Faso National Assembly, 2018.

Note: For companies in the renewable energy sector, the criteria of investment and job creation thresholds are reduced to a quarter; N/A = data not available.

Table 26: Benefits granted to companies benefiting from one of the five privileged regimes

Regime	Exemptions
Regime A	**Investment stage** • Custom duty: 5% on operating equipment and the first batch of spare parts alongside them • VAT: exoneration on operating equipment and the first batch of spare parts alongside them • Direct taxes: exoneration of corporate income tax (CIT), patents, property tax, employer's and apprenticeship tax, tax on receivable income **Operation stage** • CIT: total exemption for the first two years, 50% deduction from years 3 to 5, full payment thereafter • Patent: exemption from proportional duty for five years • Property tax: total exemption for five years • Employer's and apprenticeship tax: total exemption for five years
Regime B	**Investment stage** • Custom duty: 5% on operating equipment and the first batch of spare parts alongside them • VAT: exoneration on operating equipment and the first batch of spare parts alongside them • Direct taxes: exoneration of CIT, patents, property tax, employer's and apprenticeship tax, tax on receivables income **Operation stage** • CIT: total exemption for the first three years, 50% deduction from years 4 to 6, full payment thereafter • Patent: exemption from proportional duty for six years • Property tax: total exemption for six years • Employer's and apprenticeship tax: total exemption for six years
Regime C	**Investment stage** • Custom duty: 5% on operating equipment and the first batch of spare parts alongside them • VAT: exoneration on operating equipment and the first batch of spare parts alongside them • Direct taxes: exoneration of CIT, patents, property tax, employer's and apprenticeship tax, tax on receivables income **Operation stage** • CIT: total exemption for the first four years, 50% deduction from years 5 to 7, full payment thereafter • Patent: exemption from proportional duty for seven years • Property tax: total exemption for seven years • Employer's and apprenticeship tax: total exemption for seven years

Regime	Exemptions
Regime D	**Investment stage** • Custom duty: 5% on operating equipment and the first batch of spare parts alongside them • VAT: exoneration on operating equipment and the first batch of spare parts alongside them • Direct taxes: exoneration of CIT, patents, property tax, employer's and apprenticeship tax, tax on receivables income **Operation stage** • CIT: total exemption for the first four years, 50% deduction from years 5 to 7, full payment thereafter • Patent: exemption from proportional duty for seven years • Property tax: total exemption for seven years • Employer's and apprenticeship tax: total exemption for seven years
Regime E	**Investment stage** • Custom duty: 5% on operating equipment and the first batch of spare parts alongside them • VAT: exoneration on operating equipment and the first batch of spare parts alongside them • Direct taxes: exoneration of CIT, patents, property tax, employer's and apprenticeship tax, tax on receivables income **Operation stage** • Custom duties: 7.3% on all goods and services imported during 7 years, total exemption on exports of goods produced or processed within the framework of the project (with the exception of the computer fee) • CIT: total exemption for the first seven years on CIT, IRVM and instalments, 15% of CIT from years 8 to 15 • Patent: exemption for seven years • Property tax: total exemption for seven years • Employer's and apprenticeship tax: total exemption for seven years

Source: Burkina Faso National Assembly, 2018.

Annex 10: Grid expansion investment

Table 27: Investors in grid expansion in Burkina Faso

	Objectives	2030
World Bank (PASEL) – 2013	One of the four components of the project: Increasing electricity access, *i.e.* focus on grid expansion and installation of connections in 40 communities	USD 165 million
AfDB – 2016	Electrical infrastructure rehabilitation: • Rehabilitation and extension of medium-voltage / low-voltage lines • Installation of accelerated connections in urban and rural areas and installation • Rehabilitation of the distribution network and installation of prepaid meters	USD 33 million
AFD, EIB and World Bank – 2018	Construction of a 210-km 225-kV interconnection line between Bolgatanga (Ghana) and Ouagadougou	EUR 81 million loan
MCC (Burkina Faso Compact II) – 2020	Grid Development and Access Project (PRAEL): • Support transmission and distribution infrastructure in and between Ouagadougou and Bobo-Dioulasso • Realisation of feasibility studies for regional interconnection	USD 450 million

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