STEAMBIOAFRICA

POLICY ANALYSIS OF NATIONAL ENERGY POLICIES OF BOTSWANA, NAMIBIA AND SOUTH AFRICA

The potential of integrating the SteamBioAfrica clean burning solid biofuel into the countries' renewable energy mix

cscp

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EXECUTIVE SUMMARY

This policy report looks into energy and energy-related policy frameworks in Botswana, Namibia and South Africa to identify challenges, gaps and opportunities to facilitate the commercialisation of the solid biofuel within the SteamBioAfrica project.

Current rising commodity prices are hampering the population's ability to afford basic electricity services. The more unaffordable energy sources, such as electricity and LPG become, the more people will turn to traditional biomass fuels, such as charcoal and firewood. Limited access to modern and affordable energy services is an important contributor to poverty levels and has an important impact on gender equality since women and men are unevenly affected (Feenstra & Özerol, 2021). While some steps have been taken to mainstream gender and inequality issues into energy policies and tackle energy poverty it remains a pressing challenge to effectively integrate social dimensions in policy development and implementation. The lack of such integration will continue to lead to generic policy instruments that disregard and potentially exacerbate injustices among social groups and their access to energy.

Climate change is an additional common challenge to be considered in energy policy. The three counties have committed to cutting GHG emissions, reducing coal dependency and moving toward clean renewable energy. However, their commitments are conditional on receiving external financial support, and especially South Africa and Botswana are still reluctant to move away from coal completely, seeking to exploit their remaining coal reserves using clean technologies. During COP26, Botswana has even opted out of a pledge to stop issuing new coal mining licenses.

In terms of country-specific energy policy approaches, Botswana's primary energy supply sources are oil products and coal along with traditional biofuels and waste. Nearly all of the power generation is coal-based. The country produces about 55% of its own power, while the remaining 45% is imported from the SAPP. Even though existing energy policies recognise the need to transition to a supply system that includes a higher share of renewable energy the country's renewable energy supply is less than 1%. Furthermore, the government keen on exploiting untapped coal reserves to reduce their dependency on coal imports. South Africa follows a similar line, as it is a large coal producer, coal is the country's main energy source. The overreliance on coal is stressing the existing coal power stations and generating a deleterious impact on the environment. Even though South Africa is taking steps into renewable energy, and pledged to decarbonise its energy sector and move towards more sustainable and renewable alternatives, coal remains

in the focus as the main energy source. Namibia however, has taken a different approach. Around 79% of Namibia's energy come from imports, primarily from coal and oil generated in South Africa and Zambia. Namibia's domestic power generation comes mainly from hydropower, diesel, and coal. However, in September 2022 Namibia has launched its National Bush Management Resource Strategy 2022-2027 ensuring that bush resources are utilised in a sustainable and value-added manner and regulating the development of the bush biomass energy sector to ensure social benefits for local population and the integration of environmental standards in the process. Thus, it is to expect that this framework will booster the development and uptake of bush biomass as renewable energy alternatives.

CONCLUSIONS AND RECOMMENDATIONS

Energy and energy-related policy frameworks in Botswana, Namibia and South Africa encounter common challenges related to raising energy and commodity prices, targeted affordability and social and gender mainstreaming, regional integration and licensing.

In the current context of rising commodity and energy prices is affecting people's ability to afford basic energy services and debilitating energy security worldwide, including in Botswana, Namibia and South Africa. As this represents a big challenge for governments in the countries, it also represents an opportunity to facilitate the uptake of the solid biofuel, as an affordable clean and renewable energy alternative. With rising energy prices, SMEs and low-income households are struggling to cover their basic energy needs. This has an important effect on both energy security and economic development. As the access to modern forms of energy is linked to economic growth, the lack of adequate and affordable energy services is linked to poverty. Policy frameworks in Botswana, Namibia and South Africa tackle energy poverty, however regional and domestic energy policy frameworks have fallen short in integrating targeted affordability and mainstreaming gender and inequality issues . To expand access to clean energy and tackle energy poverty through the commercialisation of the solid biofuel, energy policies need to explicitly acknowledge and address social disparities within existing economic structures and prioritise vulnerable groups throughout the value chain and among end consumers.

Existing initiatives, structured around for example the Southern African Power Pool (SAPP), provide necessary building blocks for regional integration that would help countries meet their energy challenges, particularly in terms of energy security. However, to foster regional integration and achieve sustainable development in the long run, Member States' regulating bodies need to be better coordinated, increase their decision-making freedom and strengthen their capacities, particularly in terms of implementation, The ambition of regional integration should be to harmonise frameworks and focus on generating energy security and supporting the green energy transition.

For the development and commercialisation of new energy products such as the solid biofuel, the national energy regulating bodies need to issue licences in each of the countries. For this purpose, a working group, that will work to develop a framework for sustainable bush harvesting practices, product incentives and

subsidies, certifying procedures, etc. Ensuring a broad stakeholder engagement amongst the spheres of government, industry and consumer stakeholders is essential in the process of developing the new regulatory frameworks.

Finally, besides the above-presented common challenges of energy policy frameworks in the three countries, there are important differences in the approach of the energy policy frameworks. These differences are mainly related to the domestic energy strategies.

While formally policies recognise the importance of transitioning towards a greener energy mix and highlight the need to increase the production and uptake of renewable energy alternatives, South Africa's and Botswana's energy strategies are still largely entrenched in a coal-based energy system. Within the South African government, the acknowledgement that coal mining is a declining industry doomed to face an inevitable crisis is progressively growing. The realisation of the need for decarbonization of the economy is starting to assume traction. The government is currently developing the Strategic Framework for an Alien and Invasive Biomass Economy in South Africa aiming to tackle invasive and encroaching bush species and potentially use the woody biomass as a source of renewable energy. Nonetheless, the Department of Mineral Resources and Energy (DMRE) and other public stakeholders still hold on to ideas of clean coal technologies and underground coal gasification, which indicate an enduring commitment to coal as a source of primary energy. On the other hand, even though Botswana has Biofuels Guidelines in place, their focus seems to be merely on liquid biofuels. Nevertheless, as Botswana has important untapped coal reserves, the country is keen to increase its coal production in the upcoming years in order to become less dependent on South African coal imports and to increase its own exports. However, these plans are incompatible with efforts and pledges to combat climate change. In contrast to South Africa and Botswana, Namibia has shown a strong drive to foster the development of the bush biomass energy sector by addressing the invasive and encroaching bush problem. Namibia has launched a National Bush Management Resource Strategy (2022-2027) to ensure that bush resources are utilised in a sustainable and value-added manner and to regulate the development of the bush biomass sector. The launch of this strategy is an indication of Namibia's efforts to increase the share of biomass-based energy as a renewable alternative while tackling a fundamental land degradation problem. At the same time, Namibia's strategy offers a great opportunity for the SBA project and the commercialisation of the solid biofuel.

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INTRODUCTION 1

As part of the SteamBioAfrica project, this report offers an overview of the policy and regulatory framework relevant for the commercial deployment of the innovative superheated steam (SHS) technology. The technology turns woody biomass from native and invasive bush species into a clean and affordable solid biofuel. It is initially targeted for commercial post-project deployment in Botswana, Namibia and South Africa. The objective of this paper is to identify and assess existing policies and regulations in the three countries and pinpoint gaps as well as opportunities that lie within the existing policy frameworks. The end goal of this report is to facilitate the wide-scale commercialisation of the SHS solid biofuel. The report also seeks to provide a policy recommendation and identify decision makers that can contribute to an alignment of the SBA project objectives with the national objectives of the three countries.

1.1 PROJECT BACKGROUND

Countries across Southern Africa are increasingly suffering from the encroachment of native bush overgrowth and invasive species. This unwanted woody biomass competes with other vegetation for water, contributes to soil erosion, reduces livestock and wildlife carrying capacities and threatens natural habitats and local savannah ecosystems. However, the cost to control bush often exceeds the immediate benefits of increased agricultural productivity. Hence, there is a pressing need to increase the value of the harvested bush.

With the support of the European Union's Horizon 2020 Programme, the SteamBioAfrica project was launched in September 2021. It involves an EU-Africa industry research collaboration of fifteen partners working together. SteamBioAfrica seeks to tackle this crisis caused by undesirable overgrowth by creating more value from biomass than the harvesting costs. This ambition will also help to address other environmental and societal challenges in the region, such as the impact of climate change, energy and food insecurity, water shortages, social inclusion and unemployment. This will be achieved by transforming the bush and invasive plants into a clean-burning solid biofuel, water and other chemical by-products.

The SteamBioAfrica project involves an innovative application of SHS technology under mild pyrolytic conditions (torrefaction) to transform woody biomass into a solid fuel with a higher calorific value that burns with less harmful emissions. The process also produces a condensate that is rich in phytochemicals and water. The project strives to realise a wide replication of SHS technology at a commercial scale. This will lead to improved access to high-value, clean, secure, and affordable

renewable energy sources in Namibia, Botswana, South Africa and beyond. Not only that, this new source of renewable energy will promote sustainable harvesting and land management as well as stimulate effective land restoration.

A business plan has been included in the project's initial Plan for Dissemination and Exploitation of Results (PDER). It is estimated that within ten years after the project completion, Southern Africa will have an SHS processing and operating capacity of 300 tonnes/hour. This would result in over 6,000 km2 of restored land (7.6 million tonnes CO2eq saving), between 2.7-3.5 million tonnes of clean-burning solid biofuel (9.2 million tonnes CO2eq saving), 1,900 km3 of recovered water and 6,800 new jobs.

1.2 OBJECTIVES WORK PACKAGE 10

The main objective of Work Package 10 (WP10) is to identify existing biomass value chains that can be deployed for the SHS solid biofuel commercialisation, which in turn will enable large-scale implementation of SHS technology. This will involve:

- Mapping the downstream value chain of the biomass sector and identifying impact groups and intervention areas for biofuel commercialisation.
- Creating a pool of local workforce with the skills required to support the long-term feedstock supply of the SHS technology in Southern Africa.
- Identifying viable sustainable business models that will support the commercialisation of solid biofuel in local markets. This will focus on micro, small- and medium-sized enterprises (MSMEs), women-led enterprises, and job creation.
- Engaging locally with government and policymakers to identify policies that will support the project implementation and its long-term impact.
- Identifying financial instruments that can support local implementation of and sustain the project results long into the future.

To sum it up, partners involved in WP10 seek identify new business models, develop value chains and identify financial tools for the commercialisation of the solid biofuel.

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Work Package 10 is closely linked to Work Package 9 (WP9). WP9 aims to assess the potential market for solid biofuel generated by the SHS technology in the domestic household sector. WP 9 focuses on identifying factors that influence consumer behaviour and market acceptance of solid biofuel. In addition, WP9 identifies and engages strategically with key value chain actors in the three participating African countries, across rural, urban, and peri-urban areas to create local demand and markets.

This report is a deliverable (D10.3) under WP10, which aims to analyse existing policies and regulations of renewable energy and technologies in the three target countries. The objective is to identify entry points in the three countries' policy and regulatory frameworks for a wide-scale replication of the SHS technology in Botswana, Namibia and South Africa. Moreover, the report intends to identify and establish contact with key policy and decision-makers relevant to the commercialisation of solid biofuel.

1.2.1 Methodology

The report uses qualitative methods in its data analysis. The main sources of data collection are interviews with key informants and reviews of documents and grey literature. The collected qualitative data went through a process of triangulation to gain different insights about the same phenomenon and to complement and validate the gathered information. The data were assessed to identify gaps and opportunities for the deployment of SHS technology and commercialisation of the solid biofuel.

Interviews with key informants

Key informant interviews were conducted online (using Zoom) by the project partner CSCP, using informal and semi-structured formats. The interviews took place in July and August 2022. In total 3 interviews took place with policy experts and key informants from Botswana and Namibia. The interviews ran between 30-45 minutes. Experts and key informants provided insights on existing regulation and policy frameworks related to several topics such as energy (renewable energy, access to energy, clean energy and energy transition), carbon markets, nationally determined contributions (NDCs), bush encroachment and other topics relevant for the commercialisation of the solid biofuel. Moreover, the informants helped identify relevant policy-makers in the three target countries for policy dialogue and engagement in the future.

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Review of documents and grey literature

By reviewing a variety of published literature, additional data was collated. The source of information included reports and newspaper articles as well as grey literature. This covered country- and region-specific documents and literature on topics such as:

- Renewable energy,
- Green transition,
- Access to clean and affordable energy sources,
- Socio-economic context and energy poverty,
- Energy security,
- Bush encroachment and biomass overgrowth,
- GHG emission and carbon markets,
- NDCs and sustainable development goals (SDGs)

Ethics

The data collection of this report was carried out in compliance with the project's ethical framework that was established in Work Package 13 (WP13). Interviewees were well-informed of the purpose of the study and how the collected data would be used. Interviewees were informed that their participation was completely voluntary (free informed consent) and that they had the option to opt out of the interview at any time. Other data collection methods did not involve external participants.

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2.1 ECONOMIC CHALLENGES AND ACCESS TO CLEAN ENERGY

In sub-Saharan Africa, the global outbreak of the COVID-19 pandemic has led to its first recession in 25 years, setting back progress in economic and social development. The crisis has worsened many already existing challenges, it has increased socio-economic inequalities, disrupted supply chains, stagnated infrastructure development and led to political instability.

In South Africa, Namibia and Botswana the GDP growth for 2020 decreased by 6%, 8% and 8% respectively. The subsequent surge in commodity prices as a fallout of Russia's invasion of Ukraine is making matters worse for many resource-poor and import-dependent countries in sub-Saharan Africa (IEA, 2022a). In 2019, about 38,3% of the population in sub-Saharan Africa (SSA) was living in extreme poverty (The World Bank Group, 2019). Estimations of the World Bank indicate that the crisis and inflation caused by the pandemic and Russia's invasion of Ukraine will drive another 25 million people in SSA into extreme poverty. The consequences of Russia's invasion of Ukraine are felt in the prices of many commodities, including prices of LPG and electricity, and prices of natural gas-based fertilisers, which further threaten food security in many import-dependent countries. In general, Africa is highly sensitive to global price fluctuations of food commodities, since it is heavily dependent on imports. It is estimated that the African continent imports more than 30% of its cereal demand (IEA, 2022a).

Access to modern forms of energy is indispensable for overcoming poverty and promoting economic growth

In recent years countries in SSA have experienced a rise in extreme poverty. The trend has been initially triggered by the COVID-19 pandemic and has been accelerated by Russia's invasion of Ukraine, which has caused global inflation. This development has drastically hampered the population's ability to afford basic electricity services. Thereby, the region's access to clean energy and overall energy security has been affected. According to reports, in 2021, around 390 million people, approximately equivalent to three-quarters of the population in SSA that already have an electricity connection, were unable to afford an extended bundle of electricity services. In addition, about 150 million people were unable to afford even an essential bundle of electricity services. Some places are facing energy price increases of 100% - 200% in relation to prices in 2019. Energy security will further be threatened when some of the African governments currently subsidising energy sources remove subventions to reduce escalating burdens (IEA, 2022a). The more unaffordable energy sources, such as electricity and LPG become, the more people will turn to traditional biomass fuels, such as charcoal and firewood. Thus, especially in the current context of spiking energy prices, to expand access to clean energy, targeted affordability is key.

2.1.1 Energy poverty and gender

In the Global South, scholars refer to energy poverty as inadequate access to affordable modern and/or sustainable energy services. Scholars in the Global North tend to use the term fuel poverty to refer to insufficient economic resources to cover energy needs, measured through affordability. The UNDP has a wider encompassing definition for energy poverty, by understanding it as the inability for households to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read or for other household and productive activities at sunset" (Modi et al., 2006, p. 9).

Either understanding of the term is linked to energy vulnerability, where individuals become incapable of securing, socially and materially, the level of energy service required in the home (Castaño-Rosa et al., 2019). Households can face various degrees of vulnerability depending on their exposure, sensitivity and adaptive capacity. Especially under the current context of rising energy prices, energy poverty is one of the biggest challenges worldwide, severely affecting the most vulnerable members of society.

Access to modern forms of energy is indispensable for overcoming poverty, promoting economic growth, expanding employment opportunities, supporting the provision of social services, and fostering human development. The Sustainable Development Goals (SDGs), specifically SDG7, aim to ensure access to affordable, reliable, sustainable and modern energy for all. To maintain economic growth, ensure energy security and reduce energy poverty, availability, affordability and reliability are three important indicators of access to energy services. However, as access to modern forms of energy is linked to economic growth, the lack of adequate and affordable energy services is linked to poverty. Limited access to modern and affordable energy services is an important contributor to poverty levels, particularly in SSA. For instance, access to modern forms of energy greatly improves the quality and availability of educational services and increases the probability of children attending and completing schooling. Moreover, access to clean and affordable energy options has also an important impact on gender equality. Women and men are unevenly affected by limited access to energy services in society as well as within households. This tends to be reflected in school enrolment of girls and the engagement of women in economic activities, especially in rural areas (Feenstra & Özerol, 2021).

Presently, 842.47 million people in SSA have no access to clean energy to cook. About 87% of these 842.47 million people without access to electricity are located in rural areas, and most of them are composed of female-headed households.

Reports indicate that when energy is scarce, the girl child over the boy child is burdened with providing the energy, which tends to lead to them withdrawing from school and becoming illiterate. Illiterate women usually have more children, and larger and poorer families reinforce the cycle of poverty (Fatona et al., 2013). While for poor people, the energy problem is mainly associated with a lack of energy, for women it is further burdened by social dynamics, power relations and lack of access and control. Women in countries of the Global South spend between 2–9 h a day collecting fuel and fodder and performing cooking-related chores. Thereby women tend to forego opportunities to actively engage in income-generating activities (SEA, 2017). Thus, socially determined gender roles assigned to girls and women generate proportionally a higher burden of energy services and energy use inefficiency (Fatona et al., 2013).

It remains a global challenge to integrate the social dimensions and address existing inequalities in energy policy. The lack of such integration has led to generic policy instruments that disregard and potentially exacerbate injustices among social groups and their access to energy.

2.2 SUSTAINABLE DEVELOPMENT GOALS (SDG) AND NATIONALLY DETERMINED CONTRIBUTIONS (NDC)

Reducing GHG emissions and 'ensuring access to affordable, reliable, sustainable and modern energy for all' (SDG 7) are pressing global challenges declared in the Sustainable Development Goals and the Paris Agreement, respectively (UN, 2021; UNFCCC, 2022)To achieve these goals, national policies need to define strategies to deliver relevant outcomes.

Africa is a minor contributor to global climate change. It generates less than 4% of the global CO2 emission today and accounts for the lowest emissions per capita in the world. Nonetheless, many African governments have made commitments toward international climate and environmental goals, including ambitious pledges to cut GHG emissions and a move towards clean and renewable energy, while ensuring energy security.

At the core of the Paris Agreement on climate change, adopted in 2015 by 196 parties at the COP21 in Paris, are the Nationally Determined Contributions (NDCs). The NDC embodies the efforts of individual countries to reduce domestic GHG emissions and take action to mitigate and adapt to the impacts of climate change. As of May 2022, 53 of 54 African countries have submitted their NDCs on

climate change to the United Nations Framework Convention on Climate Change (UNFCCC). If fully implemented, these countries would collectively mitigate about 550 Mt CO2 by 2030, which is equivalent to 40% of Africa's emissions today.

The NDCs submitted by African countries vary significantly in terms of their specificity and coverage. While many are merely aspirational and do not set concrete targets for emission reductions, most NDCs set conditional mitigation and adaptation targets. Conditional targets involve requests for economic, financial and technical capacity-building support from more advanced economies, which amounts to USD 1200 billion in the period to 2030. The requested support exceeds pledges made by advanced economies to provide USD 100 billion annually to low- and middle-income countries from 2023.

During COP26, new and more ambitious commitments on climate change and pledges aiming for net zero emissions were reached. South Africa has committed to decarbonise its economy and phase down coal use, while twelve African countries have announced long-term net zero emission pledges, aiming to reach carbon neutrality between 2050 and 2070, including South Africa and Namibia (IEA, 2022a). Table 1 shows the type of NDC targets set by Botswana, Namibia and South Africa as well as pledges made to reach climate neutrality. Namibia and particularly South Africa seem to be highly committed to cutting GHG emissions, reducing coal dependency and moving towards clean renewable energy. However, many NDCs, including South Africa's are conditional on receiving international support.

Country	Type of NDC targets	Sectors covered by targets	Pledges of net zero emissions
Botswana	Unconditional	• Energy, • Waste, • Agriculture, forestry and land use	No
Namibia	Unconditional & conditional	• Energy, • Waste, • Agriculture, forestry and land use, • Industrial processes and product use	Yes, by 2050
South Africa	Conditional	• Energy, • Waste, • Agriculture, forestry and land use, • Industrial processes and product use	Yes, by 2050

Table 1 *NDCs and net zero emission pledges in selected African countries (IEA, 2022a)*

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As one of the 10 largest coal producers in the world, South Africa relies heavily on coal for its energy production. About 80% of its domestic energy comes from coal and 30% of that energy is exported. It is estimated that the coal industry generates around 80,000 jobs in South Africa. Nonetheless, during the COP26, South Africa agreed to reduce its dependence on coal and fast track towards renewable energy after the USA, UK, France, Germany, and the European Union agreed to grant South Africa a USD 8.5 billion to help South Africa reach its targets and fund its transition away from coal (Adnane, 2021; IEA, 2022). As is the case with South Africa, in many sub-Saharan countries, financial support from advanced economies plays an essential role in the implementation of NDCs and can boost efforts to reduce GHG emissions of the energy system. In July 2021, Namibia submitted its revised NDC to the UNFCCC, which defines a number of ambitious mitigation and adaptation actions to tackle climate change. The Namibian government estimates it will require approximately USD 5.33 billion to implement its NDC. Out of the estimated amount 10% will be provided through the national budget, while 90% will rely on international support (Triple Capital, 2021). However, Botswana took a different approach during COP 26. It officially committed to moving away from coal and moving into clean power but opted out of a pledge to stop issuing new coal mining licenses. Botswana has more than 200 billion tonnes of untapped coal resources and minerals. Local authorities have been explicit regarding their intention to exploit these resources using clean technology, within the three-decade window provided by global climate change commitments (Botswana Mining Review, 2021).

Women and men are unevenly affected by limited access to energy services in society as well as within households

2.2.1 Climate Finance

Coined under "climate finance" is local, national and transnational financing that aims to support mitigation and adaptation actions that tackle climate change. The Paris Agreement requires the developed countries to financially assist the less endowed and more vulnerable countries in the implementation of climate change action, including efforts to reduce GHG emissions. Resources can come from private and public funds (UNFCCC, 2022a). This is based on the so-called "climate equity" principles, which imply that governments of emerging economies should not have to bear the whole climate adaptation costs, given their marginal contribution to cumulative global emissions to date (IEA, 2022a).

A total of 48 African countries have requested over USD 1,200 billion of international support by 2030 to implement their NDCs. Out of 48, only 14 countries have specified their concrete emission outcomes associated with actions for which they

request financing. Thus, there is a need for clarification about sectors that will benefit from the financing, as well as an indication of the expected GHG emission reduction that results from the climate actions.

Climate finance does not necessarily have to come from countries. There are multiple sources of capital to fund Africa's climate change actions and energy transition. Compliance and voluntary carbon markets are expanding the opportunities and creating schemes to promote and fund the reduction of global GHG emissions.

2.2.2 Carbon Markets

Currently, the carbon industry is composed of two types of carbon markets: voluntary and compliance markets. Voluntary markets are established by private companies, by developing and operating their marketplace to enable transaction of carbon offset. This type of market is based on incentives and enables individuals and private entities to buy carbon offsets or credits on a voluntary basis. In contrast to voluntary markets, compliance or mandatory markets are usually established by governments to target particular industry sectors and tackle specific sources of GHGs. To do so, the government places caps on GHG emissions, to which the industry or source emitters are compelled to offset their emissions to. In such a market, emitters are assigned emission permits or allowances to meet the established cap limits, which, if that are unused, can be traded with other emitters or financial institutions to make a profit (Brown, 2021). While most carbon markets are currently voluntary, projects to develop compliance markets, carbon taxes and carbon regulation schemes are increasingly developing around the globe. The Biden Administration has announced plans to develop a carbon border tax and the EU is developing mechanisms to avoid carbon leakage (Clifford Chance, 2021a).

As part of the European Union (EU), Green Deal and efforts directed to address climate change, the European Commission (EC) is intending to launch a new carbon border adjustment mechanism (CBAM) to tackle the issue of carbon leakage (Clifford Chance, 2021b). The goal is to avoid EU companies from moving their carbon-intensive production to other countries to elude EU regulation and benefit from lower standards or avoid EU companies from importing cheaper, more carbon-intensive products. The CBAM is part of the proposed measures of the 'Fit for 55' initiative launched in 2021, which targets the reduction of 55% of GHG emissions by 2030. It introduces a tariff on all products imported into the EU that are produced under lower environmental standards elsewhere. Thereby, importers in the EU will have to buy carbon certificates to make up for the carbon

price that would have been paid for the production of the goods under EU carbon pricing regulation. However, if a producer outside of Europe can demonstrate that the carbon for the production of the goods has already been paid for, the corresponding costs can be fully deducted from the EU importer. The EC aims to incentivise foreign producers to adopt greener practices in their production processes. The CBAM will initially cover five sectors (iron, cement, aluminium, fertiliser and electricity generation) but will eventually be extended to other 63 sectors after 2026. The CBAM will have implications on the global carbon market, trade and international competitiveness. However, carbon markets and carbon market tools offer a great opportunity for sub-Saharan countries to capture funds for the transition towards clean and renewable energy and to meet their NDCs

2.3 AFRICA AND THE EU GREEN DEAL

The European Green Deal was announced by the EC in 2019. It represents the new growth strategy for the EU and aims to transform the continent into a climate-neutral, fair and prosperous society with a modern, resource-efficient and competitive economy. As the overarching goal is to become the first climate-neutral continent by 2050, the decarbonisation of the energy system and energy efficiency are at the core of the framework. Currently, about 75% of the GHG emissions in the EU are related to energy production and use.

To support the transition to clean energy, various activities are being carried out to promote renewable energy and innovative technologies as well as modern infrastructure, including the promotion of EU energy standards and technologies at a global level (EC, 2019). In this context, research and innovation projects are being funded to respond to the climate crisis. In 2020, a call for proposals with a value of EUR 1 billion was launched under the Horizon 2020 programme, focusing on the EU Green Deal and covering ten different thematic areas. Thematic area II has a focus on clean, affordable and secure energy. It includes “accelerating the green transition and energy access – partnership with Africa” as one of the themes, which is in line with Action I of the new Comprehensive Strategy with Africa (EC, 2021).

In its “Joint Communication for a Comprehensive Strategy with Africa”, the EC emphasises the importance of partnering with the African Union (AU) in order “to tackle together the challenges of the 21st century” and where developing a green growth model is of common interest (EC, 2020, p. 1). The action aims to build a partnership for a green transition and access to energy to enable a low-carbon, resource-efficient and climate-resilient future, in which access to technologies and their local adaptation through innovation is key. These will include supporting

the implementation of nationally determined contributions (NDCs), green finance partnerships, the establishment of a 'Green Energy Initiative' and implementation of recommendations of the High-Level Platform on Sustainable Energy Investment in Africa (EC, 2020).

2.4 REGIONAL ENERGY INTEGRATION AND TRADING

The Southern African Development Community (SADC) was founded in 1992 as an inter-governmental organisation focused on regional socio-economic cooperation and integration as well as political and security cooperation. It encompasses 16 countries in southern Africa, including Botswana, Namibia and South Africa (SADC, 2018).

Recognising the fundamental role of energy in achieving economic growth and development, SADC has developed a series of legal and institutional tools for regional energy integration and cooperation among the SADC Member States (see Figure 1) (Gaylor & Bhavna, 2017). Overall, SADC region has allowed SADC Member States to easily sell and buy surplus electricity from each other, thus helping some Member States to meet their rising demand for energy (SADC, 2018). Some of the most relevant of these tools are the Southern African Power Pool (SAPP), the Protocol on Energy and the Regional Electricity Regulators Association of Southern Africa (RERA).

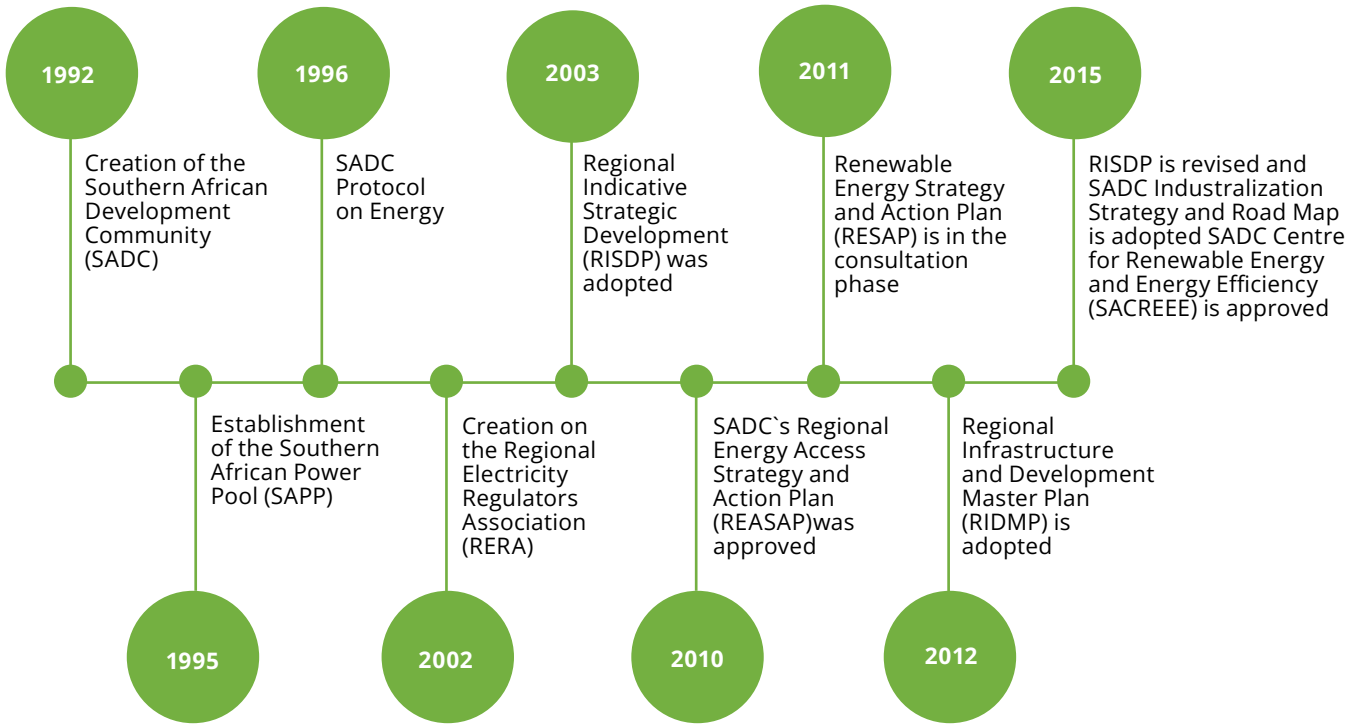

Figure 1 *Timeline of regional cooperation and energy integration in SADC (Gaylor & Bhavna, 2017:14)*

REGIONAL SOCIO-ECONOMIC CONTEXT AND INTERNATIONAL POLICY FRAMEWORK

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The **Southern African Power Pool (SAPP)** was established in 1995 by SADC member governments (with the exception of Mauritius) through a Memorandum of Understanding to improve access to energy for rural communities through environmentally friendly and cost-effective solutions. It consists of a 12-member regional body that coordinates the planning, generation, transmission and marketing of electricity on behalf of Member State utilities in SADC. The power utilities of most of the SADC Member States are interconnected through SAPP, enabling them to sell energy to one another through a competitive market. Through the SAPP, significant progress has been made regarding the implementation of the power trading system in the region. It offers flexibility for countries to be able to turn off some of their power generation stations to do maintenance work without cutting off power for its consumers. Since power generation stations can buy surplus power from other regional countries, power traded on the market has decreased load shedding (SADC, 2018). However, since 1999, the SAPP has struggled to provide sufficient generation capacity due to rapidly increasing power demand (SAPP, 2022). In 2017, the SAPP Plan was adopted with generation projects and priority interconnection investments for the period 2018-2039.

The **Protocol on Energy**, promotes the harmonious development of national policies and matters of common interest for the balanced and equitable development of energy security throughout the region, particularly through data and information exchange. Accordingly, SADC's Directorate for Infrastructure and Services has the vision to ensure the availability of sufficient, least-cost, environmentally-sustainable energy services in the region (Gaylor & Bhavna, 2017).

Adapted from two key SADC energy instruments, the **Regional Energy Access Strategy and Action Plan (REASAP)** and the **Regional Infrastructure Development Master Plan (RIDMP)**, set regional targets for up to 2030 and aim to increase energy access and security, foster socio-economic development and enhance environmental sustainability (SADC, 2016).

The Revised Regional Indicative Strategic Development Plan (RISDP) 2015-2020 further supports the development of sufficient, reliable, and least-cost energy service, notably through greater cooperation, interconnectedness, power pooling and the connecting of national electricity grids. In addition, the 2015 Industrialisation Strategy and Roadmap 2015-2063 stresses the need to address energy security concerns to underpin the success of the industrialisation strategy (Gaylor & Bhavna, 2017).

REGIONAL SOCIO-ECONOMIC CONTEXT AND INTERNATIONAL POLICY FRAMEWORK

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The SADC Renewable Energy and Energy Efficiency Strategic Action Plan (REEESAP) spans the period 2016-2030 and offers a framework for member states to develop renewable energy strategies, leading to greater uptake of renewable energy resources as well as mobilisation of financial resources for the sector. It is to be implemented by the Energy Division of the SADC Secretariat and SACREEE through national action plans. Furthermore, REEESAP is intended to highlight the added value of a regional approach to exploit economies of scale and synergies among SADC members (IRENA, 2021).

The **SADC Centre for Renewable Energy and Energy Efficiency (SACREEE)**, was established in Namibia as a regional platform to promote the implementation of the REEESAP. The establishment of the centre was a key milestone towards attaining the United Nations Sustainable Development Goal No.7 (SDG7) which aims at access to affordable, reliable, sustainable and modern energy for all. The core objectives of SACREEE are to contribute toward increased access to modern energy services and improved energy security across the SADC region through the promotion of market-based incentives for the uptake of renewable energy and energy efficiency technologies and systems. SACREEE has also taken up efforts to mainstream gender issues in energy policies and programs in the region. It is working with the National Renewable Energy Laboratory (NREL) to develop a strategy to address gender disparity and promote women in the value chain of the sustainable energy sector (SADC, 2018).

In 2002, the Ministers of Energy agreed to form the **Regional Electricity Regulators Association of Southern Africa (RERA)** to harmonise the regulatory framework as well as provide a conducive environment for investment in the region's power sector. The association set its efforts towards the harmonisation of national regulatory systems with regulatory guidelines, approved by the SADC Energy Ministers. The guidelines aim to ensure that efficient cross-border transactions are not limited by imprecise or complex processes for making regulatory decisions. The guidelines however focus on large-scale/long-term transactions, which are more likely to influence investment decisions, the efficiency of electricity interconnections, and electricity trade in the region (Gaylor & Bhavna, 2017; SADC, 2018). It is important to highlight that these guidelines are merely voluntary and have no formal legal status for the SADC member states. In practice, the RERA is predominantly a platform through which national regulators share their experiences.

Critics have highlighted that the SADC energy regulation is still relatively incipient in the region and lacks capacity and skills at a domestic and regional level. "Energy policy appears fundamentally inadequate, with long-term planning being largely

outdated in time and best practice, and lagging in implementation. Furthermore, regulators lack independence and remain pray to regulatory capture and political pressure" (Gaylor & Bhavna, 2017:42). Nonetheless, existing initiatives, structured around the SAPP and the RERA, provide important building blocks for regional integration and offer support to individual countries to meet their energy challenges. Nonetheless, this task should not be allocated to utilities and regulatory bodies alone. Domestic and regional institutions need to step up to achieve inclusive governance in the sector and leverage individual countries' experiences. After all, regional integration is not an end in itself, but a means to achieve a sustainable development pathway in the region (Gaylor & Bhavna, 2017).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

3

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

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3.1 BOTSWANA

Botswana is one of the members of the Southern African Development Community (SADC) and has been considered a stable middle-income democracy since its independence in 1966. Being an arid to semi-arid country, Botswana is landlocked in the centre of southern Africa and borders Namibia to the west, South Africa to the south, Zimbabwe to the east and Zambia to the north. It has an area of about 600,000 square kilometres, is topographically predominantly flat, with about 70% of its territory covered by the Kalahari Desert. At present, the population is about 2.35 million, of which 30% live in rural areas. Although the country exhibits a stable democracy with a solid economy, it is still one of the most income-disparate countries in the world, with a GINI index of 0.605 and an unemployment rate of 21% in 2020 (CSCP, 2022; WBG, 2022b).

In Botswana renewable energy sources such as wind and solar energy have roughly tripled since 1990 but they do not account for even 1% in 2019

Since its peaceful independence from Great Britain in September 1966, Botswana has been considered a flagship country with a multi-party democracy offering the best ranking among African countries in Transparency International's Anti-Corruption Index by ranking in the top quarter of least corrupt countries worldwide (TI, 2022). Furthermore, Botswana's economy is still heavily dependent on diamond mining and export, but the country succeeded in directing the returns from diamond production into the development of a health care system and gradually started to diversify its economy (Sandner, 2017). Since 2000, Botswana's GDP has close to tripled (IRENA, 2021).

Within the energy sector, Botswana is overly dependent on fossil fuels such as coal and oil, sourced partially from domestic sources, but also imported from neighbouring countries, particularly South Africa. Although renewable energy sources such as wind and solar energy have roughly tripled since 1990, they do not account for even 1% in 2019 (see Figure 2). The total energy supply from coal, on the other hand, almost doubled from 2010 to 2015 (increase of about 97%) and has remained at a similar level since then.

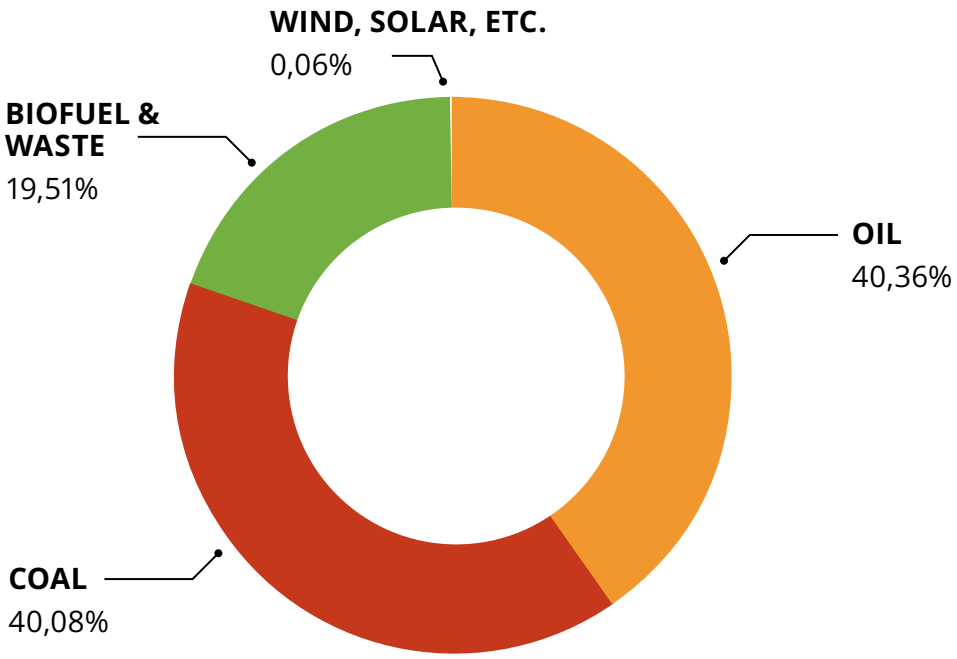

Figure 2 *Total (primary) energy supply in Botswana broken down by source (2019)(IEA, 2022b)*

In Botswana, the transport sector is the largest consumer of energy, accounting for about 45% of the country's total energy consumption. Other major consumers of energy are the residential sector, the industry sector and, to a lesser extent, the commercial and public services sector. They account for about 31%, 15% and 5% respectively (see Figure 3). Apart from this, total household access to electricity is estimated to have increased from 70% in 2019 to 72% in 2020 (WBG, 2022a).

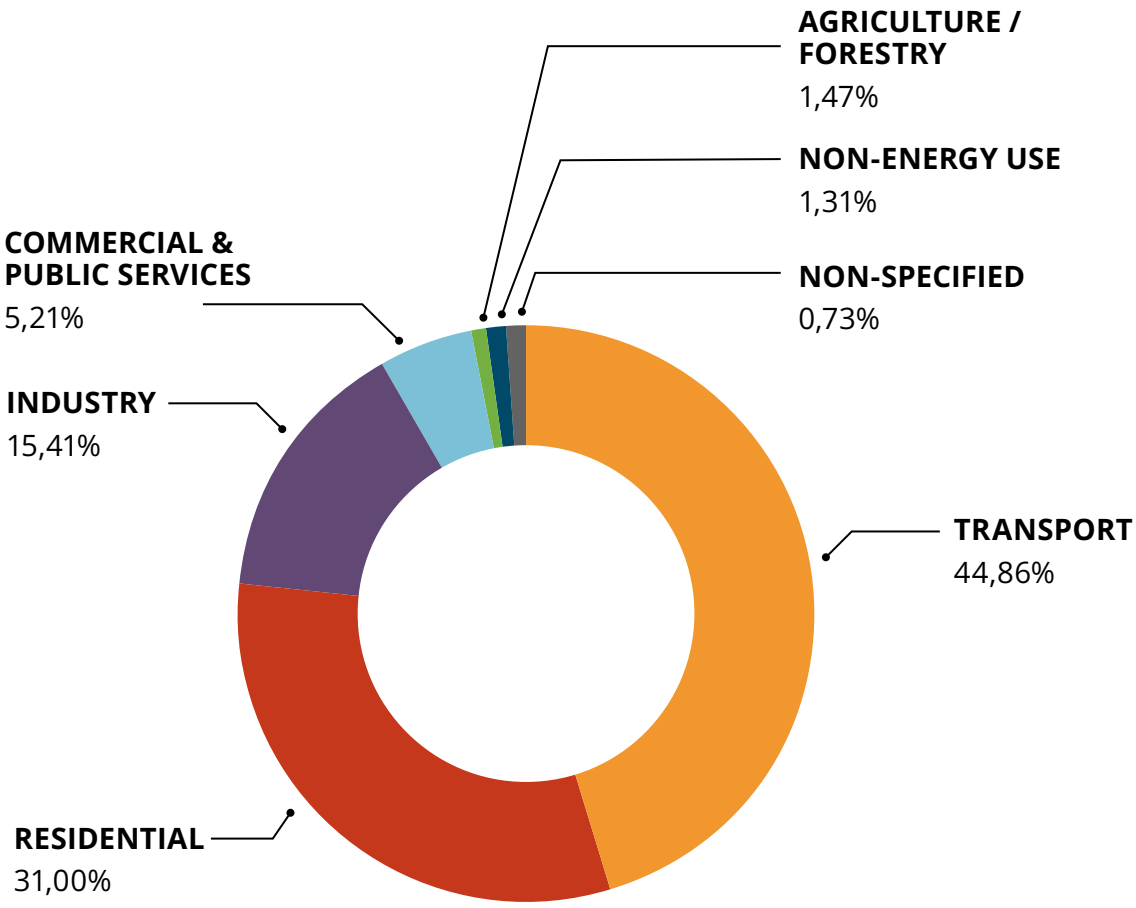

Figure 3 *Total Energy consumption in Botswana per sector (2019) (IEA, 2022b)*

3.1.1 Governance and general policy landscape

Botswana's form of government is that of a presidential republic. Parliament is elected every five years on a majority voting system and is the supreme legislative authority in the country. According to the electoral law, 57 members of parliament are elected directly in as many constituencies, six members are elected indirectly with presidential nomination and confirmation by parliament, whilst two members, namely the president and the attorney general, are elected ex officio. Both parliament and the country's current fifth president were last elected in October 2019. Thus, Head of State and Government Dr. Mokgweetsi Eric Keabetswe Masisi, who belongs to the Botswana Democratic Party (BDP) and has been acting president since April 2018, was confirmed in office. The president is elected by the parliament and may officially hold office for up to ten years. As of 2024, the next elections will take place (Auswärtiges Amt, 2021; bpb, 2022).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

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Gender equality and equity has been on Botswana's development agenda since 1981, but there has been little progress so far. Moreover, women are poorly represented at the political decision-making level: In the last elections in 2019, only three out of 57 seats in the National Assembly went to women, representing a decline in women's representation in political leadership positions (Dube, 2019). Although women play an important role in the energy sector and policy makers have started to address their inclusion, a study conducted by the Gender and Energy Network of Botswana (GENBO) found that the sector still pays little attention to gender equality and that energy programmes and policies do not yet sufficiently address gender issues (BPC, 2011).

In general, Botswana's energy supply system remains volatile, investments and maintenance costs are low, while the service costs are high (IRENA, 2021). Primary energy supply sources are oil products and coal along with (traditional) biofuels and waste. Nearly all of the power generation is coal-based, with the country producing about 55% of its own power, while the remaining 45% is imported from the SAPP (Statistics Botswana, 2022). Thus, the country is currently overly dependent on coal-fired electricity, supported by diesel power plants (Matshelagabedi and Orapa) and unreliable electricity import from South Africa's limited generation capacity (mainly from ESKOM) (SEFA, 2021). In part this is due to the fact that in the 1990s, in the early years of power plant development, the government decided to not invest in power plants for reasons of cost-effectiveness. Importing electricity from neighbouring countries seemed to be more economically viable, and so until 2012 Botswana operated only one power plant, namely Morupele Power owned by the national BPC, with a capacity of 132 MW and not meeting the country's energy demand. However, rising costs for imported electricity combined with power shortages in the 2000s forced the government to rethink and further expand its energy supply strategy (Maswabi & Kim, 2018). Since the expansion of the Morupule Power Station in 2012, Morupule B (planned capacity of 600 MW), and its commissioning, electricity imports have decreased significantly and most of the electricity demand is covered by local generation (GoB, 2021). Currently, Botswana is estimated to hold huge coal reserves of 212 billion tonnes, which are expected to be exploited in the near future (a $2.5 billion coal liquefaction plant is planned), not least in view of the Russian-Ukrainian war, which is driving up energy prices (Reuters, 2022). Not only to become less dependent on imports from South Africa at the national level, but also as an opportunity for exports, as Botswana has recently been overwhelmed with requests to supply coal to European countries due to the current energy policy situation (AV, 2022).

Key stakeholders and decision-makers of Botswana's energy sector

The national key stakeholders in the Botswanan energy sector are governmental and parastatal institutions (see Figure 4). On the government level, the **Ministry of Mineral Resources, Green Technology and Energy Security (MMGE)** is the primary decision-maker. It is particularly effective through the Department of Energy (DoE) in all matters of energy supply and demand, as well as in the formulation and coordination of national energy policies and programmes. Other important national stakeholders that are parastatals of the MMGE are the Botswana Power Corporation, the Botswana Energy Regulatory Authority and the Botswana Oil Limited. The **Botswana Power Corporation (BPC)** is the national utility for large-scale power generation in Botswana and has a monopoly on transmission, importation and distribution. Although Independent Power Producers (IPP) are allowed by the 2007 amendment to the Electricity Supply Act, there are currently no active IPPs (SEFA, 2021). The **Botswana Energy Regulation Authority (BERA)** was enacted in 2017 under the Botswana Energy Regulatory Authority Act (2016) and is tasked with ensuring an efficient energy regulatory framework by guaranteeing a competitive environment. Its purpose is to ensure an efficient energy regulatory framework covering electricity, gas, coal, petroleum products, solar energy as well as all other forms of renewable energy. In addition, the authority is responsible for ensuring transparency of tariffs, committed to ensuring a secure and sustainable energy supply, and preserving and protecting the environment and natural resources in accordance with applicable law (BERA, 2018; IRENA, 2021).

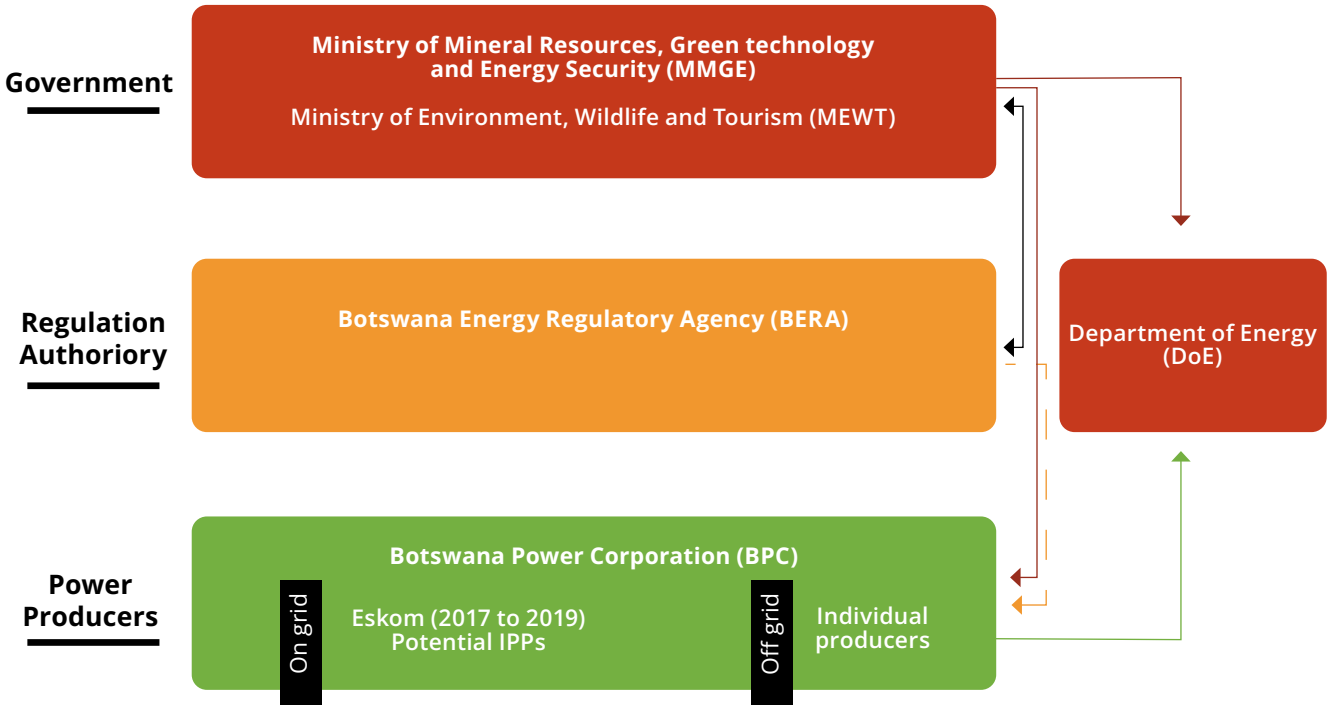

Figure 4 Key institutional stakeholders for the energy market in Botswana adapted from (REAB, 2018, p. 17; IRENA, 2021, p. 52)

Other Botswanan ministries and agencies that may be crucial for energy-related matters and the promotion of the SHS solid biofuel from bush and other woody biomass are listed in Figure 5. For instance, stakeholder engagement with the Ministry of Environment, Conservation of Natural Resources and Tourism (MEWT) will be necessary. Its Department of Environmental Affairs to promote environmental conservation and protection or its Department of Forestry and Range Resources to ensure sustainable resource use will be critical stakeholders to involve in the process of the commercial roll-out of the SHS solid biofuel. Botswana is also engaged in regional associations to ensure energy security, e.g., the country joined the Southern African Development Community (SADC) and the Southern African Power Pool (SAPP). Furthermore, the country holds ties with other international stakeholders, such as Power Africa, a partnership led by the US government and coordinated by the United States Agency for International Development (USAID), which has been bringing together public-private partnerships for power generation projects in sub-Saharan Africa, including Botswana, since 2013 (RERA, 2021; USAID, 2021).

Figure 5 *Botswana Ministries and Agencies (RoB, 2022)*

3.1.2 Energy poverty and security

Access to energy is a prerequisite for economic development and is anchored in SDG 7, with the goal of ensuring universal access to affordable, reliable energy for all by 2030. However, Botswana belongs to the countries which are still affected by energy poverty as energy supply, especially in rural areas, is still inadequate. Although there is sufficient electricity capacity in the towns and villages connected to the grid to meet demand, there are generation deficits due to technical challenges (REAB, 2018). In addition, the cost of connecting to the electricity grid in rural areas is still prohibitive for many (BPC, 2011). According to the World Bank, 72% of Botswana's overall population had access to electricity in the 2020 (WBG, 2022a). However, particularly in rural areas of the North-East and South-West of the country, electricity transmission and distribution are inadequate, with losses accounting for up to 79 % in remote areas (REAB, 2018). Access to electricity in rural areas reached only 26.4% in 2020 (compared to 90.7% in urban areas) and had been declining since 2017 (WBG, 2022a). Access to clean cooking fuels and technologies has steadily increased overall (65% of Botswana's population in 2020), although there is a large discrepancy between urban and rural areas. In urban areas, 85.6% had access to clean cooking fuels and technologies in 2020, while in rural areas the percentage of access had decreased since 2010 from 28.6% to 25.2% in 2020 (WBG, 2022a).

Primary energy sources in Botswana include electricity, fuel wood, LPG, petrol, diesel and aviation gas, while solar energy, biogas and diesel together account for only about 1%. Although the consumption of fuel wood has declined in recent years due to increasing prosperity and access to electricity, fuel wood still plays an important role in households, especially in rural areas. About 46 % of national households use it as a primary source of energy for cooking, rising to 77% in rural areas (RoB, 2019). This heavy reliance on fuel wood, predominantly in rural areas, is considered very critical in terms of climate change, as it contributes to a carbon-intensive energy system (GoB, 2018).

Botswana belongs to the countries with a high proportion of female-headed households, where unemployment and poverty levels are higher compared to male-headed households. The majority of women are engaged in agricultural subsistence and production or in the informal sector, where they are paid only occasionally or poorly and lack social and legal protection. The lack of economic resources in turn leads to difficulties in obtaining and accessing electricity, especially in rural areas. Women are an important player in the energy sector when it comes to the use, management and handling of energy. Particularly in rural areas, they are responsible for procuring energy sources, most notably, for

cooking food or heating the household. Moreover, studies show that there is a disparity even in access to biomass energy. In this regard, women tend to use more laborious methods than men to collect firewood and, as a result, collect less material quantitatively and qualitatively than men. Also, women were found to be more likely to collect firewood for household consumption, while men collect them for sale (BPC, 2011). All in all, women have less access to and control over productive resources, including modern energy, than men and are therefore more likely to be affected by poverty (GoB, 2021). Aiming to tackle this, in 2009 the Botswana Power Company launched a gender mainstreaming process with the aim of ensuring that gender issues were considered during the planning and implementation of energy projects and programmes. This project was developed after an audit of energy policies and programmes exposed that the energy sector in Botswana was not gender-sensitive and energy policies and programmes were not gender-responsive. Since then the Draft National Energy Policy has recognised gender as a central component and has included a specific gender objective, which calls for the inclusion and consideration of gender differences in energy planning. However, the measure has had little effect on practice and has not managed to 'engender' the energy sector (BPC, 2011).

Under the eleventh National Development Plan (NDP) (2017-2023), Botswana aims to invest in productive economic infrastructure such as the energy sector. **The goal is to increase the population's access to energy supply from 81.5% in 2020 to 100% in 2030** and to increase capacity up to 1540 MW in 2040, whereas the current installed capacity in Botswana is 890 MW and is almost entirely dominated by coal (SEFA, 2021). Furthermore, the BERA is responsible for ensuring a secure and sustainable supply within the energy sector, setting and maintaining service standards, conserving and protecting the environment, as well as upholding best international regulatory practice (BERA, 2018).

Milestones in Botswana's policy and regulatory framework for the energy sector include the amendment of the Electricity Supply Act to allow IPPs (2007), the establishment of the independent regulatory authority BERA (2016), the approval of the long-term Integrated Resource Plan (2020) and the adoption of an updated/revised National Energy Policy (2021). It is however worth mentioning that after the amendment of the Electricity Supply Act, there was little progress in promoting IPPs until 2019, when the BPC started procuring a 100 MW solar PV IPP programme. In addition, the BERA has not yet commenced its activities as an independent technical and economic regulator, as regulated prices are yet to be approved by the Cabinet (SEFA, 2021).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

Policy framework: Energy poverty and security

Botswana Energy Master Plan (BEMP) (1985, 1996, 2003)
Goals for rural electrification including renewable energy

Electricity Supply Act (1973, amendment 2007 & 2016)
Ensure energy supply, liberalisation private sector

National Development Plan (NDP) 11 (2017-2023)
Increase self-reliance on energy including renewable energy

Integrated Energy Resource Plan (IRP) (2020)
Implementation of a mix of energy sources

National Energy Policy (NEP) (2021)
Ensure energy supply and self-sufficiency including renewable energy

The country's energy sector has been guided by the **Botswana Energy Master Plan (BEMP)** since 1985 (GoB, 2018). Since its revision in 2003, the BEMP has encompassed the country's socio-economic and environmental goals and described the results achieved since the previous review in 1996. Its objectives include the promotion of solar energy, integration of grid and non-grid technology, promotion of renewable energy-related R&D and development of an institutional framework to support renewable-based rural electrification. It also aims to define strategies to remove barriers to renewable energy uptake and to promote the well-being of children and women through the use of photovoltaics for lighting (IRENA, 2021).

The Botswana Power Corporation Act from 1970 is mandated to manage electricity generation, transmission, supply and distribution in areas approved by the Minister and to trade electricity, purchase and sell in bulk. It was also mandated to prescribe tariffs and methods of charging for different customer categories (IRENA, 2021). **The Electricity Supply Act** was passed in 1973 and established the BPC in practice as an integrated monopoly for the generation, transmission, distribution and retail of electrical energy. The **2007 amendment** waived consultation with the BPC and allowed the ministry to grant licenses, while encouraging IPPs to operate in the energy sector, for example with PV power plants (RoB, 2019). With the 2016 amendment, the licencing tasks were officially transferred to BERA. The Environmental Impact Assessment (EIA) Act from 2005 requires that every licensing authority must ensure that an authorisation application contains an EIA before a licence is granted (IRENA, 2021).

The Economic Stimulus Programme (ESP) was launched in 2015 to boost Botswana's economic growth, diversify the economy and create jobs. Amongst other things, the energy sector was addressed to promote electrification of urban and rural areas and to become a surplus producer of energy (IRENA, 2021, p. 2).

The **Botswana 2017-2023 National Development Plan 11s' (NDP)** goal is to increase the country's autonomy from energy imports and increase energy conservation in all sectors. It intends an increased participation of IPPs in the energy mix and an increased use of indigenous sources of energy, including fossil resources. With the support of the World Bank, the government began developing a comprehensive renewable energy strategy under the plan to create a solid foundation for promoting investment in the sector (IRENA, 2021). Renewable energy opportunities in the NDP 11 are primarily mentioned in the area of solar energy, and although biofuels are listed, only biogas and biodiesel are specified. Notably, one of the energy targets was to "half by 2020 the percentage of households (46%) who use wood as the main source of fuel" (GoB, 2016b, p. 17).

In 2020, the **Integrated Energy Resource Plan (IRP)** launched, encompassing the national framework planning for electricity generation over the next 20 years (2020 – 2040) based on a least-cost development plan. The IRP is in line with the NDP 11 and as such forms an integral part of Botswana's energy planning development to meet the growing energy demand. It identifies priority projects for renewable and thermal energy and includes technologies such as solar photovoltaics and wind power with plans to introduce 485 MW of renewable energy generation capacity until 2027 (RoB, 2020). Some objectives of the IRP include the diversification of sources of electricity generation, the security of energy supply and the mitigation of environmental impact through different methods such as using low carbon technologies in coal (IRENA, 2021).

Botswana launched the latest **National Energy Policy (NEP)** (2021) with the overall objective to ensure the country's energy security while promoting sustainable and low-carbon economic development. It aims to establish an energy system with reliable and secure provision of modern energy services to all economic sectors and to substantially reduce energy-related emissions by 2040. The promotion of renewable energy sources (e.g., solar and clean coal technologies) is one of the objectives of the policy to diversify the national energy mix. Furthermore, the NEP puts measures to ensure sustainable use of the wood resource for energy. Policy statement 12 in the subsector of biomass and biofuels states that "The Government will ensure sustainable and efficient use of firewood to reduce

resources and to protect the environment" (GoB, 2021). Another key objective is to position Botswana to fulfil its vision in becoming a regional net exporter in the electricity sector (IRENA, 2021). Finally, a very significant element is that the NEP explicitly addresses gender issues and recognises women as important actors in the energy sector who need to be empowered. In the NEP, the government commits to "promote gender mainstreaming in the energy sector and [to] ensure alignment of gender concerns with appropriate health, safety and environmental standards" (GoB, 2021, p. 19).

3.1.3 International agreements, climate change and renewable energy

At present, 99% of Botswana's power generation is dominated by coal, although the country is seeking to encourage the development of an energy mix by engaging the private sector to contribute additional capacity with renewable energy sources (SEFA, 2021). By 2030, the **government aims to ensure that renewable energy accounts for 15% of the national energy mix**, and to reduce GHG emissions in total by 15% as part of its commitments to the United Nations Framework Convention on Climate Change (UNFCCC) (IRENA, 2021). In this context, BERA seeks to foster IPPs and private investments to expand renewable energy generation to support green technologies and GHG reduction (BERA, 2018).

As Botswana claims to dispose of about 66 % of Africa's untapped coal reserves, the country is keen to increase its coal production in the upcoming years in order to become less dependent on South African coal imports and to increase its own exports. However, these plans are incompatible with measures to combat climate change. Botswana's GHG emissions are expected to increase up to approximately 49 Mt CO2 by 2030 in a Business-As-Usual (BAU) scenario, 85% above 2010 levels (IRENA, 2021). Research shows that Botswana needs to phase out coal-fired power generation by 2030 (2040 at the latest) to find a 1.5°C-compatible pathway, and that renewable energy could reach a 72-99% share of the power mix by 2040 (Climate Analytics, 2021). The energy sector is the largest sector in GHG emissions (see Table 2) and accounted for around 73.8% of total national GHG emissions excluding Land Use, Land Use Change and Forestry (LULUCF) in 2015 (RoB, 2019). In its first Nationally Determined Contribution (NDC) of November 2016, the country committed to reducing its overall GHG emissions by 15% until 2030, using 2010 as the baseline year. According to the NDC, **GHG reductions are to be achieved primarily in the area of energy sources**, followed by agriculture and waste. To this end, it was announced that a long-term low-carbon strategy will be developed in order to identify initiatives to achieve implementation (RoB, 2016). However, Climate Analytics calculated that in order to meet the Paris Agreement's long-term temperature target of 1.5°C, Botswana would need to

reduce its emissions by 46-57% compared to 2010, excluding LULUCF. Moreover, the country has not yet presented its long-term low-carbon strategy (Climate Analytics, 2021). However, the Government of Botswana (GoB) is committed in its NEP to increase the share of renewable energy to 25 % by 2030 (RoB, 2019).

SECTOR	CO_2	CH_4	N_2O Gg Co2-eq	HFC_s	Emissions	CO2 Removals
Total National Emissions and Removals (with LUCF)	4814.092	4720.603	783.383	0.797	10318.875	
1. Energy	6617.883	2161.833	474.578		9254.294	
2. Industrial Processes and Other Product Use (IPPU)	1083.667	NO	NO	0.797	1084.464	
3. Agriculture, Forestry, and Other Land Use (AFOLU)		2015	286		2300.430	-288.458
4. Waste	NO	544.067	23.088		567.155	
Total National Emissions (without LUCF)	7701.550	4720.603	783.383	0.797	13206.344	

NO=Not Occuring

Table 2 *GHG emission by sector in Botswana according to the 2012 national GHG inventory (GoB, 2018, p. 69)*

Climate change mitigation and adaptation are explicitly addressed in Botswana's 11th NDP. In one of the six identified priority areas, "Sustainable Use of Natural Resources", energy is pointed out as one of the key areas for economic development. It also states that action to mitigate and adapt to climate change is central to economic growth and job creation, especially in vulnerable sectors such as agriculture. It is further informed that NDP 11 will focus on the implementation of the country's Climate Change Policy draft of 2016, which has since been complemented by the National Climate Change Strategy for Botswana of 2018 (GoB, 2016b; GoB, 2018).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

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In its first Biennial Update Report (BUR) to the United Nations Framework Convention on Climate Change (UNFCC) from October 2019, renewable energy sources, in particular solar power plants, solar panels and methane capture for energy use are mentioned as feasible mitigation measures, while biomass biofuels are not mentioned at all. Drawing on that set of mitigation measures in the report, it is assumed that the 15% reduction in GHG emissions indicated in Botswana's NDC can be achieved by 2030 (RoB, 2019). The introduction of the Renewable Energy Feed-in Tariff (REFIT) is considered one of the policy instruments for investing in climate mitigation. This includes promoting electricity generation from renewable energy sources, to ensure that renewable electricity producers have a guaranteed market and a reasonable rate of return, to ensure that renewable energy is a sound long-term investment for investors, and to encourage foreign direct investment. Other policies to be envisaged are subsidies for solar power and solar appliances, and tax exemptions for environmentally friendly houses (RoB, 2019).

There are considerable opportunities in the renewable energy sector in Botswana, especially for solar energy, though also for biomass. In an assessment of the MMGE on renewable energies, a total potential for energetic biomass from residues of about 32 million GJ/year was calculated. The greatest potential in the field of renewable energy, however, is unambiguously expected from solar energy, followed by wind energy and bioenergy, although in general these sources are hardly being exploited yet (IRENA, 2021). Especially in rural areas, there is a perceived opportunity to cover the lack of energy supply with off-grid solar energy, as the sun is abundant with high, market-competitive irradiation levels and thus the opportunity to relieve, for example, the pressure on the use of firewood (REAB, 2018,). In this context, since the first publication by the government in 2016, solar atlases of Botswana have been released regularly (IRENA, 2021).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

3

Policy framework: Energy poverty and security

Botswana Biomass Energy Strategy (BEST) (2009)
Comprehensive strategy for the use of biomass energy sources

National Energy Efficiency Strategy (NEES) (2017)
Infrastructure development and electricity generation from renewable sources

National Climate Change Strategy and Action Plan (NCCSAP) (2018)
Transition towards a climate-resilient society

National Renewable Energy Strategy (and Roadmap) (2018)
Infrastructure development for renewable energy sources by support of private sector

Vision 2036
Sustainable economic development and energy security by the promotion of renewable energy sources

Biofuels Guidelines for Botswana 2022
Tool to guide biofuel production (mainly liquid)

The **Botswana Biomass Energy Strategy (BEST)** (2009), developed with the support of the Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) by the government, includes a comprehensive strategy for the use of biomass energy resources and outlines the biomass energy demand as well as the supply of woody and non-woody biomass and possible interventions (REAB, 2018). It aims to address the needs of biomass energy end-users in Botswana, focusing on domestic, industrial, and institutional thermal applications of biomass, like cooking and heating (GoB, 2016b).

In order to achieve the priorities of the National Development Plan 10 (2009-2017), Botswana adopted a World Bank-funded **National Energy Efficiency Strategy (NEES)** in 2017. The strategy supports national energy security, climate change, economic development as well as universal and affordable energy access. It symbolises the government's commitment to support the achievement of these goals by providing a strong mandate for energy efficiency. Among the efficiency strategies identified is the use of renewable energies, such as solar water heating (IRENA, 2021).

In 2011, a **Renewable Energy Feed-in Tariff (REFIT)** study was commissioned by the government through the DoE with the objective to stimulate private sector participation in power generation in Botswana, particularly in renewable energy technologies (RETs). REFIT was designed to create regulatory mechanisms that reduce risk for investors and developers and to create an environment in which renewable energy targets can be met. However, the REFIT has not been implemented due to high proposed tariffs as well as additional financing needs and was to be reviewed and updated by the end of 2021 (IRENA, 2021).

The **National Climate Change Strategy and Action Plan (NCCSAP)** from 2018 envisions a climate-resilient society. Its strategy aims to meet socio-economic development goals, realise Botswana's Vision 2036 and achieve the UN Sustainable Development Goals (SDGs) as well as the objectives of the NDP (IRENA, 2021). At the same time, it also contributes to aligning Botswana's response to climate change with its other international commitments in the context of multilateral treaties and conventions (GoB, 2018). Within the context of climate change mitigation, strategies for a sustainable energy sector are presented, including the adoption and implementation of the Botswana Renewable Energy Strategy from 2017 and increasing the level of incentives for renewable energy technologies, highlighting solar power for domestic, industrial and commercial purposes in particular (S12.3, S12.5, S12.6) (GoB, 2018). For instance, one of the strategic interventions named is to develop a comprehensive financial and tax incentives programme for energy efficiency, energy conservation and clean energy use in micro, small and medium enterprises.

Currently, there is no renewable energy law but the Government of Botswana had agreed with the World Bank to develop a renewable energy and energy efficiency strategy, which was communicated in 2018 (REAB, 2018). The so-called **Renewable Energy Strategy (and Road Map)** was introduced with an investment programme which derived from the Capacity Expansion Plan. Its objective is to lay out the enabling environment conditions for the implementation of the investment plan and has a focus on private sector participation in the provision of renewable energy, conforming to the NEP. The strategy (based on least-cost analysis) envisages the development of large-scale grid-connected renewables capable of meeting 20% of total electricity consumption by 2030, and the roadmap recommends the addition of 300 MW of concentrated solar power and 350 MW of photovoltaics by the end of 2030 (IRENA, 2021).

Access to electricity is supported through the Rural Electrification Programme (REP) (implemented by the BPC) under the Revised National Policy for Rural Development, together with the National Electricity Standard Connection (NESC) programme, which provides a low-cost connection to the electricity grid for selected villages. This includes the government's Off-grid Solar Action Plan (OSAP) for non-NESC public facilities with funding from the Word Bank to develop ongoing solar electrification projects. With the support of Power Africa, the Rooftop Solar Deployment Programme (RTS) was developed and finalised in 2020 with policies, regulations, administrative procedures and standards. The programme was set up to increase the acceptance of solar energy and to encourage private sector participation, such as by end-users generating their own electricity and selling the surplus to BPC (IRENA, 2021).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

3

In its **Vision 2036**, Botswana aims to transform the country from an upper-middle income country to a high-income country by 2036 and achieve prosperity for all based on four pillars, namely sustainable economic development; human and social development; governance, peace and security; and sustainable environment. Under the latter pillar, one of the priorities is to promote, among other things, the maximum use of renewable resources (GoB, 2016a). Energy security is considered one of the objectives and prerequisites for social and economic development. Safe and clean energy sources are to be pursued, renewable energy sources to complement the use of non-renewable resources, and Botswana to become a net energy exporter. Furthermore, an enabling environment, supported by policy and legislation, is to be created for investment in clean energy technologies and renewable energy sources, among other things to minimise GHG emissions (GoB, 2016a).

The **Biofuel Guidelines for Botswana** were developed as part of the Biogas Project, which facilitates low-carbon investments in the production and utilization of biogas from agro-waste. The focus is mainly on the large-scale development of liquid biofuels. Through this framework, the government aims to increase the production and uptake of biofuels to partially cover the national and possibly regional energy demand.

In addition, the introduction of solid biofuels in SHS would create new employment opportunities within the value chain, provide innovative technology and knowledge transfer and capacity building opportunities for rural sectors. Job creation, e.g. through competence development for maintenance and repair of renewable energy infrastructure as well as commercialisation, should explicitly focus on gender-sensitive measures to promote equity and equality. Socio-economic development in rural areas could be enhanced by explicitly empowering women, specifically as evidence has shown that they are more willing to adopt energy-efficient technologies in decision-making for the procurement of energy sources, particularly if the technologies can help reduce tedious household chores (BPC, 2011).

As previous plans and strategies in renewable energy programmes and projects have only been partially implemented, the lack of an overarching and binding energy concept, a specific framework and the absence of incentives for renewable energy requires a transformation into binding commitments by the government (IRENA, 2021). There is a need to engage with all relevant stakeholders to develop a common regulatory framework that includes incentives, harmonisation of regulations and the product as a government priority in terms of off-grid alternatives for rural and economic development and reduction of CO2 emissions.

There is a need for incentives and funds in the renewable energy sector. Attractive incentives should be provided to support the uptake of SHS technology and clean solid biofuel through policy.

3.2 NAMIBIA

Namibia is also part of the Southern African Development Community (SADC). It is located in sub-Saharan Africa bordering South Africa and Botswana. It is sparsely populated with 2.55 million people. The sparse population, particularly in rural areas, requires long-distance grid connections, making it difficult to increase access to electricity in many parts of the country. Namibia supports a middle-income economy based mainly on agricultural, tourism, and mining industries, with high exports in Uranium, diamonds, and livestock. The country has socially and economically progressed since receiving its independence from South Africa in 1990, yet it remains one of the most unequal countries in the world, with a Gini coefficient of 59.1 in 2015 second only to South Africa. Namibia also has relatively high poverty and unemployment for its level of development, which continues to be challenged by socio-economic inequalities and structural constraints (WBG, 2022).

High levels of inequality in Namibia result in high poverty, lagging human capital, and poor access to basic services, including energy. Before 1990, the black majority population was excluded from participating in economic activities, and its effects continue to shape economic and social development. The government has made concerted efforts to include women in decision making and economic opportunities. 44% of the seats in Parliament are held by women, and 64% of students at the University of Namibia are women. However, social discrimination and violence towards women remains a challenging issue to address. 28% of women and 22% of men in Namibia believe that a husband beating his wife is a justifiable act. The culture of gender inequality in the workplace and home perpetuates traditional gender roles which can limit opportunities and safety of women.

Namibia is the driest country in Sub-Saharan Africa, and with extreme weather events and droughts increasing in frequency and severity due to climate change, the risks of water scarcity are even more prevalent. 70% of Namibia's population depends on agricultural activities and/or the beef industry for livelihoods, areas that are highly sensitive to changing climates (Shikangalah & Mapani, 2020). In 2019, Namibia saw its worst drought in 90 years, in which agricultural output fell below 50% and at least a third of the population was left without adequate food supplies (Shikangalah, 2020). Encroaching bush in Namibia contributes to these

water shortages, as the presence of bush can reduce groundwater recharge by up to a third (GIZ, 2018). Encroaching bush covers 30% of land mass in Namibia, and is growing at 3% per year, which also threatens agricultural productivity (BUKEA, n.d.; MME, 2017). The loss of land to bush reduces potential grazing and agricultural land area, accounting for 1.6 billion N$ per year of agricultural losses (STEAG, 2013). Removing bush to produce added-value products like firewood, charcoal, and electricity generation offers an additional economic incentive. In fact, removing encroaching bush could bring an added N$48 billion over 25 years (UNIDO, 2019).

The electricity generation sector of Namibia is dominated by hydropower, contributing towards 65% of the country's own electricity generation

The electricity generation sector of Namibia is dominated by hydropower, contributing towards 65% of the country's own electricity generation. Coal makes up 24%, followed by 6% fuel oil and 2% solar PV. There is great potential to develop sustainable energy sources in Namibia, including solar, wind, and biomass. There is high solar irradiation in Namibia, causing the ceiling potential for concentrated solar power to be 70% of the world's electricity production (Fol & Ndhlukula, 2012). Also, biomass from encroaching bush remains an untapped source of energy. The energy content of woody bush in Namibia has been estimated to be 1000 TWh, while existing applications of biomass only use 3% of the potential energy.

Total Primary Energy (TPES) supply in Namibia remains dependent largely on oil, with about 72% of TPES from oil in 2019 (see Figure 6) (IEA, 2022c). Namibia remains without refinery capacity, and therefore imports all its liquid fuels from international sources (MME, 2017).

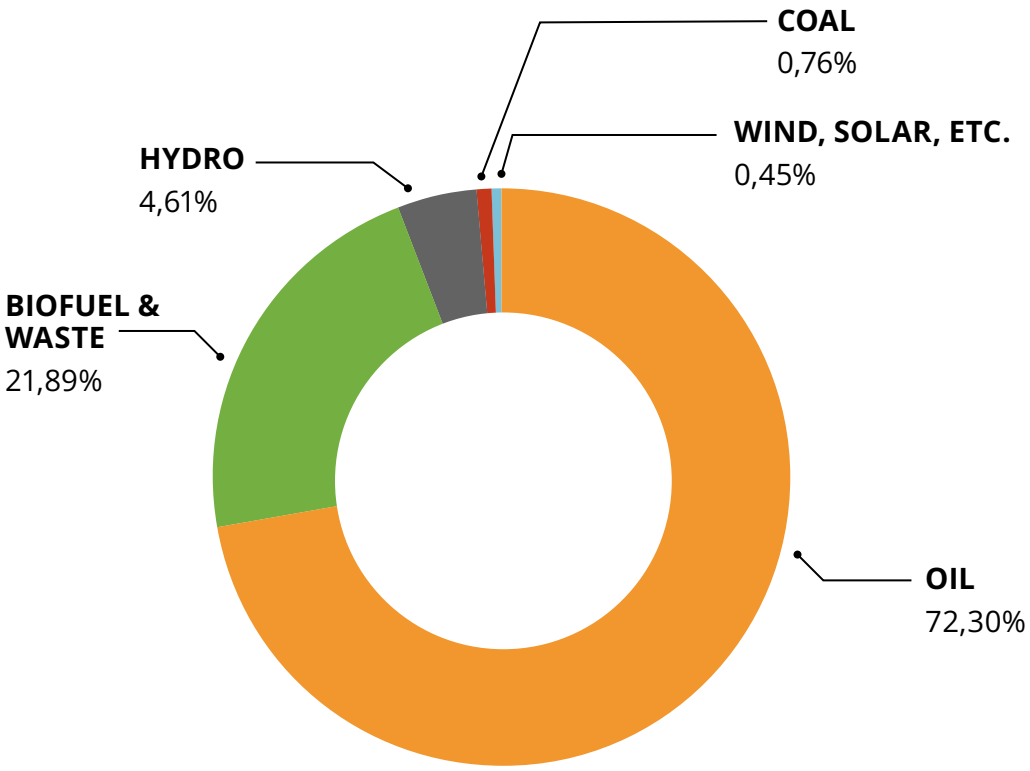

Figure 6 *Total (primary) energy supply in Namibia broken down by source (IEA, 2022c)*

In Namibia, the transport sector is the largest consumer of energy, accounting for about 37% of the country's total energy consumption. A large part of the energy consumption is unspecified (22.48%), whereas other major consumers of energy are agriculture and forestry (18.77%), the residential sector (10.41%) and the industry (9.49%) (see Figure 7). Electricity and biomass make up 20% of total energy use each. The country remains dependent on imports for electricity as well, importing over half of their grid power (500 MW in 2016) mostly from South Africa's public electricity utility Eskom. Access to power from the grid is lagging, as only a third of all Namibians have access to electricity, with only 24% in rural areas. 54% of households continue to use traditional biomass for cooking, which is further disaggregated into about 86% of rural households and 20% of urban households (MME, 2017). This places a disproportionate burden on women for fuelwood collection, results in significant health problems and environmental degradation, and increases socio-economic disparities.

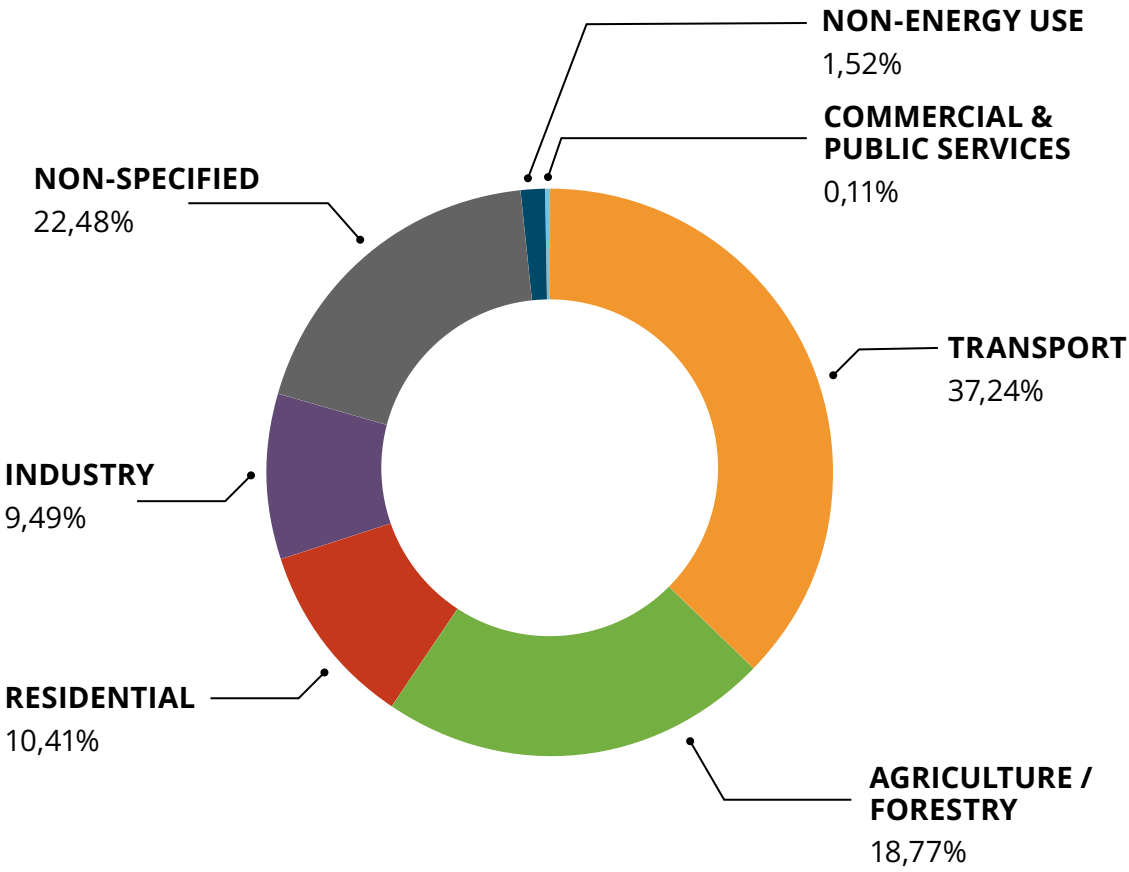

Figure 7 *Total energy consumption in Namibia broken per sector (IEA, 2022c)*

3.2.1 Governance and regulatory landscape

Namibia is a multi-party parliamentary democracy. The executive body of government is the Cabinet, which consists of the President, who is directly elected by citizens, and the Prime Minister and ministers, who are appointed by the president. Namibia's bicameral Parliament is made of the National Assembly, with 104 total members, and the National Council with 3 members from each of the 14 Regional Councils. The president, Hage Heingob, has served since 2015, and represents the SWAPO party, which has held a two-thirds majority in Parliament since the country's independence in 1990 until 2019, when the single-party system was challenged by the People's Democratic Movement and the Landless People's Movement (BTI, 2022; M., 2019).

Key stakeholders and decision-makers of Namibia's energy sector

The **Ministry of Mines and Energy (MME)** is responsible for preparing national policies regarding energy and electricity. To do so, MME confers with relevant stakeholders, including the **Electricity Control Board of Namibia (ECB)** who is Namibia's electricity regulating authority (ECB, n.d.). The ECB, with approval from the MME, may develop rules and codes regulating the operation and

administration of the electricity market, including pricing, safety, and security. The Namibian Energy Regulatory Authority Bill was drafted in 2018 and was set to be adopted by 2022. The bill aims to replace the ECB with the Namibian Energy Regulatory Authority (NERA), expanding the authority's current mandates to beyond just electricity, but also including gas, petroleum, renewables, and energy efficiency and lays out the necessary structures and financial provisions (Republic of Namibia, 2018). **NamPower** is the public utility which owns and operates all major generating stations and acts as the country's single buyer. Other prominent electricity distributors are the three Regional Electricity Distributors (REDs) i.e., **NORED, CENORED, and Erongo RED**, the City of Windhoek, and Oshakati Premier Electric (OPE) established. The **Ministry of Environment, Forestry, and Tourism (MEFT)** in Namibia is responsible for tourism, natural resource management including forest services and conservation, biodiversity, etc. One of MEFT's functions is to compute the National Inventory of Greenhouse Gases within the framework of UNFCCC and prepare reports regarding NDCs.

The National Energy Council was established under the Petroleum Products and Energy Act in 2003, acting as an advisory group to the MME on energy supply, resources, and industry. **Renewable Energy and Energy Efficient Institute (REEEI)** was established in 2006 under the Renewable Energy and Energy Efficiency Capacity Building Programme (REEECAP). REEEI intended to disseminate information, research standards and technology, and support the MME in planning and policy. In 2014, the REEEI evolved into the **Namibian Energy Institute (NEI)** and was integrated into the Namibia University of Science and Technology (NUST). MME now confers with NEI on a variety of policy making decisions. And in 2015, the **SADC Centre for Renewable Energy and Energy Efficiency (SACREE)** replaced REEEI under the NEI and NUST (NUST, 2015). Under the Petroleum Products and Energy Act of 1990, the **National Energy Council (NEC)** was founded in 2003. The NEC advises the minister of MME developing, supplying, and exploiting energy resources (Republic of Namibia, 1990).

The National Planning Commission (NPC) is responsible for planning and directing national development through coordination efforts, monitoring and evaluation of councils, and providing advisory services in the development of national development plans (NPC, n.d.). The **National Climate Change Committee (NCCC)**, established by MET in 1999, is responsible for overseeing climate change policies developed by the Cabinet, preparing reports, and advising the Cabinet on climate change issues. The commission involves participation from representatives from different ministries and various stakeholders and forms the low-carbon goals compatible with a growing economy and population (HSF, 2015; MET, 2002).

The **National Petroleum Corporation of Namibia (NAMCOR)** is a government owned entity which operated both upstream and downstream in the oil industry. NAMCOR is responsible for exploration, production, and promotion of oil, as well as advising the MME on technical matters. The corporation also participates in fuel supply tenders and targets commercial and retail sectors. (NAMCOR, n.d.). The **Geological Survey of Namibia (GSN)** is a directorate of the MME, facilitates information regarding Namibia's geological resources and is involved in land-use decisions (MME, n.d.-a). The **De-Bushing Advisory Service (DAS)** is a national advisory service provider, serving farmers, land-users, and bio-based industries by providing information and knowledge regarding bush encroachment and control (DAS, n.d.).

The most important governmental stakeholders in the energy sector and relevant actors for the commercialisation of the proposed solid biofuel are the MME and the MEFT listed in Figure 8.

Figure 8 *Namibian Ministries for the commercialisation of solid biofuel (Namibia House, n.d.)*

3.2.2 Energy poverty and security

Though economic and social development has greatly improved since Namibia's independence from South Africa in 1990, Namibia remains dependent on South Africa for energy needs and lacks significant generation capacity of its own. Around 79% of Namibia's energy comes from imports, primarily from coal and oil generated in South Africa (51%), Zambia (29%) and Zimbabwe (10%) (Namibia Statistical Agency, 2022). Namibia's generation capacity remains at around 500 MW, mainly from hydropower, diesel, and coal. A large portion of Namibian energy policy is dedicated to increasing energy security by increasing Namibia's generation capacity. Electrification also remains an important policy area, particularly in rural areas which are lacking grid connections. Over half of households use wood as a fuel source for cooking and/or space heating, and only a third of Namibians have access to electricity. Namibia has therefore made it a priority to increase electrification to households and schools through new energy policies in order to reduce poverty and improve industrialization efforts. The country has abundant solar and moderate wind potential, as well as large amounts of biomass,

particularly from encroaching bush. Exploiting these renewable energy resources, when economically feasible, contributes to the commitments laid out in BUR4 and low-carbon development strategy introduced in the National Development Plan.

In 1990, Namibia implemented its first energy policy, the **Petroleum Products and Energy Act**. The policy sought regulations and frameworks for the petroleum and energy industries and made provisions for establishing a National Energy Fund (NEF), funded by levies on petroleum (Republic of Namibia, 1990). It currently receives funds from NamPower and through an electricity levy (MME, n.d.-b). The NEF funds the National Energy Council and new energy development projects (MME, n.d.-c). **The Petroleum (Exploration and Production) Act** of 1991 designated the functions of NAMCOR and established the Petroleum Training and Education Fund (Petrofund) to provide training and capacity building programmes through top universities (Petrofund, n.d.).

Namibia adopted the **SADC Energy Protocol 1996** in 1996 with other South African countries. This protocol laid out institutional mechanisms and financial provisions guiding the region in developing cooperative energy policies and programmes (SADC, 1996). Thereafter, the SADC countries continued enacting strategies for advanced harmonious energy development, including the SADC Energy Cooperation Policy and Strategy in 1996, the SADC Energy Action Plan in 1997, the SADC Energy Activity Plan in 2000, the Regional Infrastructure Development Master Plan and Energy Sector Plan.

Policy framework: Energy poverty and security

White Paper on Energy Policy (1998)
Ensure energy supply, security & access including renewable energy

Rural Electricity Master Plan (2000) & Off-Grid Energisation Master Plan (2007)
Goals for rural electrification & framework for off-grid electrification from renewable sources

Electricity Act (2000, 2007)
Ensure energy supply including renewable energy and centralisation of electricity energy supply (ECB)

National Integrated Resource Plan (NIRP) 2016-2035 (2013, 2016)
Ensure energy supply including renewable energy

National Energy Policy (2017)
Ensure energy access & definition of goals in different energy sectors

National Electrification Policy (2021)
Increase energy access & national strategy for grid and off-grid electrification

National IndependentPower Producer Policy (2018)
Ensure energy supply, liberalisation private sector

Two years later in 1998, the MME issued the **White Paper on Energy Policy**, which created direction for Namibia's energy supply and established the original framework consistent with current energy policy (MME, 1998). Energy security, growth, socio-economic development, energy access, and renewable energy were prioritised topics. This document also set the sustainable use of biomass as a priority and recognized the potential for encroaching bush as a potentially economical source of energy. The White Paper created ambitious goals for the electricity sector - that at least 100% of peak demand and 75% of electric energy demand will be supplied by internal sources by the year 2010. The Namibian energy supply has so far fallen short of these goals yet continues to prioritise generation capacity building.

The goals of the energy sector have changed to represent more realistic scenarios since the White Paper on Energy Policy. With the **Rural Electricity Master Plan** in 2000, the government planned for rural grid expansion. This was followed by the **Off-Grid Energisation Master Plan** in 2007, which established a preliminary framework for the goal of off-grid electrification. Electrification rates still remain low, especially in rural areas, but the National Planning Commission intends to connect 50% of rural households by 2025 (ECB, 2018). Also in 2000, the Cabinet

approved the Single Buyer (SB) electricity market model, which centralised the buying and selling of electricity from domestic and international sources, delegating NamPower as the single buyer (MME, 2000).

Beginning in 2000 with the **Electricity Act**, the electricity supply industry was centralised under a national regulating authority, the Electricity Control Board (ECB) (Republic of Namibia, 2000). The Act and its updated version in 2007 set out regulations for licensing of electricity related activities and developed net metering rules to promote sustainable energy sources and reduce net imports (Republic of Namibia, 2007a). The most updated version, the **Electricity Bill of 2018**, remains a draft. The bill will ultimately give powers to the Minister of MME, stipulating they are responsible for the preparation and implementation of the National Integrated Resource Plan developed in 2013 to determine the optimal resource mix that balances the country's electricity supply in an efficient and reliable way at the lowest cost (MME, 2016; Republic of Namibia, 2018a).

The **National Integrated Resource Plan (NIRP)** is a 20-year development plan for the electricity supply industry in Namibia, spanning 2016 to 2035. NIRP plans for generation capacity increases to be met by mainly solar and wind resources, with only a share of 11% of energy generation to be allocated to the encroaching bush biomass in 2030, as there are considerable and more economical potentials for solar and wind that should be prioritised (MME, 2016). NIRP projects that the power demand will increase and require N$ 90 - 97 billion to meet their goals for future demand.

In 2017, MME implemented the **National Energy Policy**, which addresses improving grid access and more. The policy updates national priorities in alignment with HPPII targets regarding the future development of the energy sector in Namibia by setting goals in different sectors of energy use, including electricity, upstream oil and gas, downstream liquid fuels, gas, and thermal energy. And in 2021, MME implemented the **National Electrification Policy** to substantially increase energy access, ultimately with the goal of universal access by 2040. It does so by proposing an implementation framework and national strategy for electrification using grid and off-grid approaches.

Since 2005, the MME has issued 3 production licences for the development of the Kudu gas field, a potential source of 1.3 trillion cubic feet of offshore natural gas in the Orange Sub-basin. The Kudu gas field remains the only commercially viable gas or oil resource in Namibia, despite considerable efforts and exploration by NAMCOR. There have not been significant changes to petroleum or gas policies

since the 1998 White Paper. The government of Namibia is also concerting effort on introducing private investments into the energy sector. The **National Independent Power Producer Policy** of 2018 establishes a new approach for the procurement of Independent Power Producer (IPP) projects and proposes a modified single buyer market (MSB) rather than the previous SB market model to allow generators to sell directly to REDs and other customers rather than strictly to NamPower (MME, 2018). By introducing smaller power producers Namibia hopes to make the electricity market more competitive, increase capacity, and reduce the price of power. In 2020, only 5 years after IPPs were first allowed to supply grid energy, 25% of the installed generation capacity was from IPP's, all renewable energy based (Kruger, 2022).

3.2.3 International agreements, climate change and renewable energy

Namibia is a country with abundant natural resources and a growing economy. During the period between 1991 and 2015, the country saw an average annual economic growth of 4.4%, but still high unemployment, poverty rates, and economic inequality remain key development issues which constrain the country from working towards development goals (WBG, 2022). National development policy in Namibia therefore remains focused on economic and social development. Namibia is susceptible to climate change, particularly in terms of water scarcity, agricultural productivity, and public health. Though Namibia is a low carbon emitter and has abundant sinks of carbon, the government recognises its part in mitigating climate change, and has committed to a low carbon development pathway. Namibia ratified the Paris Climate Agreement in 2016 and is a signatory member of the UNFCCC. Namibia has since pivoted its development agenda towards a green low carbon economic pathway, codified by Nationally Determined Contributions (NDC) to the UNFCCC. In Namibia's most recent NDC, enacted in 2021, Namibia set energy, mitigation, and behaviour change targets. The country sets aggressive climate goals with the main objective being avoiding 90% of BAU emissions by 2030. Other goals include to reduce energy imports by 30% in 2030 by increasing renewable energy production, implement fuel efficiency and GHG emission standard regulations, and reduce the deforestation rate by 75% (Republic of Namibia, 2021b). Namibia's Fourth Biennial Update Report (BUR4), a report which provides the most recent national (GHG) inventories and updates on actions undertaken to meet Namibia's NDCs, include power plant installations, energy efficiency measures, and actions to move towards cleaner fuels, but the report lacks measurements of the impacts of these actions (Republic of Namibia, 2021c).

The renewable energy sector is expanding in Namibia, and several factors such as high resource potential for solar, low population density, and few competing land uses, make the country an attractive location for new projects. The

government recognises that investor interest is needed to expand renewable energy, which is why the National Renewable Energy Policy seeks to accelerate investment, procurement, and project development in renewables. Additionally, NamPower's Renewable Energy Feed-In Tariff (REFIT) Programme for solar PV and wind projects with a capacity of 500 kW to 5 MW aims to accelerate investments (NAMPower, n.d.). The UNDP has launched projects attempting to increase the uptake of solar. Concentrating Solar Power Technology Transfer for Electricity Generation in Namibia (CSP-TT) 2012-2017 sought to develop the technological framework for large scale solar operations. This paved the way for the Omaruru solar voltaic plant in 2015, the first renewable energy project developed by an IPP, the GreeNam Solar PV plant in 2018, and the Alten Solar PV plant in 2019. More large-scale projects are ongoing, and the landscape of small power farms will continue to evolve because of new IPP policies.

Biomass for fuel use is already a large share of Namibia's energy supply yet remains a largely underutilised resource. Over half of Namibian households rely on wood or wood products for cooking, with about 30% of the total landmass covered by woody invasive bush species. Commercial and industrial applications of encroaching bush are being explored to establish bush-based value chains. The companies Namibia Breweries Limited and Ohorohngo Cement currently use wood chips and charcoal to generate process heat for their manufacturing processes (EEP Africa, 2016; Ohorongo Cement, n.d.). The project Combating Bush Encroachment for Namibia's Development (CBEND) developed a roadmap for a 250-kW bush-to-electricity power plant which feeds electricity directly to the national grid, but operations never fully commenced (DRFN, n.d.). And more recently, a 40 MWe bush-to-electricity project is under development by NamPower, aiming for completion in 2025, using upwards of 200,000 tonnes of bush biomass per annum to generate baseload electricity and contributing towards ecosystem restoration of 15,000-20,000 hectares per annum (NamPower, 2022).

Commercial charcoal production is a well-established industry in Namibia, currently producing over 200,000 tonnes of charcoal annually, primarily for export, making Namibia one of the largest charcoal exporters globally. Approximately 60% of the charcoal produced is destined for European markets. The Namibian Charcoal Association (NCA) was formalised in 2016, in order to strengthen the charcoal sector in a sustainable manner by promoting cooperation between producers and advocating for legislation (NCA, n.d.). The charcoal sector has shown great economic potential, becoming one of the country's most valuable agricultural exports and employing approximately 10,000 workers as of 2022, with continued growth expected. The Namibia Biomass Industry Group (N-BiG) was established

in 2016 as a non-profit industry association with the vision of shaping and growing biomass uses in Namibia (N-BiG, n.d.). N-BiG has helped to organise the industry, contribute towards policy development, and support national biomass initiatives and projects such as the aforementioned NamPower bush-to-electricity project.

Policy framework: Energy poverty and security

Namibia's Vision 2030 (2004)
Sustainable economic development and energy security by the promotion of renewable energy sources

Harambee Prosperity Plan I, II (HPP) (2016, 2021-2025)
Increase resilience aligned with Vision 2030 goals

Namibia's Fifth National Development Plan (NDP5) (2017-2022)
Operationalisation of the Vision 2030 through goals and strategies

National Policy on Climate Change NPCC (2010)
Outlines objectives for the country's response to climate change

National Climate Change Strategy and Action Plan (NCCASP) (2013-2020)
Measures for adaptation, mitigation, and cross-cutting issues due to climate change

National Renewable Energy Policy (NREP) (2017)
Targeting the domestic energy supply by increasing its renewable energy sources

National Startegy on Sustainable Management of Bush Resources
Framework for sustainable bush resource utilisation and the development of the bush biomass sector

Namibia's Vision 2030 was adopted in 2004 by the former president Sam Nujoma, which set long-term goals for Namibia's development to ensure sustainability, economic prosperity, and equity (Republic of Namibia, n.d.). The 5 pillars of Vision 2030 are people, prosperity, planet, peace, and partnership, and consider the UN Sustainable Development goals. Though Vision 2030 sets sustainability, environmental security, and renewable energy as national priorities, the document lacks a clear goal for carbon emissions. And while the plan addresses that biomass is an important source of energy, bio-based fuels are largely ignored as a potential resource.

In 2016, the president of Namibia released the first **Harambee Prosperity Plan (HPP)** which lays out Namibia's short-term development priorities. In 2017, guided by the second Harambe Prosperity Plan (HPPII) and Fifth National Development Plan (NDP5) (see 5.2.3), the MME implemented the **National Renewable Energy**

Policy (NREP), setting the target for domestic energy supply to be 70% of demand by 2030 by increasing solar, wind, and biomass energy production (MME, 2017). HPPII sets the intermediary goal of increasing generation capacity by 100 MW by 2025. The now active HPPII plan contains strategies spanning 2021-2025 builds off the original plan with Vision 2030 goals in mind. HPPII sets goals and strategies for 5 pillars of development to increase resilience and security for the country's economic, social, and environmental future (Republic of Namibia, 2021a). HPPII also coincides with **Namibia's Fifth National Development Plan (NDP5)**, the fifth of seven plans to be created by the National Planning Commission which operationalize the Vision 2030. The NPDs set short term goals and strategies spanning five years at a time working towards the long-term goals laid out in Vision 2030. NDP5, active from 2017-2022 focuses on four objectives – economic progression, social transformation, environmental sustainability, and good governance (NPC, 2017).

The Environmental Management Act, enacted by Parliament in 2007, provides the framework for environmental legislation in Namibia. It promotes sustainable management and protection of the environment and natural resources, including disposal of waste, land use, transportation, and water use by using environmental assessments and regulations. Under the Act, the Sustainable Development Advisory Council was established, and responsibilities were delegated to the Environmental Commissioner (Republic of Namibia, 2007b). The **National Policy on Climate Change (NPCC)** followed in 2010, developed by the MET and UNDP. The NPCC set objectives for the country's response to climate change, emphasising its need for disaster risk management and international cooperation (Republic of Namibia, 2011). In 2013, the **National Climate Change Strategy and Action Plan (NCCASP)** for the years 2013-2020 was developed by the MET to implement objectives laid out in the NPCC. The NCCSAP proposes measures needed for adaptation, mitigation, and cross-cutting issues due to climate change. Mitigation focuses mainly on reducing emissions from the transportation and energy sectors by implementing energy efficiency measures and renewable energy development (MET, 2013).

At the time in which the NCCASP was drafted, Namibia had no obligation to reduce its GHG emissions under the Paris Climate Agreement, and therefore only committed to reducing emissions where financially and environmentally feasible.

Approximately 66% of Namibia's surface area is classified as tree and shrub savanna biome, characterised by large, open expanses of grassland dotted with a predominance of thorn trees and bushes. Over the past years Namibia's savannahs have increasingly been covered by thorny and impenetrable bush,

causing considerable negative impacts on biodiversity, soils, water availability, the productivity of the land and rural livelihoods. Bush encroachment has become a main indicator for land degradation and is a major climate change adaptation challenge for Namibians. Currently Namibia has an estimated 45 million hectares (Southern African Institute for Environmental Assessment, 2015) of land affected by bush encroachment. If thinned sustainably, Namibia could generate up to N$76 billion over the next 25 years out of the encroaching woody biomass (Southern African Institute for Environmental Assessment, 2015). The restoration of this encroached land is a national commitment included in Namibia's National Development Plan, as well as one of Namibia's climate change mitigation and adaptation contributions to the UNFCCC Paris Agreement. (National Strategy on the Sustainable Management of Bush Resources, 2022). Thus, one of the most important policy frameworks in Namibia's energy sector is the newly launched **National Strategy on Sustainable Management of Bush Resources 2022-2027**. It was launched in September 2022 to ensure that bush resources are used in a sustainable and added-value manner and to regulate the development of the Bush biomass sector. The goal is to exploit the woody biomass.

3.3 SOUTH AFRICA

South Africa is located at the very southern tip of Africa between the Atlantic and the Indian ocean. Neighbouring countries are Namibia, Botswana, Zimbabwe, Mozambique, eSwatini and Lesotho. In 2019, the population was reported to be approximately 58,7 million. South Africa is classified as an emerging economy. In 2020, the unemployment rate was estimated at 29,1%, which reflects the high poverty and inequality levels. The COVID-19 pandemic and Russia's invasion of Ukraine have worsened the situation, through increased unemployment rates, increased commodity prices, and increased prices of traditional fossil fuel-based energy (DFFE, 2021).

One of the main drivers of economic growth is mining. South Africa is the world's largest exporter of gold and platinum. As South Africa continues to be one of the biggest suppliers of mineral commodities, the total energy consumption per unit of GDP is close to 50%, higher than the world's average. South Africa relies heavily on extractive industries with little or low-grade processing, making them energy-intensive industries. Additionally, South Africa holds the highest carbon dioxide (CO2) emission per capita within the Global South. This is mostly due to its strong dependency on a coal-based energy production system, and high emission from the transport sector and energy-intensive industries (DFFE, 2021).

Coal remains South Africa's predominant energy source (see Figure 9). However, its contribution to the energy mix declined between 2016 and 2018, but has been rising again since then. With the increasing costs of traditional fossil fuel-based energy, the uptake of renewable energy is growing and becoming a more viable option in South Africa.

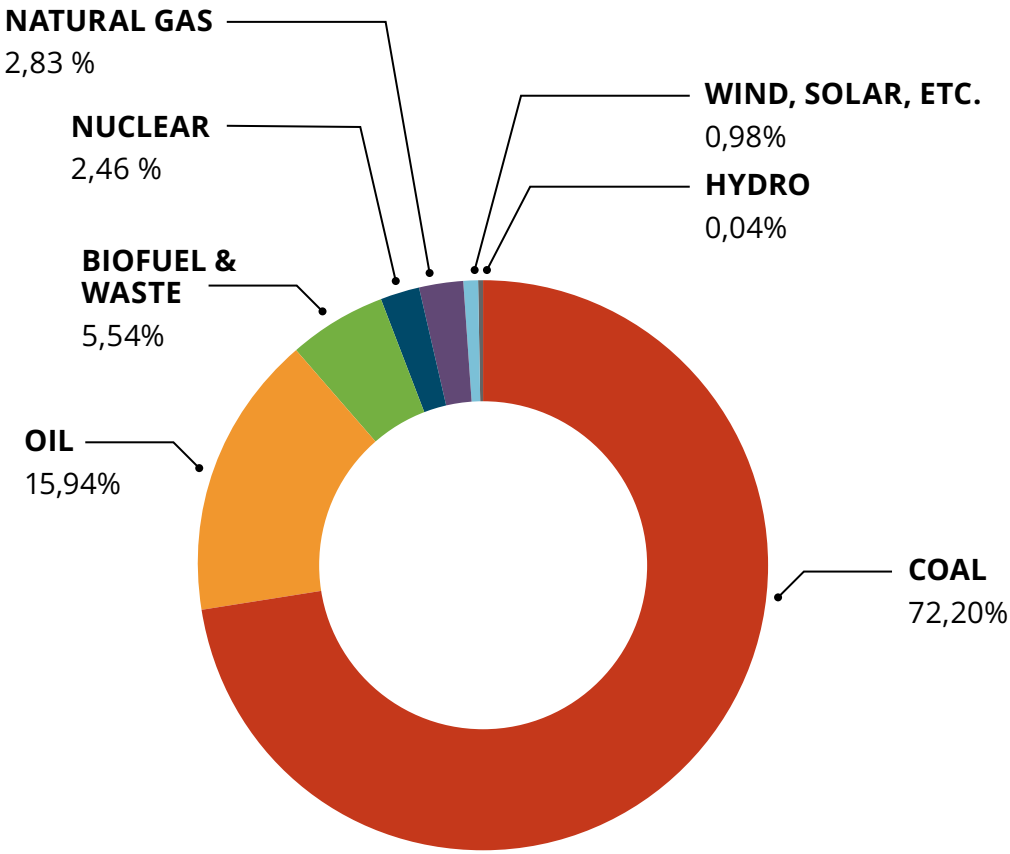

Figure 9 *Primary energy supply in South Africa broken down by source (2019) (IEA, 2022d)*

In South Africa, the industrial sector is the largest consumer of energy. In 2019, it absorbed around 35% of the total energy consumption in the country. Other key energy consumers are the transport sector as well as residential and commercial sectors, absorbing 28% and 18% respectively (see Figure 10). Moreover, it is estimated that households' access to electricity has increased from 84,2% to 84,7% from 2017 to 2018 respectively.

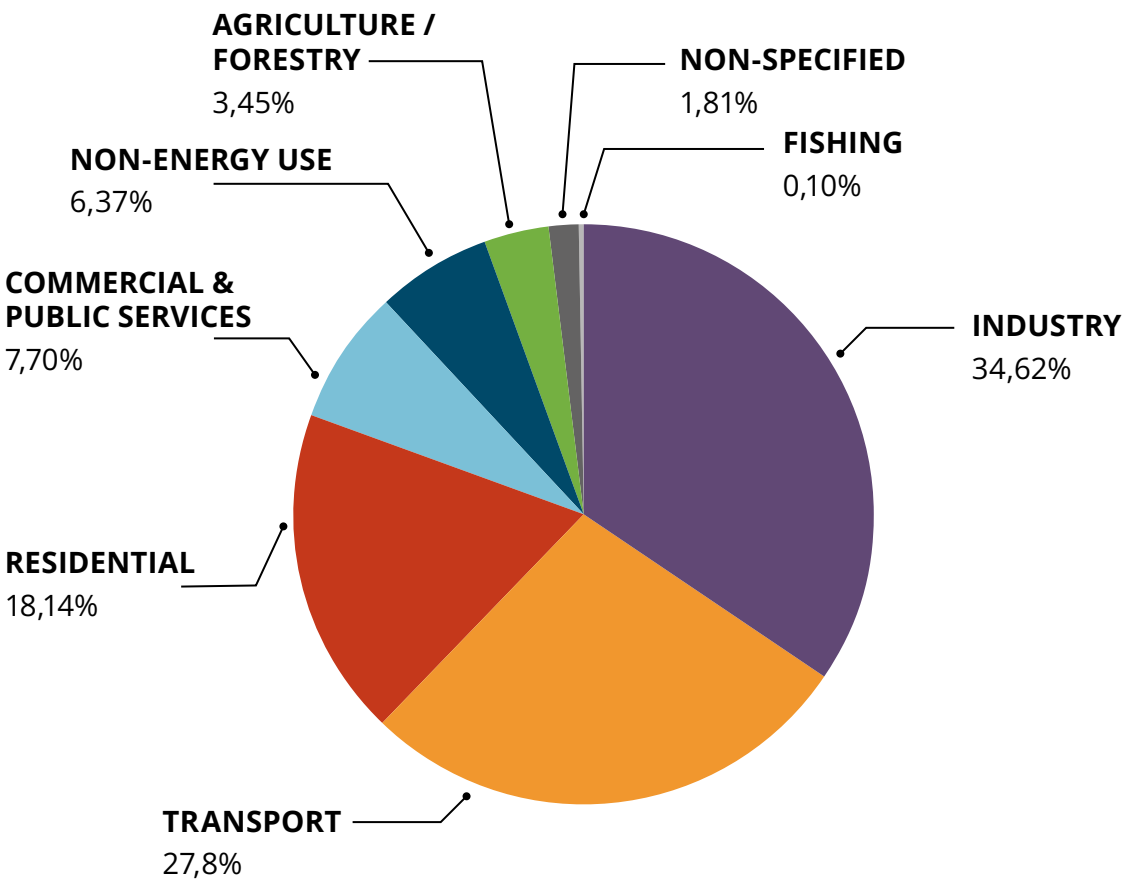

Figure 10 *Energy consumption in South Africa per sector (2019) (IEA, 2022d)*

3.3.1 Governance and general policy landscape

South Africa is governed through a constitutional democracy and structured on three spheres composed of national, provincial and local governments. Local governments have a relatively autonomous mandate, particularly regarding generating revenues and designing local policies as long as they are aligned to national and provincial policy frameworks (DFFE, 2021). Local governments in South Africa, play a crucial role because of their level of autonomy and their closeness to people. Particularly in rural areas where the central government is absent or non-existent, local governments tend to step in and have overarching competencies.

In general, the country's priorities remain those of an emerging country. These include the closing of the remaining gaps in electricity access among its population while creating and transforming jobs in the energy sector, and adjusting to industrial- and market-driven energy demands. Since 2007, South Africa has experienced recurrent power cuts and shortages that are not only an inconvenience for daily life but also limit the growth of the national economy. Thus, there is a need to focus on better infrastructure maintenance, investment

and planning. The South African Department of Energy made provisions to add a new energy mix and attract foreign investment. Concerning renewable energy, South Africa has the largest installed renewable energy capacities (wind and solar energy) on the African continent (Maupin, 2016). However, South Africa is known to be the 7th largest coal producer in the world. So, it is not surprising that coal has become its main energy source. It is estimated that 85% of electricity is generated by coal. While coal has been key in power generation, it has also placed South Africa among the top 10 GHG emitters in the world (Akinbami et al., 2021). However, South Africa is now taking action to reduce its GHG emissions and has shown commitment to the development of renewable energy sources to diversify its energy mix.

South Africa is one of the biggest coal producers in the world and coal is its predominant energy source

An important step towards renewable energy was taken with the release of a White Paper on Renewable Energy in 2003, specifying how the country meant to generate 10 TWh of electricity from renewable sources (biomass, wind, solar, and hydropower). With this policy instrument, the government set the ground for the development of renewable energy. Years later, in May 2011 the South African government launched the Integrated Resource Plan 2010-2030. The Plan set another goal by adding 17,800 MW of renewable energy to the country's energy mix by 2030. In the same year, the Renewable Energy Independent Power Producer's Programme (REIPPP) was established to attract private investment into the country's energy transition. The REIPPP was an ambitious policy component structured on three main themes, which are CO2 emissions; improvement in renewable energy generating capacity; and support for economic development. The initiative proved to be successful in fostering a diversification of the energy mix and has led to a steady rise in renewable energy capacity in South Africa (Akinbami et al., 2021).

Key stakeholders and decision-makers in South Africa's energy sector

One of the most important stakeholders of the energy sector in South Africa is Eskom, which is a state-owned utility and the dominant electricity generator in South Africa. About 95% of the electricity is generated by Eskom whereas coal is the primary energy source. The energy mix is supplemented by the Koeberg nuclear station, hydroelectric and pumped storage schemes and an Eskom-owned 100 MW wind farm (DEA, 2018). Eskom has maintained its monopoly in providing electricity to South Africa and its mandate includes growing national energy production. While ESKOM generates about 95% of all South Africa's electricity, the municipalities and independent power producers make up the remaining (Akinbami et al., 2021). As the only energy supplier, Eskom has a generating plant mix that consists of 14 coal-fired power stations. Most of them are clustered in

Mpumalanga province, mainly due to its geographic location is close to coal mines. In addition, ESKOM operates Africa's only nuclear power plant, which is located in the Western Cape region (Akinbami et al., 2021).

Among some other stakeholders and decision-makers is the **National Energy Regulator of South Africa (NERSA)**. It regulates the liquid fuels, gas and electricity sectors and was established in 2004. The **Central Energy Fund (CEF)** is a partial government-funded entity reporting to the Department of Energy (DoE) to operate the oil and gas assets of South Africa. It also promotes energy research, renewable energy and energy efficiency in South Africa. The **South African Energy Research Institute (SANERI)** operates the coordination and undertaking of public interest energy research, development and demonstration. Together with the **National Energy Efficiency Agency (NEEA)**, they are both hosted in CEF. Renewable promotion is taken on by the South African Energy Development Institute which is mandated by the 2008 Energy Act and includes both SANERI and NEEA. As a response to the 2007 electricity crisis in South Africa, the **National Electricity Response Team (NERT)** was established as a public-private structure to help operate the power system whilst supply was constrained. However, NERT has all but ground to a halt due to funding issues and a lack of continuity during the restructuring of the DoE. Furthermore, municipalities are important in their role as electricity distributors. The **Energy Intensive User Group (EIUG)** represents 250 large energy users and promotes the interests of the companies in the sector (Tyler, 2010).

Other governmental stakeholders playing a role in the energy sector and relevant actors for the commercialisation of the proposed solid biofuel in South Africa are the following:

Figure 11 *State-led agencies and stakeholders of the Energy Sector*

3.3.2 Energy poverty and energy security

A common definition of energy poverty is a lack of access to clean, safe and affordable energy. In South Africa, energy poverty is measured by the household expenditure capacity, whereby households spending more than 10% of their income on energy are considered energy poor. Based on this parameter, about 47% of households in South Africa are considered energy poor (DoE, 2013). On average, South Africans spend 14% of their income on energy, however, low-income households spend as much as 27% of their income on energy (DoE, 2012).

Energy poverty is a complex and multi-dimensional problem which is driven by a variety of social and economic factors such as rising electricity prices, household incomes, and energy inefficiency among others. Low-income households are typically burdened with high energy-related costs to cover their basic energy needs which include cooking, water heating, space heating and lighting, which tend to be energy-intensive activities (SEA, 2017).

South Africa has several energy policies targeting low-income households. One of the earliest energy policies adopted in South Africa is the White Paper on Energy Policy of 1998. The policy provides guidelines on energy security for all through affordable energy sources, improved governance and an economic development strategy. Subsequent policies have been developed to assist in the implementation of the White Paper such as the Integrated National Electrification Plan (INEP) and some other policies discussed in the following section.

The INEP is an award-winning electrification programme meant to provide universal access to electricity in the country. As of today, the INEP has resulted in 87% of households in urban areas having access to electricity. However, affordability remains an important challenge, as low-income households battle to bear the cost of electricity for an entire month (SEA, 2014; Vermeulen, 2016). As a result, households turn to traditional forms of energy such as firewood, paraffin, etc. to cover their basic energy needs. These forms of energy tend to be perceived as cheaper alternatives because they can be purchased in small quantities. However, the use of firewood and paraffin for cooking and lighting respectively, are usually not cost efficient compared to modern fuels (Barnes et al., 2005). Hence, low-income households end up spending a bigger share of their income on energy services than those households with higher income (Reddy, 2008). Due to affordability, close to 50% of households in South Africa use electricity in combination with other fuels such as firewood, paraffin and gas for cooking (DoE, 2013).

DOMESTIC POLICY FRAMEWORKS: BOTSWANA, NAMIBIA, SOUTH AFRICA

3

In South Africa, poverty tends to be consistently high amongst Blacks/Africans, the less educated, the unemployed, female-headed households, large families and children. However, especially Black/African female households exhibit more vulnerability to energy poverty. The Constitution of South Africa supports women's rights and empowerment and declares to guarantee gender equality in the economic and social realms (Ngarava et al., 2022). However. most policies and programmes do not explicitly acknowledge structural gender of ethnical inequalities, which in many cases exacerbates injustices among social groups. This has a significant impact on women's education, employment and income, property ownership, health and access to basic services such as electricity and water. To reduce vulnerability to energy poverty and promote energy security, stakeholders need to prioritise the inclusion of gender and race/ethnic divide in the making of energy policy (Ngarava et al., 2022).

Policy framework: Energy poverty and security

White Paper on Energy (1998)
Increase energy access and infrastructure

Integrated National Elecrification Plan (INEP) (2001)
Provide universal electrification

White Paper on Renewable Energy (2003)
Renewable energy strategy

Free Basic Electricity Policy (FBE) (2003)
Implementation of energy efficiency technologies

Free Basic Alternative Energy Policy (FBAE) (2007)
Support of renewable energy production

National Energy Act (2008)
Ensure energy supply

Integrated Energy Plan (2013)
Implement a mix of energy sources

The **White Paper on Energy** was published in 1998 and was ground-breaking in the sense that it defined a new direction. The Paper recognized structural inequalities in the energy sector in terms of energy usage and access and highlighted the need for increased access to affordable energy for all South Africans (DoE, 2015). However, it is only one of the first policies to address South Africa's exposure and

response to climate change (DEA, 2018). Other policies aim to increase energy access and infrastructure, promote access to affordable energy services for disadvantaged households, small businesses and community services to reduce poverty in South Africa, and support and promote the development of renewable energy (Maupin, 2016; Trollip, 2007).

The **Integrated National Electrification Plan (INEP)** became operational in 2001 to provide universal access to electricity. The INEP has been remarkable, increasing electrification nationwide. However, most of the electrification success is concentrated in the urban areas. By 2011 about 89% of urban households were electrified in relation to 77% in 1996 (SEA, 2017).

The **White Paper on Renewable Energy** provides a wide range of measures to bring about the integration of renewable energies into the mainstream energy economy while it informs the renewable energy strategy for the country. These measures include the implementation of generation or refining licenses, new infrastructure to connect renewable energy supplies to the existing transport infrastructure and a power purchase agreement of sufficient duration between the generator and the purchaser of the electricity (DME, 2003). The White paper sets out a target of 10.000 GWh renewable energy contribution to South Africa's final energy consumption by 2013. The sources of renewable energy include biomass, solar, small-scale hydro and wind (DEA, 2018).

The **Free Basic Electricity Policy (FBE)** (2003) is an attempt to provide poor households with electricity. The policy allows households 50 kWh of free electricity per month to meet basic energy needs. The policy is funded by the national government through the Local Government Equitable Share (LGES), a grant that is an unconditional grant paid to municipalities for the provision of basic services to households, and through cross-subsidies from high-end users. However, access to FBE does not reach all households in need. The DoE (2013) indicates that 59% of poor households benefit from the FBE, while the National Treasury reports 30% and Stats SA 51% (SEA, 2014).

In 2007, the new **Free Basic Alternative Energy Policy (FBAE)** was introduced. Its objective is to support indigent households by providing them with the equivalent of R56.29 per month of alternative fuels (e.g. paraffin, LPG). However, there has been no successful implementation of FABE because it's very difficult for the municipalities to administer and monitor (SEA, 2014).

In 2008, the **National Energy Act** was published by the Government of South Africa. Its objectives include, amongst others, ensuring the uninterrupted supply of energy to the Republic, promoting the diversity of supply of energy and its sources, commercializing energy-related technologies and contributing to sustainable development of South Africa's economy (RSA, 2008).

The **Integrated Energy Plan** (2013) aims to meet current and future energy service needs in the most efficient and socially beneficial way by implementing a mix of appropriate sources and forms of energy (DFFE, 2021).

3.3.3 International agreements, climate change and renewable energy

South Africa is a signatory to three conventions, which were established by the UN as a result of climate change, desertification and the loss of biodiversity being identified as the greatest global challenges to sustainable development in 1992 (DEA, 2019). These commitments include the United Nations Convention on Biological Diversity (UNCBD), whose signatories are accountable for conserving the natural biodiversity of the country. The UNCBD was ratified by South Africa in 1995
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The United Nations Convention to Combat Desertification (UNCCD) was ratified by South Africa in 1997. Signatories are addressing unsustainable land management practices to combat desertification. The last commitment is the United Nations Framework Convention on Climate Change (UNFCCC) whose signatories are accountable for reducing GHG emissions by increasing the carbon sink capacity of the country. The UNFCCC was ratified by South Africa in 2016 (DEA, 2018).

South Africa frequently updates and enhances its **nationally determined contribution (NDC)** under the Paris Agreement every five years. The latest update states that in South Africa, a just transition is a core to increasing sustainability, fostering climate resilience and low GHG emissions development. Under the national commitment, GHG emissions are expected to peak between 2020 and 2025, a plateau between 2025 and 2035, and decline after. On September 14, 2021, South Africa's Cabinet approved a more stringent GHG emissions target range to strengthen the ability to meet the above overarching goals. The newly approved target range in South Africa's NDC is 350-420 t CO_2e. The previous target range was 398-614 t CO_2e for 2025 to 2030 (Norton Rose Fulbright, 2021).

The adoption of the **National Climate Change Adaption Strategy (NCCAS)** in 2020 by the South African government provided a policy instrument in which national climate change adaption objectives can be articulated to guide all economic sectors. Furthermore, during COP 26, South Africa expressed its expectation of continued provision of climate finance by the developed countries.

The country also expects developed countries to show progression beyond previous efforts, to set a new collective quantified goal from a floor of USD 100 billion per year. Additionally, South Africa will seek to develop small, medium and micro-enterprises to implement innovative technologies and create sustainable employment. Between 2018 and 2019, South Africa received USD 4.9 billion in climate finance, the majority in form of loans. South Africa's main goal for its updated first NDC is to achieve significantly higher levels of climate finance during the implementation periods of the first NDC to reach a floor of USD $8 billion per year by 2030 (RSA, 2021).

In terms of renewable energy, in 2008, South Africa's National Energy Regulator (NERSA) agreed to the country's first **renewable energy feed-in tariff (REFIT)**. The REFIT aimed to facilitate the introduction of renewable energy into the power system. A year later, in 2009, NERSA announced REFITs with proposed tariffs meant to cover generation costs plus a real after-tax return on equity of 17%, fully adapted for inflation. The REFIT tariff policy marked a turning point in renewable energy policy in South Africa. It highlighted the country's commitment to reaching its renewable energy targets and drew investor interest and capital from across the globe to South Africa. Ultimately, the actual implementation was carried out through a competitive tendering system (the REIPPPP) with REFIT rates used as caps. The competitive bidding process proved to be useful to lower prices while still providing adequate incentives for market entry by renewable energy investors. Even though the implementation required close to a decade to translate the policy aspirations articulated in the founding policy documents, the results have been noteworthy. Reviews of South Africa's progress in implementing the REIPPPP have been positive, placing South Africa among the top-10 countries in relation to investment in the sector of renewable energy (DoE, 2015)

Policy framework: Climate change and Renewable energy

National Energy Efficiency Strategy (NEES) (2005, 2008)
Overall energy intensity reduction target

Net Growth Path (2010)
Development of Green Economy

National Climate Change Response Policy (NCCRP) (2011)
Transition to a climate-resilient and lower-carbon economy and society

Energy Efficiency (Green) Accord (2011)
Increase energy security and promotion of energy efficiency

Integrated Resource Plan (IRP) 2010-2030 (2011, 2013)
Infrastructure development and electricity generation from renewable sources

Carbon Tax Act (2019)
Support of renewable energy producers in South Africa

Renewable Energy Independent Power Produces Procurement Programme (REI4P) (2011)
Renewable energy

The **National Energy Efficiency Strategy (NEES)** (2005 reviewed 2008) outlines a strategy for the country to reach an overall energy intensity reduction target of 12% by 2015 (DEA, 2018). In 2016, the Draft Post-2015 National Energy Efficiency Strategy was developed to further develop energy reduction targets; however, the document has been widely criticized for barely mentioning mitigation targets for the industry sector or concrete measures for the implementation (Climate Action Tracker, 2021). The South African Centre for Carbon Capture and Storage (2009) works towards the implementation of a roadmap for evaluating the potential for carbon capture and storage. It was implemented by the DoE in partnership with the South African National Energy Development Institute - SANEDI. A project that was introduced in 2010 to facilitate the implementation of wind power in South Africa is the South African Wind Programme. The Programme focuses on wind resource assessment, capacity building and strengthening of institutions (DEA, 2018).

The **Net Growth Path** (2010) mandates the development of the 'Green Economy', creating 300,000 jobs through clean manufacturing and environmental services over the next decade. It aims to enhance growth, employment creation and equity. The policy's primary target is to create 5 million jobs during the next 10 years.

The Net Growth Path represents an important development in South Africa's strategic response to climate change in the context of the country's industrial growth (DEA, 2018).

The **National Climate Change Response Policy (NCCRP)** was one of the first formal policy provisions relating to climate change in the country. It was published as a white paper in 2011 and is South Africa's most overarching climate change policy. The policy presents the government's vision for an effective climate change response and the long-term transition to a climate-resilient and lower-carbon economy and society. It aims to effectively manage the inevitable climate change impact through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity (DFFE, 2021).

The **Energy Efficiency (Green) Accord** (2011) and the Energy Efficiency Leadership Network are fuelled by the National Efficiency Strategy policy. Their purpose is to increase energy security through better use of existing and new generation capacity, improving South Africa's global competitiveness through lower energy costs. They were implemented by the Department of Energy and the private sector (DEA, 2018).

The **Integrated Resource Plan (IRP) 2010 to 2030** was promulgated in 2011 and updated in 2013 and remains under consideration. It is an electricity infrastructure development plan that directs generation expansion and demand-side intervention programmes to meet electricity demand. Furthermore, it makes provision for increased electricity generation from renewable and nuclear energy sources (DEA, 2018). Its objectives include affordable electricity, carbon mitigation, reduced water consumption and gradual decarbonization of the electricity sector in South Africa (DoE, 2013). Furthermore, the plan determines the demand profile for electricity over the next 20 years and details how this demand can be met from different sources (nuclear, coal, gas and renewable energy) in the most efficient way (DoE, 2019). The plan serves as a roadmap for the development and regulation of energy demand and supply in South Africa through 2030 (Norton Rose Fulbright, 2021).

The South African **Carbon Tax Act** was launched in 2019 and aims at businesses and companies that have high carbon emissions and pollute the atmosphere. Those industries rely heavily on fuel consumption and electricity generation. The Carbon Tax Act implements the polluter-pays-principle for large emitters and

helps to ensure that businesses and consumers consider negative adverse costs in their future production, consumption, and investment decisions. Companies are incentivised to adopt clean technologies over the next decade and beyond. During the first phase from 1 June 2019 to 31 December 2022, the carbon tax rate will be relatively modest ranging from R6 to R48 per ton of CO2 equivalent emitted (IEA, 2020).

The Department of Energy's **Renewable Energy Independent Power Producer Procurement Programme (REI4P)** (2011) supports and develops the slowly growing renewable energy producers in South Africa. It makes provision for the generation of 17.8 GW of renewable energy by 2030 (DFFE, 2021). The programme covers renewable energy technologies (solar, wind, biomass, hydro and landfill gas) and is based on a competitive bidding format. Prospective power producers submit bids which are adjudicated to different criteria, while the price is the most critical. As part of this competitive procurement programme, power producers submit bids to supply renewable energy to the national grid (DEA, 2018). The programme prioritises the inclusion of energy derived from renewable sources and has gained traction among international energy stakeholders. In 2016, it raised its commissioned renewable energy capacity to 6329 MW which is close to the DoE interim target of 7 GW by 2020 (Maupin, 2016). Job creation and significantly cheaper renewable energy prices are some of the benefits of the REI4P.

The National Cleaner Production Centre South Africa (NCPC) promotes the implementation of resource efficiency and cleaner production (RECP) practices to help the industry reduce costs through lower energy, water and material consumption and better waste management. This national programme was implemented by the government of South Africa and is hosted by the Council for Scientific and Industrial Research (CSIR) on behalf of the Department of Trade and Industry. As a member of the United Nations Industrial Development Organization and the United Nations Environmental Programme's global RECP network, it plays a leading role in the African Roundtable on Sustainable Production and Consumption (CSIR, 2022).

GAPS AND OPPORTUNITIES

4

GAPS AND OPPORTUNITIES

4

This section presents country-specific gaps and opportunities that have arisen from the policy mapping and assessment. The identified gaps and opportunities offer important insights that are relevant for the commercialisation of the solid biofuel.

4.1 BOTSWANA

Botswana has great potential to transition from a fossil fuel-based energy supply to one that includes a significant share of renewable energy. Currently, the country's renewable energy supply is less than one percent (see Figure 2 Total (primary) energy supply), although the government has long recognised the importance of solar energy, in particular, for a greener energy mix. Botswana has a very high supply of solar energy with around 3,200 hours of sunshine per year, and with decreased cost of PV technology over the past few years, policies, projects and investments in the renewable energy sector are mainly targeting solar energy potential as a source of electricity. The NEP e.g., endorses up scaling of solar energy use, both at small scale and large-scale levels across the entire country. However, a number of renewable energy projects and programmes have failed due to poor quality of equipment, poor workmanship and lack of maintenance of installed systems, as well as poor planning and execution. For instance, the experience in RERE shows that the installed solar systems could not be operated sustainably, mainly due to lack of maintenance and follow-up, insufficient training of users and lack of technical support (IRENA, 2021).

Botswana has great potential to transition from a fossil fuel-based energy supply to one that includes a significant share of renewable energy

Other types of renewable energy sources are not as extensively supported by the government. A 2018 estimate suggests that installed renewable capacity for solar PV was less than one per cent, while wind and hydropower account nearly for zero (WBG, 2014; REAB, 2018). In IRENA's assessment of Botswana's readiness for renewable energy, for instance, only one project on waste-to-energy and one research project on biofuels are mentioned. Similarly, the Biofuel Guidelines for Botswana only cover liquid biofuel and fail to extend the framework to promote the production and uptake of solid biofuels and potential of woody biomass.

Although biomass, especially woody biomass in the form of fuel woods, is traditionally consumed by a large share of Botswanan at household level (particularly in rural areas), it has not been so far at the core of policy interest. The widespread use of firewood, combined with a poorly regulated harvesting regime, is expected to worsen woodland depletion and agricultural productivity,

while posing health and safety risks to the consumers (MMEWR, 2009). Therefore, a clean and affordable biomass-based alternative, such as the SHS solid biofuel would be beneficial. On top of that, SHS technology would offer the possibility of using water as a by-product to contribute to water security, as Botswana already suffers from water scarcity that is expected to worsen in the future (GoB, 2016a).

The introduction of the SHS solid biofuel would add to the diversification of the energy mix and support the government's ambition in its Vision 2036 to ensure energy security, contribute to safeguarding biodiversity and meet the environmental goals of the NDCs and the Paris Agreement to reduce the country's GHG emissions by 15% by 2030 and to increase the share of renewable energy to at least 15% of the energy mix by 2030 (RoB, 2019). Further on, the use of solid biofuel from the encroacher bush as a substitute for firewood would support the NEP target of ensuring sustainable use of firewood to reduce deforestation, as well as the NDP 11 target of halving the proportion of households using firewood as their main energy source.

In addition, the introduction of solid biofuels in SHS would create new employment opportunities within the value chain, provide innovative technology and knowledge transfer and capacity building opportunities for rural sectors. Job creation, e.g. through competence development for maintenance and repair of renewable energy infrastructure as well as commercialisation, should explicitly focus on gender-sensitive measures to promote equity and equality. Socio-economic development in rural areas could be enhanced by explicitly empowering women, specifically as evidence has shown that they are more willing to adopt energy-efficient technologies in decision-making for the procurement of energy sources, particularly if the technologies can help reduce tedious household chores (BPC, 2011).

As previous plans and strategies in renewable energy programmes and projects have only been partially implemented, the lack of an overarching and binding energy concept, a specific framework and the absence of incentives for renewable energy requires a transformation into binding commitments by the government (IRENA, 2021). There is a need to engage with all relevant stakeholders to develop a common regulatory framework that includes incentives, harmonisation of regulations and the product as a government priority in terms of off-grid alternatives for rural and economic development and reduction of CO_2 emissions.

There is a need for incentives and funds in the renewable energy sector. Attractive incentives should be provided to support the uptake of SHS technology and clean solid biofuel through policy instruments such as pricing schemes or subsidies. Key actors that have offered financing opportunities in the renewable energy sector so far included the Sustainable Energy Fund for Africa (SEFA), which supports Botswana's energy transition by providing a grant of 1 Mio. USD to the government and is managed by the African Development Bank (AfDB) (BERA, 2022); in collaboration with USAID/Power Africa; the Green Climate Fund (GCF) as the operating entity of the UNFCCC's financial mechanism, which offers a range of financial products, including grants, concessional loans, subordinated debt, equity and guarantees (GoB, 2018); or the Climate Investment Platform (CIP), a global initiative supported by IRENA, the UNDP and Sustainable Energy for All (SEforAll) in cooperation with the GCF to accelerate renewable energy investments and enable the success of NDCs (IRENA, 2021).

4.2 NAMIBIA

Climate change presents a large risk for Namibian power supply. More than two thirds of Namibian power come from hydropower, and as the climate warms and rain becomes more variable, hydropower in Namibia appears increasingly unreliable, presenting a great threat to energy security (Ndhlukula, 2010). Investments in other renewables is critical to ensuring energy security and low prices. A potential industry that appears promising to investors is green hydrogen, because of Namibia's excellent co-located wind and solar resources, large swathes of uninhabited, government owned land, and strong support from the government (von Oertzen, 2021). Namibia has the potential to produce the cheapest hydrogen in the world at 1.50-2.00 EUR per kg (Randowitz, 2021). The Namibian government intends to develop ten hydrogen projects and has already announced three.

Due to climate change rain becomes more variable and therefore hydropower becomes unreliable

Long distances and sparse populations are both significant barriers to increasing energy access and lowering prices. There is great potential to supply rural populations with energy generated by small, localised independent power producers. Great progress has been made since the adoption of the National IPP Policy, with 25% of Namibian power now coming from IPPs, not including small-scale customer-owned projects (Kruger, 2022). However, lack of financing options and high implementation costs discourage investments in privately owned projects. Costs for generating, transmitting, and distributing energy are high due to the low density of the population, long geographical distances, and

low utilisation of capacity. As of July 1, 2022, ECB has raised electricity tariffs by 7.3% as a result of Covid-19 related downturns, weather, and foreign exchange fluctuations. It remains a challenge to provide secure and inexpensive energy for Namibians. Concerted efforts by the Namibian government must therefore be made to continue the growing share of IPPs and increase domestic supply.

There are opportunities to market biofuel as fuel for the tourism sector. If a biofuel can successfully be produced in rural areas at a low cost, there could be great potential to market bio-based fuel to lodges. Nature-based tourism is the third largest income from foreign sources in Namibia, which presents an interesting opportunity to utilise biomass resources.

Namibia's strategy on sustainable bush management offers clear guidelines on the sustainable management and use of bush resources. It provides guidance on bush control and harvesting and the development of bush-based value chains to ensure that the development of the bush biomass sector benefits the local population and minimizes environmental impacts. If done correctly, bush control can contribute to sustainable development, improved management of natural resources, and enhance the functioning of ecosystem services. This policy framework offers great opportunity for the development of bush biomass renewable energy and thus, offers a regulatory framework for the commercialisation of the solid biofuel.

4.3 SOUTH AFRICA

Currently, in South Africa, coal is the primary fuel source. The country holds large reserves of coal, making it a relatively cheap energy source. However, the overreliance on coal is both stressing the existing coal power stations and generating a deleterious impact on the environment. Therefore, the development of renewable energy sources is of extreme importance. Fortunately, South Africa is endowed with enormous biomass, wind and solar energy potential which can help South Africa replace coal and traditional energy sources with more modern and less polluting alternatives. To reach its potential, however, some challenges (technical, financial and policy-related) hindering the transition towards renewable energy need to be overcome (Akinbami et al., 2021).

Overall, in South Africa, the process of policy implementation is hampered due to a lack of alignment of policies between departments and between spheres of government as well as the lack of coordinated planning across spheres and sectors of government. Furthermore, different municipalities vary in capabilities in terms of human, infrastructure and financial resources (SEA, 2014).

GAPS AND OPPORTUNITIES

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Many of the policy objectives of the 1998 White Paper have not yet been achieved concerning electricity supply industry (ESI) restructuring, even though the 1998 policy document is still in force today. This policy uncertainty, combined with the rapid turnover of ministry officials in the Department of Energy, has meant that integrated planning in the energy and power sectors has been erratic, uncoordinated, and incoherent at best. For example, section 6 (1) of the National Energy Act 34 of 2008 requires an Independent Energy Plan (IEP) to be developed, reviewed and published annually by the Minister of Energy. However, no final IEP has been published since 2008, when the law was first promulgated. Although there are encouraging policy statements and commitments from political leaders that indicate a shift in thinking to enable the unbundling and restructuring of Eskom to create a state-owned Independent Transmission System and Market Operator (ITSMO) with power planning, procurement, contracting and system operations functions, there is still an urgent need for policy, legal and regulatory reform and restructuring of the electricity supply industry (ESI). One positive policy position coming from political leaders is the restructuring and unbundling of Eskom, which is unavoidable because the company is insolvent and needs massive rescue measures (Yelland, 2020).

South Africa holds large reserves of coal, making it a relatively cheap energy source that generates a deleterious impact on the environment

In general, South Africa has to deal with financing barriers to overcome energy poverty and generate a cleaner energy mix. Various investment promotion mechanisms would help to overcome these existing barriers. In 2014, USD 5.5 billion were invested in South Africa, whereas most investment comes from the Development Financial Institutions (DFIs). Other multi- and bilateral development banks also contribute to providing financial help (IRENA, 2015).

In South Africa, the Department of Mineral Resources and Energy (DMRE) and other public stakeholders still hold on to ideas of clean coal technologies and underground coal gasification, which indicate an enduring commitment to coal as a source of primary energy. However, within the government, the acknowledgement that coal mining is a declining industry doomed to face an inevitable crisis is progressively growing. At the same time, the realisation of the need for decarbonization of the economy is starting to assume traction. Thus, the socio-political context for renewable and clean energy alternatives is increasingly improving.

GAPS AND OPPORTUNITIES

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South Africa's National Development Plan (NDP) and Constitution highlight the role of women in economic development and encourage further participation of them. Policies in South Africa also commit to promoting access to affordable, clean and sustainable energy services for all. However, in the 2017 SDG baseline report, South Africa does not indicate what concrete reforms are planned to provide women equal rights to economic and energy resources. Moreover, the existing energy policy framework in South Africa does not tackle structural inequalities such as gender and race/ethnicity issues (Ngarava et al., 2022).

Even though electrification is high in South Africa, especially in urban areas, low-income households are unable to afford electricity costs throughout the whole month, so, they turn to alternative energy sources to cover their basic energy needs. These alternatives are typically traditional biomass energy sources such as charcoal, firewood, and paraffin. These energy sources can be accessed in small quantities; thus households pay less at the time, however, traditional biomass energy sources tend to be less efficient and households end up paying more overall for energy. Hence, affordability remains an important challenge in South Africa (SEA, 2017).

CONCLUSIONS AND RECOMMENDATIONS

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This report identifies and assesses energy and energy-related policies in Botswana, Namibia and South Africa. It offers an overview of the existing policy landscapes, highlighting pressing challenges and exploring gaps as well as opportunities to be considered for the commercialisation of the solid biofuel (generated by the SHS technology) in the target countries.

Energy and energy-related policy frameworks in Botswana, Namibia and South Africa encounter common challenges related to raising energy and commodity prices, targeted affordability and social and gender mainstreaming, regional integration and licensing.

The policy analysis was undertaken in the current context of rising commodity and energy prices, as fallout of Russia's invasion of Ukraine. The situation has been affecting people's ability to afford basic energy services and debilitating energy security worldwide, including Botswana, Namibia and South Africa. While this presents an enormous challenge to the governments in the three countries, it also presents an opportunity for the uptake of the solid biofuel, as an affordable clean and renewable energy alternative. Particular emphasis should be made on affordability. With rising energy prices, small-scale consumers and low-income households are unable to afford electricity. In most of the cases, electricity costs are accumulated over the month and charged as a lump at the end of the month. As electricity may become less or un-affordable, small- and medium-sized enterprises (SMEs) and households will turn to alternative energy sources to meet their basic energy needs. Typically, these alternatives are traditional biomass energy sources such as charcoal or firewood. The advantage of these energy sources is that they can be accessed in small quantities, allowing consumers to buy smaller amounts at a time. However, traditional biomass energy sources tend to be less efficient than electricity and households end up spending more on energy. Hence, to improve the access to clean energy and promote energy security, availability but also affordability is key. This means that the solid biofuel should not only be readily available but also affordable, and for the commercialisation, diverse payment options, as well as diverse product packaging sizes should be offered for vulnerable and low-income consumers.

As access to modern forms of energy is linked to economic growth, a lack of adequate and affordable energy services tends to exacerbate poverty. The national policy frameworks in Botswana, Namibia and South Africa acknowledge this link and, therefore, seek to tackle energy poverty. The governments have taken concrete actions through electrification and tariff adjustment programmes. However, the regional and domestic energy policy frameworks have fallen short

in integrating social, particularly gender components. The lack of such integration runs a risk of potentially exacerbating injustices among vulnerable groups and further reduces their access to energy. To expand the access to clean energy and tackle energy poverty, energy policies need to explicitly acknowledge and address gender-ethnic disparities under the existing social structures in policy planning and implementation. Hence, efforts in commercialising solid biofuel and enhancing access to clean energy need to consider gender and other structural social inequalities.

Existing energy and energy-related policy frameworks tend to focus on the supply side and be disconnected from the demand side. However, it is important to develop a policy framework that acknowledges that small-scale consumer and households use an energy mix and tend to stack energy sources. Thus, policy need to take a more holistic approach. “Plans to improve household energy security require a clear overview of how demand will be met in a way that connects planning for all forms of energy” (Doggart et al., 2020). Moreover, governments need to recognise that traditional biomass energy sources are in many cases the main energy sources for households, especially for cooking. Thus, effective action needs to be taken to provide affordable and clean alternatives to these households.

In many cases, the lack of resources and infrastructure represent important challenges for the implementation of energy policies and regulation. Following a similar line, South Africa and Namibia have explicitly expressed external financial support to plays an essential role in the implementation of NDCs and can boost efforts to reduce GHG emissions. Thus, it would be strategic to link efforts of energy security and access to clean energy sources with climate change to meet NDC and thereby increase the access to financial resources. For now, some identified financing opportunities include the Sustainable Energy Fund for Africa (SEFA), which supports Botswana’s energy transition and is managed by the African Development Bank (AfDB) (BERA, 2022) in collaboration with USAID/Power Africa; the Green Climate Fund (GCF) as the operating entity of the UNFCCC’s financial mechanism, offers a range of financial products, including grants, concessional loans, subordinated debt, equity and guarantees (GoB, 2018); or the Climate Investment Platform (CIP), a global initiative supported by IRENA, the UNDP and Sustainable Energy for All (SEforAll) in cooperation with the GCF to accelerate renewable energy investments and enable the success of NDCs (IRENA, 2021).

CONCLUSIONS AND RECOMMENDATIONS

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Existing initiatives, structured around the SAPP and the RERA, provide the necessary building blocks for regional integration that would help countries meet their energy challenges, particularly in terms of energy security. However, this task should not be left to utilities and regulatory bodies alone. Regulating bodies along member states need to be more synchronised, gain independence for decision-making and increase their capacities, particularly in terms of implementation. However, domestic institutions need to step up and support regional integration, as it is not an end in itself but rather a means to achieve a sustainable development pathway in the region. The ambition of regional integration should be to harmonise frameworks and focus on generating energy security and supporting the green energy transition (Gaylor & Bhavna, 2017).

For the development and commercialisation of new energy products such as the solid biofuel, the national energy regulating bodies need to issue licences in each of the countries. For this purpose, a working group or task force within the national energy authorities needs to be established, that will work to develop a framework for sustainable bush harvesting practices, product incentives and subsidies, certifying procedures, etc. Ensuring a broad stakeholder engagement amongst the spheres of government, industry and consumer stakeholders is essential in the process of developing the new regulatory frameworks.

Finally, besides the above-presented common challenges of energy policy frameworks in the three countries, there are important differences in the approach of the energy policy frameworks. These differences are mainly related to the domestic energy strategies.

While formally policies recognise the importance of transitioning towards a greener energy mix and highlight the need to increase the production and uptake of renewable energy alternatives, South Africa's and Botswana's energy strategies are still largely entrenched in a coal-based energy system. Within the South African government, the acknowledgement that coal mining is a declining industry doomed to face an inevitable crisis is progressively growing and the realisation of the need for decarbonization of the economy is starting to assume traction. In fact, the government is currently developing the Strategic Framework for an Alien and Invasive Biomass Economy in South Africa aiming to tackle invasive and encroaching bush species and potentially use the woody biomass as a source of renewable energy. Nonetheless, the Department of Mineral Resources and Energy (DMRE) and other public stakeholders still hold on to ideas of clean coal technologies and underground coal gasification, which indicate an enduring commitment to coal as a source of primary energy. On the other hand,

even though Botswana has Biofuels Guidelines in place, their focus seems to be merely on liquid biofuels. Nevertheless, as Botswana has important untapped coal reserves, the country is keen to increase its coal production in the upcoming years in order to become less dependent on South African coal imports and to increase its own exports. However, these plans are incompatible with measures to combat climate change. Botswana's GHG emissions are expected to increase up to approximately 49 Mt CO2 by 2030 in a Business-As-Usual (BAU) scenario, 85% above 2010 levels (IRENA, 2021). In contrast to South Africa and Botswana, Namibia has shown a strong drive to foster the development of the bush biomass energy sector by addressing the invasive and encroaching bush problem. In September 2022 Namibia has launched a National Bush Management Resource Strategy (2022-2027) to ensure that bush resources are utilised in a sustainable and value-added manner and to regulate the development of the bush biomass sector. The launch of this strategy is an indication of Namibia's efforts to increase the share of biomass-based energy as a renewable alternative while tackling a fundamental land degradation problem. At the same time, Namibia's strategy offers a great opportunity for the SBA project and the commercialisation of the solid biofuel.

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