SADC
Energy Investment Yearbook
2018

November 2018

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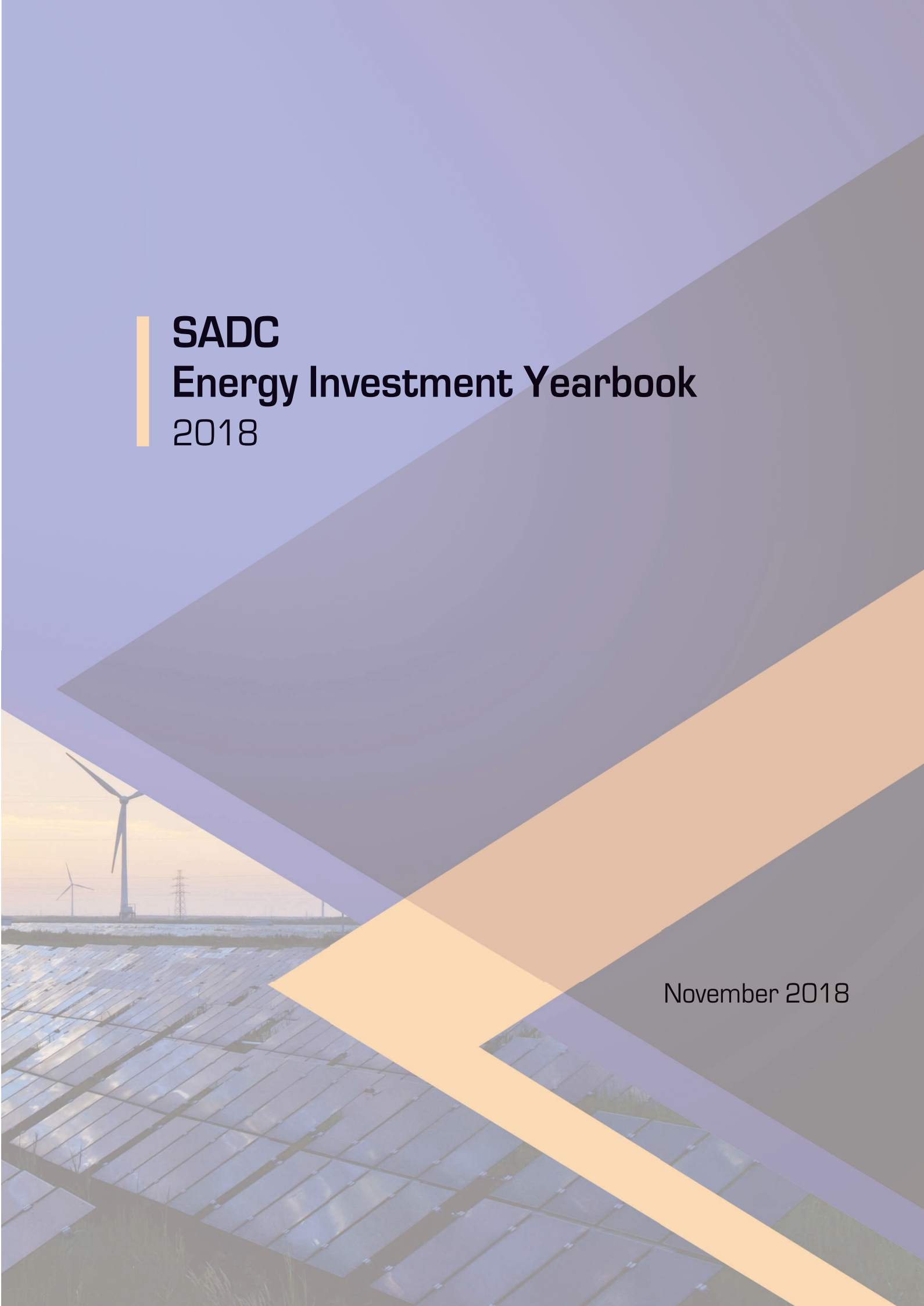

November 2018

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PREFACE

The year 2018 has been a historic one for SADC in terms of energy development. Ahead of the 38th SADC Summit of Heads of State and Government held in Windhoek, Namibia in August, the SADC Council of Ministers approved plans to develop a regional master plan that will guide the exploitation of the vast natural gas resources that exist in the region.

The decision to develop a regional gas master plan will go a long way to facilitate an increase in universal access to energy as well as to promote industrial development in SADC. The harnessing of alternative energy sources will contribute to expanding the regional energy mix, which is currently dominated by coal and hydro.

Another significant development in the energy sector was the official launch of the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) in Namibia in October. SACREEE will act as a "clearing house" for setting standards in the SADC renewable energy sector, and will spearhead the promotion of renewable energy development in the region.

The above cited developments are just two examples of what SADC is doing to harness and invest in its energy sector, as access to energy is one of the key enablers of sustainable development and regional integration.

The SADC region is generously endowed with energy resources that range from solar to wind energy, and from hydro to gas. If these sources are fully harnessed, the region has the potential to achieve universal access to modern energy services. However, most countries in the region have harnessed only a small amount of the available resources.

This calls for improved cooperation between and among SADC Member States to ensure that access to energy is prioritized to allow the region to realize its vision of a united, prosperous and integrated community.

SADC must put in place viable and vibrant policy and regulatory frameworks to make the development of energy infrastructure a reality and to attract investment into the gas sector. The region can also learn from what other Regional Economic Communities in Africa and the rest of the world are doing to harness their energy resources.

A critical factor is to fully implement all regional strategies such as the Revised Regional Indicative Strategic Development Plan (RISDP) and SADC industrialization Strategy and Roadmap, as well as the SADC Regional Infrastructure Development Master Plan (RIDMP).

The Energy Sector Plan of the RIDMP identifies a total of 89 energy infrastructure projects that need to be implemented over next few years at an estimated total cost of between US$114 billion and US$233 billion. Some flagship projects include the Inga III Hydropower Project in the Democratic Republic of Congo and the Mphanda Nkuwa Hydropower Project in Mozambique.

This third edition of the *SADC Energy Investment Yearbook* documents investments taking place in the energy sector in southern Africa, highlighting progress towards meeting the regional objective of ensuring "the availability of sufficient, least-cost, environmentally sustainable energy services".

This publication is produced to assist SADC Member States and other players in the energy sector to identify opportunities for investment, and is intended as a reference for SADC Member States and policy makers, the SADC Secretariat and its subsidiary organisations, international cooperating partners, private sector and investors, researchers and academic institutions, as well as media houses.

SADC Energy Investment Yearbook 2018 is produced by the Southern African Research and Documentation Centre (SARDC) through its Regional Economic Development Institute (REDI), in consultation with the Energy Division of the SADC Secretariat, and with financial support from the Austrian Development Agency/Austrian Development Cooperation (ADA/ADC). It is our hope that this publication will be of great use to all those involved in the SADC energy sector as well as the regional integration agenda in southern Africa.

SARDC

ACKNOWLEDGEMENTS

This publication was made possible through collaborative efforts. Special thanks to the Regional Economic Development Institute (REDI) of the Southern African Research and Documentation Centre (SARDC) for putting together a team of researchers and writers who contributed various chapters to the publication. The team comprised of the Head of SARDC REDI Joseph Ngwawi, his deputy who is the Senior Researcher/Projects Manager Kizito Sikuka, and Danai Majaha, Kumbirai Nhongo, Tanaka Chitsa, and Ayub Blessing Moyo.

In the production process, SARDC REDI worked with various organizations, experts and individuals to gather and analyse the information. Valuable information came from the SADC Secretariat through its Energy Division, as well as its subsidiary organizations including the Regional Electricity Regulators Association of Southern Africa (RERA), the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), and the Southern African Power Pool (SAPP).

We also acknowledge with deep appreciation the guidance and support of the SARDC Executive Director, Munetsi Madakufamba, who supported the process throughout, from conceptualising the initiative through ideas and informed analysis for content, and Phyllis Johnson, SARDC Founding Director and Special Projects for the active engagement through technical review and knowledgeable eye for accuracy that made this publication a cut above the rest.

Special thanks also goes to the creative work of the SARDC design and publishing team, comprising Tonely Ngwenya and Anisha Madanhi who worked tirelessly to ensure an engaging product that is presented in an attractive and accessible manner.

We express deep gratitude to the Austrian Development Agency/Austrian Development Cooperation (ADA/ADC) for the generous financial support it continues to provide for the research, development and publication of the *SADC Energy Investment Yearbook*, and for their consistent support and contribution to sustainable development in southern Africa through funding this important initiative.

The contribution and pivotal role of all institutions and individuals who supported the preparation of this publication and may not have been credited by name, is gratefully acknowledged. Thank you for your essential support.

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ACRONYMS

ADA/ADC	Austrian Development Agency/Austrian Development Cooperation
AfDB	African Development Bank
ANPG	National Oil and Gas Agency
BOSA	Botswana South Africa
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-and-Transfer
BOT	Build-Operate-Transfer
bpd	barrels per day
CCGT	Combined Cycle Gas Turbine
CSP	Concentrated Solar Power
CTF	Clean Technology Fund
DBSA	Development Bank of Southern Africa
DFI	Development Financing Institutions
DRC	Democratic Republic of Congo
EE	Energy Efficient
EEP	Energy and Environment Partnership
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ETG	Energy Thematic Group
EU	European Union
EUEI PDF	EU Energy Initiative Partnership Dialogue Facility
EU-TAF	European Union Technical Assistance Facility
GDP	Gross Domestic Product
GEF	Global Environment Facility
ICPs	International Cooperating Partners
IDC	Industrial Development Corporation of South Africa
IGMOU	Inter-Governmental Memorandum of Understanding
IPPs	Independent Power Producers
IIPSA	Infrastructure Investment Programme of South Africa
km	Kilometres
kV	Kilovolts
LEC	Lesotho Electricity Company
LNG	Liquefied Natural Gas
MoZiSa	Mozambique Zimbabwe South Africa
MW	Megawatts
NOIC	National Oil Infrastructure Company of Zimbabwe
OPPPI	Office for Promoting Private Power Investment, Zambia
PAU	Project Advisory Unit
PPAs	Power Purchasing Agreements
PPDF	Project Preparation and Development Facility
PPI	Private Participation in Infrastructure
PPPs	Public Private Partnerships
PV	PhotoVoltaic
RE	Renewable Energy
RECP	Africa-EU Renewable Energy Cooperation Programme
RECs	Regional Economic Communities
REEESAP	SADC Renewable Energy and Energy Efficiency Strategy and Action Plan
REN 21	Renewable Energy Network for the 21st Century
RERA	Regional Electricity Regulators Association of Southern Africa

RIDMP	Regional Infrastructure Development Master Plan
RISDP	Regional Indicative Strategic Development Plan
RTN	*Rede Nacional de Transporte de Electricidade*
SACREEE	Southern African Centre for Renewable Energy and Energy Efficiency
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SARDC	Southern African Research and Documentation Centre
SEFA	Sustainable Energy Fund for Africa
SEZ	Special Economic Zones
SIEEP	SADC Industrial Energy Efficiency Programme
SOLTRAIN	Southern African Solar Thermal Training and Demonstration Initiative
SREP	Scaling Up Renewable Energy in Low Income Countries
TESCO	Tanzania Electricity Supply Company
tfc	Trillion Cubic Feet
TPDC	Tanzanian Petroleum Development Corporation
UNIDO	United Nations Industrial Development Organization
ZESA	Zimbabwe Electricity Supply Authority
ZESCO	Zambia Electricity Supply Corporation
ZiZaBoNa	Zimbabwe Zambia Botswana Namibia
ZTK	Zambia Tanzania Kenya

INTRODUCTION

The *SADC Energy Investment Yearbook* is now in its third edition. This edition includes a review of investments made in the energy sector in the last year, to give the reader a comprehensive idea of what the region is doing to improve access and availability of energy to its citizens.

The development of sustainable energy solutions is vital for SADC Member States to achieve their aspirations to grow from low-income into middle-income economies by transformation from solely agrarian and extractive activities through beneficiation and value addition. The success of the drive towards industrialisation in SADC through the implementation of the SADC Industrialisation Strategy and Roadmap 2015-2063, requires an enabling environment that facilitates domestic capacity in various sectors, notably for energy infrastructure and technology.

One of the key enablers for driving the regional integration agenda therefore, is investment in the energy sector. The *SADC Energy Investment Yearbook 2018* is thus a resource for investors, international businesses and local businesses on the potential business opportunities in the SADC energy sector, and serves as a medium to enhance cooperation with international and local organisations to increase energy access.

Chapter 1 gives a general overview of infrastructure investment in the renewable energy subsector. This is intended to provide an overview of the opportunities, key risks and return drivers to invest in the renewable sector

As SADC embarks on an industrialisation drive to develop the regional economy, Chapter 2 looks at developments to promote industrial energy efficiency given that available power generation is not sufficient to meet the expected increase in demand as the regional pushes towards industrial development.

Chapter 3 examines the level of investment made by SADC and Member States to harness the huge potential of gas and oil in the region following the recent discovery of these resources in most parts of the region.

Chapter 4 looks at current initiatives for off-grid investment and the status of mini-hydro and mini-grids as well as the challenges in terms of the policy landscape and unlocking financial resources.

Chapter 5 highlights some of the possible financing mechanisms in the SADC energy sector. The concluding Chapter 6 proffers recommendations and policy options for SADC and Member States on how to develop and attract investment in the energy sector.

Chapter 1 Investment in Electricity

1.1 Introduction

Energy is one of the key enablers of the SADC regional economic integration agenda, particularly as the region embarks on a journey towards industrialisation.

Industrial development has been placed at the core of the developmental integration agenda of SADC. Member States acknowledge that industrial development is central to diversification of their economies, development of productive capacity, and the creation of employment in order to set their economies on a more sustainable growth path.

The essential role of energy is reflected by the prominence accorded to energy-related issues in regional processes, including the Revised SADC Regional Indicative Strategic Development Plan (RISDP) 2015-2020 and the SADC Industrialisation Strategy and Roadmap 2015-2063. These processes identify the availability of affordable and sustainable energy as key to the realisation of sustainable development.

In the electricity sub-sector, the region has identified a number of priority generation and transmission power projects that should be implemented by 2022. These are at various stages of implementation and require billions of dollars in investment. According to the Southern African Power Pool (SAPP), the region faced an electricity deficit of about 400 megawatts (MW) as of October 2018. Massive investment in generation, transmission and distribution infrastructure is required to sustain the projected increase in power demand in the region.

This chapter highlights developments in terms of investment in the power sector during the past year, and reviews some of the investment sources and targeted projects.

1.2 Generation Projects Commissioned in 2017/18

This section looks at the new generation capacity commissioned during the past year. The number of commissioned projects reflects the level of investment in the power sector in terms of rehabilitation of existing plants or construction of new ones.

Generation Projects Commissioned in 2017 Table 1.1

Country	Utility	Name of Project	Type	Generation Capacity (MW)	Project cost (US$ million)
Angola	*Rede Nacional de Transporte de Electricidade* (RTN)	Causa	Hydro	668	
		Soyo	Gas	250	
		CT Hambo	Gas	50	
		Camama	Gas	50	
		Moroto Bento	Gas	50	
		Kileva	Hydro	75	
		Chiumbe Dala	Hydro	12	
Botswana	Botswana Power Corporation	Moropule A	Coal	120	
DRC	*Société Nationale d'Électricité*	Zongo 2	Hydro	150	
Malawi	Electricity Supply Corporation	Diesel	Disiel	6	
Mozambique	Independent Power Producer (IPP)	Kavaninga	Gas	40	
Namibia	IPP	Solar	Solar	70	
South Africa	ESKOM	Kusile	Coal	720	
	IPP	Cogen	Gas	24	
	IPP	CSP	Solar	100	
	IPP	Wind	Solar	240	
	IPP	PV	Solar	150	
Tanzania	Tanzania Electric Supply Company	Kinyerezi	Gas	28	
Zambia	IPP	Ndola Energy	Hfo	55	40.92
Zimbabwe	Zimbabwe Electricity Supply Authority	Kariba South Extension	Hydro	150	
TOTAL				**3 008**	

Source: SAPP, October 2018

According to SAPP, a total of 20 generation projects were commissioned in 2017. They added 3,008 MW of new generation capacity to the regional grid.

Most of the new generation capacity in 2017 came from South Africa, which added 1,234 MW from five projects, as shown in Table 1.1. Another significant contribution came from Angola where the national power utility, *Rede Nacional de Transporte de Electricidade*, commissioned seven projects, with a combined capacity of 1,155 MW.

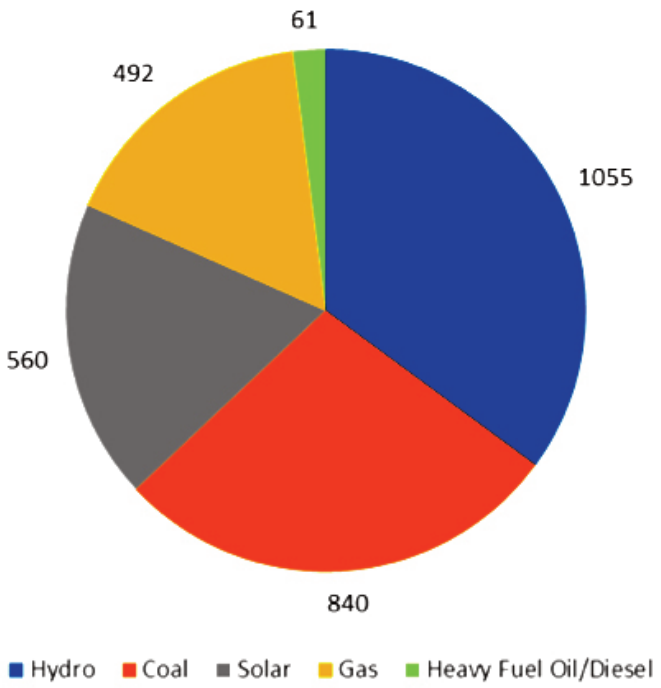
There was also increasing interest from Independent Power Producers (IPPs) who invested in seven power projects in Mozambique, Namibia, South Africa and Zambia. The interest of IPPs in Zambia is testimony to the success of the Zambian government's decision to establish a public institution, Office for Promoting Private Power Investment (OPPPI), which facilitates and promotes investment in the energy sector by private players. The OPPPI is one of two institutions formed following the liberalisation of the Zambian power sector to attract private sector participation in the generation, transmission and distribution of electricity in the country. The other institution is the Energy Regulation Board whose responsibility is to regulate operations and pricing in the Zambian electricity supply industry.

In terms of energy mix, renewable energy sources dominated the new generation capacity added in 2017.

Some 1,615 MW or 64 percent of the new capacity came from renewables. The increase of contribution from renewable energy follows a resolution made in 2012 by southern African countries to increase the uptake of cleaner and alternative energy sources that result in reduced carbon emission. The long-term target set by SADC is to achieve a renewable energy mix in the regional grid of at least 32 percent by 2020 and 35 percent by 2030.

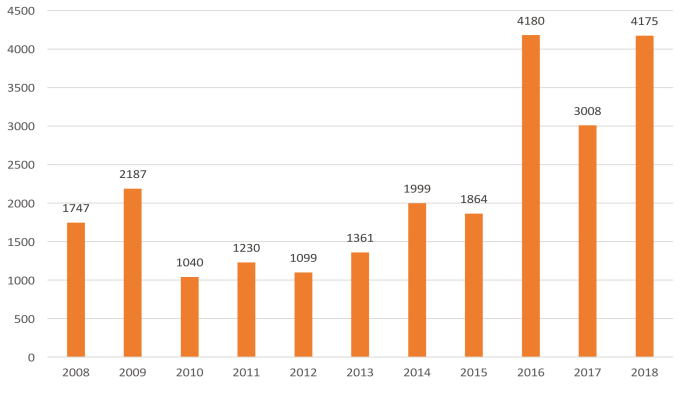
More power generation projects are expected to be commissioned by the end of 2018. According to a SAPP report presented at the meeting of the SADC Energy Thematic Group (ETG) held in Botswana in October 2018, the new projects are expected to add an extra 4,175 MW this year.

Commissioned Power Generation in 2017 (MW) Figure 1.1



Source: SAPP, October 2018

Completed Generation Projects (MW) Figure 1.2



Source: SAPP, October 2018

1.2.1 Trajectory of commissioned power projects

Investment in new power-generation projects has added more than 23,000MW to the regional electricity grid over the past decade, according to SAPP.

Investment in new generation capacity showed significant variation during the past decade, as shown in Figure 1.2, with 2016 recording the highest generation capacity installed. This was the culmination of regional efforts to increase generation capacity which date back to more than a decade ago when Member States agreed to augment generation capacity in the face of shortages of electricity that were expected to set in by 2007. Due to the long gestation period between project design and the commissioning of a power plant, the impact of the generation projects that were embarked on prior to 2007 began to be felt from 2016.

1.3 Planned Generation Projects

Southern Africa has been driving a strong energy infrastructure programme to meet the growing demand over the past few years, as shown by new generation projects and new agreements signed. To address power challenges, the SADC region has short-term measures that include rehabilitation of old plants and building of new power stations. The region plans to add around 28,000 MW of new generation capacity by 2022. Table 1.2 shows some of the planned generation projects in SADC Member States.

Planned Power Generation Projects Table 1.2

Country	Planned Projects
Angola	• 200 MW Soyo gas-fired plant to be commissioned by the end of 2018
Botswana	• The Morupule B Units 5 and 6 coal-fired plant of 300 MW is to be developed by an IPP and planned for commissioning in 2020 • A 100 MW solar plant in planned for commissioning around 2025
DRC	• The plan is to increase capacity with Busanga Power Plant (240 MW) and Nzilo Power Station (120 MW) to be commissioned in 2020
Eswatini	• An IPP has embarked on a 12 MW hydropower station at Lower Maguduza, which is expected to be completed in 2019 • A coal-fired plant with 300 MW capacity to be commissioned by 2024 • A 120 MW hydropower plant is expected to come on stream by 2022 • IPPs have offered to develop a 60 MW solar plant and a 100 MW biomass plant which are to be commissioned by 2022
Lesotho	• Planning to install a 20 MW solar photovoltaic plant in 2018 at Ramorothole in Mafeteng district. Prefeasibility studies and negotiations with the prospective cooperating partner are at advanced stage • Market study for potential hydropower projects within Lesotho Highlands Water Project Phase II with support from the World Bank is expected before the end of 2018
Madagascar	• Constructing 5 hydropower plants with a total capacity of 700 MW, with periods of performance ranging from 5-7 years • Development of renewable energy sources on nine sites, of which six sites will be hydro and will produce a total capacity of 100 MW while the other three will be hybrid solar and biomass or thermal generating using Heavy Fuel Oil (HFO) and will have a total capacity of 40 MW
Malawi	Committed to increasing generation capacity by 2020 through: • Hydropower plants at Nkula A with capacity of 12 MW to be commissioned in 2018 • Tedzani 4 with capacity of 22 MW to be commissioned in 2020 • Kamwamba which will add 300 MW to the grid in 2020 • Lower Fufu 100 MW to be ready in 2020 • Songwe 180.2 MW to be completed in 2020 • A diesel plant of 50 MW and co-generation technologies at Nchalo and Dwangwa with 20 MW and 11 MW, respectively, scheduled for completion this year • Additional 70 MW solar plant for peaking by 2019 to be developed by IPPs
Mauritius	• Will increase generation capacity by 60 MW at Saint Louis Power Station running on HFO, convertible to Liquefied Natural Gas (LNG) later • Planning to commission 120 MW Combined Cycle Gas Turbine (CCGT) plant by 2020, initially with 80 MW in open cycle running on diesel and converted to LNG when operational in combined cycle mode
Mozambique	• Benga Thermal Power Station is to be undertaken in phases, with the first 300 MW planned for 2019 • Moatize Power Station will be undertaken in phases with the first 300 MW planned for 2018 • Central Termica Mozambique Gas-powered Plant of 100 MW is expected before the end of 2018 • Temane gas-fired plant of 400 MW is expected in 2022 • Mphanda Nkuwa Hydro project with 1500 MW is expected to be commissioned in 2026 • Cahora Bassa North Bank hydropower project with 1245 MW is planned for commissioning in 2025 • 30 MW Mocuba Photovoltaic (PV) solar power plant is under construction and expected in 2019
Namibia	• 880 MW Kudu gas-fired plant is planned for commissioning in 2021 • Development of Baynes hydropower project in collaboration with Angola will add capacity of 600 MW by 2023 • Installation of a 55 MW solar PV plant is expected by the end of 2018
South Africa	• Kusile coal-fired power station will bring a total of 4310 MW by 2021 and a total capacity of 4800 MW when complete • Medupi Coal-fired Power Plant will bring full capacity of 4800 MW after final commissioning in 2022 • Updating of the Integrated Resource Plan (IRP) which will guide further investment in electricity generation, is ongoing

continued...

Planned Power Generation Projects Table 1.2

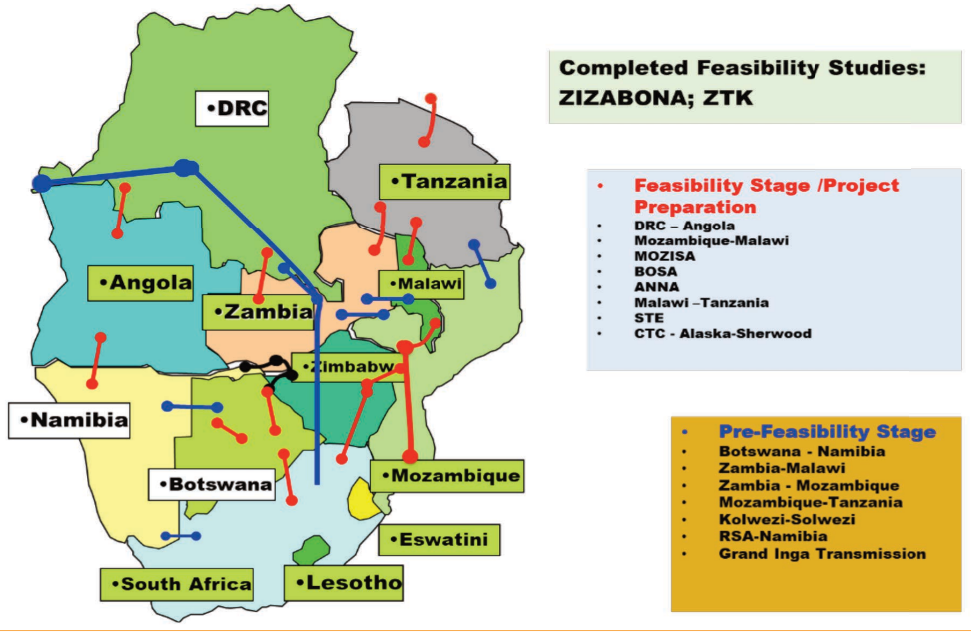
Country	Planned Projects
Tanzania	• Commissioning of Kinyerezi 3 and 4 with total capacity 930 MW are expected to be ready by end of 2018 • Two gas-fired plants, one at Somanga 210 MW and another at Mtwara 300 MW are expected to be commissioned by 2019 • Kinyerezi 1 & 2 and Somanga will commission additional 300 MW and 600 MW gas-fired by 2020 and 2022, respectively • Commissioning of Ruhudji Hydropower with 480 MW capacity is expected in 2020 • Commissioning of Mchuchuma coal-fired plant with capacity of 300 MW expected in 2021
Zambia	• The plan is to commission a total of 113 MW (Lusiwasi 86 MW, ZESCO Chishimba 15 MW and LHPC 12 MW) of hydropower by the end of 2018 • Commissioning of Kalungwishi and Lunsemfwa hydropower stations with capacities of 247 MW and 255 MW respectively, is expected by 2019 • A solar PV plant of 100 MW is expected by 2018 • A coal-fired power plant owned by EMCO Energy with capacity of 300 MW is expected in 2019 • Kafue Gorge Lower Hydro with a capacity of 750 MW developed by ZESCO is expected in 2020 • The Copperbelt Energy Corporation is developing a 40 MW hydropower plant at Kabompo site for commissioning in 2020 • Feasibility studies are ongoing for 700 MW Luapula Hydropower Plant
Zimbabwe	• Upgrading of Kariba South Extension has brought additional 300 MW • Hwange coal-fired Power Station Extension 7 and 8 with 600 MW capacity to be commissioned in 2021 • 30 MW Gairezi hydropower plant expected in 2021 • Commission IPP-driven coal-fired power plants 600 MW Gwai (CASECO), Southern Energy 660 MW and small thermals with 240 MW by the end of 2025
Zambia and Zimbabwe	• Jointly developing Batoka Hydro Electric Scheme through the Zambezi River Authority with capacity of 2400 MW to be shared equally after commissioning in 2025.

Source: SADC, June 2018

1.4 Transmission Projects

The development of regional power interconnectors will enable SADC Member States to share and benefit from increased generation capacity across borders. Several transmission projects are planned to evacuate power from countries with surplus electricity production to those with shortfalls. Once completed, the new interconnectors are expected to promote regional power trade, enhance security of electricity supply, and foster regional trade.

Priority Transmission Projects Figure 1.3



Source: SAPP, October 2018

The planned transmission projects are classified in three categories, according to SAPP.

- **Category 1** comprises projects that aim to interconnect the three SAPP non-operating members.
- **Category 2** is made up of projects to relieve transmission congestion.
- **Category 3** involves transmission projects to move power from new generating stations to load centres.

The six priority projects to connect Angola, Malawi and Tanzania in Category 1 are shown in Table 1.3.

Transmission Projects to Interconnect Non-Operating SAPP Members Table 1.3

Project Name	Countries Involved	Estimated Cost (US$ million)	Funder/s	Status
Zambia-Tanzania-Kenya	Zambia, Tanzania, Kenya	625		Feasibility studies completed
Mozambique-Malawi	Malawi, Mozambique	94		At feasibility/Project preparation stage
Angola-Namibia	Angola, Namibia	To be decided	SADC PPDF	At feasibility/Project preparation stage
DRC-Angola	Angola, DRC	To be decided		At feasibility/Project preparation stage
Mozambique-Tanzania	Mozambique, Tanzania	To be decided		At feasibility/Project preparation stage
Malawi-Tanzania	Malawi, Tanzania	To be decided		Feasibility studies completed

Source: Adapted from SAPP presentations at SADC ETG meetings, 2018

The following are the Category 2 projects being implemented by the SADC region.

Interconnector Projects to Relieve Transmission Congestion Table 1.4

Project Name	Countries Involved	Estimated Cost (US$ million)	Funder/s	Status
ZIZABONA	Zimbabwe, Zambia, Botswana, Namibia	223		Feasibility studies completed in December 2017
Central Transmission Corridor (Alaska-Sherwood)	Zimbabwe	To be decided		At feasibility/Project preparation stage
Mozambique Backbone	Mozambique	1 700		At feasibility/Project preparation stage
Mozambique-Zimbabwe-South Africa	Mozambique, South Africa, Zimbabwe	350		At feasibility/Project preparation stage

Source: Adapted from SAPP presentations at SADC ETG meetings, 2018

Transmission Projects to Move Power from New Generating Stations to Load Centres Table 1.5

Project Name	Countries Involved	Estimated Cost (US$ million)	Funder/s	Status
Grand Inga Transmission	DRC	To be decided		At pre-feasibility stage
Mozambique-Malawi	Malawi, Mozambique	To be decided		At pre-feasibility stage
Botswana-South Africa	Botswana, South Africa	To be decided		At feasibility/ Project preparation stage
Botswana-Namibia	Botswana, Namibia	To be decided		At pre-feasibility stage
South Africa-Namibia	Namibia, South Africa	To be decided		At pre-feasibility stage
Mozambique-Zambia	Mozambique and Zambia	To be decided	AfDB	At pre-feasibility stage
Kolwezi-Solwezi	DRC, Zambia	To be decided	AfDB	At pre-feasibility stage

Source: Adapted from SAPP presentations at SADC ETG meetings, 2018

1.4.1 Summary of status of some planned interconnector projects

Zambia-Tanzania-Kenya Interconnector
The engineering, procurement and construction contract was awarded in Zambia and construction of the Mbeya – Kasama line is underway. For the Kasama-Nakonde line in Zambia, the contract was awarded and construction is expected to take 18 months. Feasibility studies were completed and fundraising is underway for the Mbeya-Border (100 km) and Mbeya-Iringa (292km) lines. Construction of Iringa-Singida-Shinyama was completed and the project is under commissioning. Funding for transmission and substation segments has been secured for the Singida-Arusha-Namanga (Kenya) line. Currently in operation at 220kV is the Iringa-Dodoma-Singida-Shingana line. Commissioning of Zambia-Tanzania Interconnector is expected in 2019.

Mozambique-Malawi Interconnector
Feasibility studies have been completed and discussions are ongoing with various stakeholders. The Mozambique-Malawi interconnector will entail the construction of a power line from Matambo substation in Mozambique to Phombeya, north of Malawi's commercial capital, Blantyre. The interconnector will also allow Malawi to have access to the regional market through Mozambique's interconnected grid with Zimbabwe (Songo-Bindura) and South Africa (Songo-Apollo). Once commissioned, other SADC Member States will have access to power from Malawi as it will be connected to the regional grid.

Mozambique-Zimbabwe-South Africa Interconnector
Feasibility studies have been completed for the MoZiSa interconnector project that is expected to complement other regional transmission lines and facilitate power transfers within the SAPP network. Under the grand project, there will be various separate developments within individual countries to complement the scheme. In Zimbabwe there will be a new substation at Triangle and another one at Orange Grove. Between Zimbabwe and South Africa, the Triangle-Nzhelele interconnector will be built with a 400kv line that stretches 275 kilometres. A new 400kV line bay at Nzhelele substation is also expected to be constructed. Other major developments are being proposed between Zimbabwe and Mozambique. A 185km-long 400kV line will be developed interconnecting Orange Grove in Zimbabwe to the Inchope Interconnector in Mozambique. Furthermore, a new 400/220kV Inchope Substation in Mozambique will be established, while a 360km long 400kV Inchope-Matambo line and a 400kV that stretches 115km will be constructed at Matambo-Songo.

Mozambique-Zambia Interconnector
The consultation of stakeholders for development, and for Environmental and Social Impact Assessment (ESIA) feasibility studies, was completed in 2017. The ESIA report is expected before the end of 2018 and the final technical design report expected to feed into ongoing discussions with various stakeholders.

Kolwezi-Solwezi Interconnector
This will be a transmission interconnector between DRC and Zambia. The technical and environmental bids were evaluated and consultants appointed for the technical studies.

Malawi-Zambia Interconnector
The feasibility and ESIA studies are in progress and were expected to be finalised by the end of 2018. The project is planned for commissioning in 2019.

Malawi-Tanzania Interconnector
This is part of efforts by SAPP to link non-operating members to the regional grid. Feasibility studies are underway for the interconnector project.

Zimbabwe-Zambia-Botswana-Namibia Interconnector

Feasibility studies have been completed and are awaiting commitment from potential investors. The project has been repackaged into three components:

- Component A involving the link between Zambia and Zimbabwe;
- Component B involving link between Botswana and Zimbabwe; and
- Component C comprising the connection between Namibia and Zambia.

The total cost of the project is US$223 million, with Component A estimated to cost US$37 million while Components B and C are projected to cost US$30 million and US$127 million, respectively.

Negotiations are underway with the African Development Bank (AfDB) for funding the Zimbabwe section. The Zimbabwe Electricity Supply Authority (ZESA) has completed the ESIA as well as the process of aligning technical feasibility to environmental studies which will inform final technical specifications and Engineering, Procurement and Construction (EPC) documents.

As for Component C, Namibia and Zambia are through SAPP Project Advisory Unit (SAPP PAU) mobilising resources for project funding. When fully operational, the ZiZaBoNa line will make it possible for Namibia to import power directly from Hwange in Zimbabwe. Currently electricity from the Hwange Power Station is being routed to Namibia through South Africa.

Botswana-South Africa Interconnector

SAPP secured funding for project preparation from the Infrastructure Investment Programme of South Africa (IIPSA), which is supported by the European Union and managed by the Development Bank of Southern Africa (DBSA). A transaction advisor was appointed to carry out detailed feasibility studies and prepare the project to reach financial closure. Feasibility studies have been completed and ESIA study is yet to be approved for BOSA. The project is planned for commissioning in 2022.

Angola-Namibia Interconnector

SAPP secured funding from the IIPSA to support the project. A pre-feasibility report was approved by the stakeholders covering the options and line route selection, market analysis, preliminary design, pre-feasibility financial analysis and cost estimates and potential commercial structures. A Transaction Advisor was appointed to carry out detailed feasibility studies and prepare the project to reach financial closure.

The Inter-Governmental Memorandum of Understanding (IGMOU) between the governments of Angola and Namibia was prepared and ready for signatures by ministers responsible for energy.

The interconnector involves the construction of power transmission lines from the proposed Baynes Hydropower Plant in Lower Kunene, Namibia, to link to the national power grid of Angola. While this leg of the project focuses on the section in Angola, it forms part of the broader project which is in Namibia.

CHAPTER 2

INVESTMENT IN OIL AND GAS INFRASTRUCTURE

2.1 Introduction

The recent discovery of gas and oil in southern Africa has the potential to improve the energy situation in the region and contribute to the regional energy mix, which is currently dominated by coal and hydro. Ultimately, the exploration of oil and gas as an alternative source of energy could transform most economies in the Southern African Development Community (SADC) and promote sustainable development. This chapter, therefore, examines the level of investment made by SADC and its Member States to harness the huge potential of gas and oil in the region.

According to the International Energy Agency (2017), oil and gas will play a vital role in meeting the world's energy needs, and is expected to account for nearly half of the primary energy mix by 2040. This chapter will proffer some policy options for consideration, particularly on how SADC and its Member States could address some of the challenges encountered in fully exploiting oil and gas.

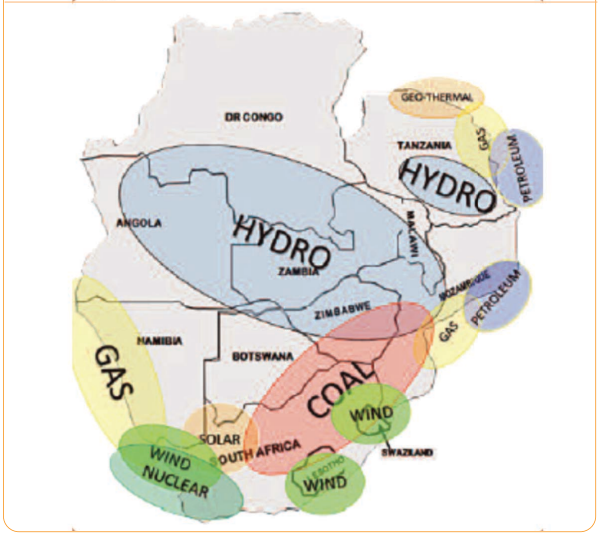
2.2 Overview of the SADC Oil and Gas Sub-Sector

The contribution of gas and oil to the SADC regional energy mix is very minimal, accounting for a mere 1.3 percent of the total power generation mix (SADC, 2016). This situation is the same at the continental level with oil accounting for 23 percent of the African energy mix while gas contributes 14 percent (Market Intelligence Report, 2018). Compared to other Regional Economic Communities (RECs) in Africa, the SADC region has the lowest percentage in terms of oil and gas use with coal playing a dominant role in the energy sector (HIS, 2016). The low use and uptake of oil and gas in southern Africa is despite the fact that SADC has some of the largest deposits of natural gas and oil in the world. Figure 2.1 provides an overview of energy resources in mainland SADC.

SADC has acknowledged the need to fully exploit the huge deposits of natural gas and oil in the region, since the development of an oil and gas market in SADC has the potential to deliver dual benefits of facilitating universal access to energy through gas-to-power and household use, as well as advancing the industrialization agenda in the region through the manufacturing of key components and other associated by-products that are critical to spur outputs in other sectors. In this regard, there are plans to ensure that the region achieves a more balanced regional energy mix by 2022, where natural gas and oil are key contributors to the energy mix.

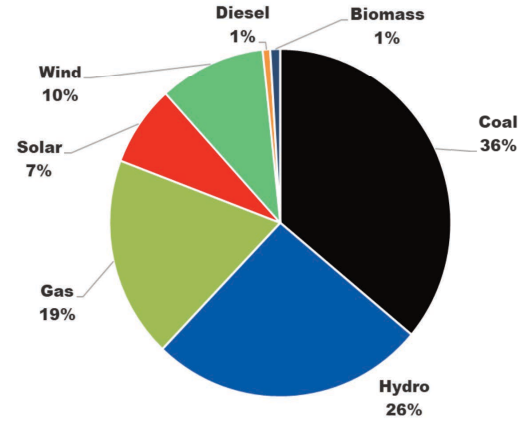
Figure 2.2 shows the projected regional energy mix in SADC by 2022.

SADC Energy Resources, Mainland Countries Figure 2.1



Source: SAPP presentation at SADC ETG Meeting, October 2018

New Generation Capacity, MW Figure 2.2



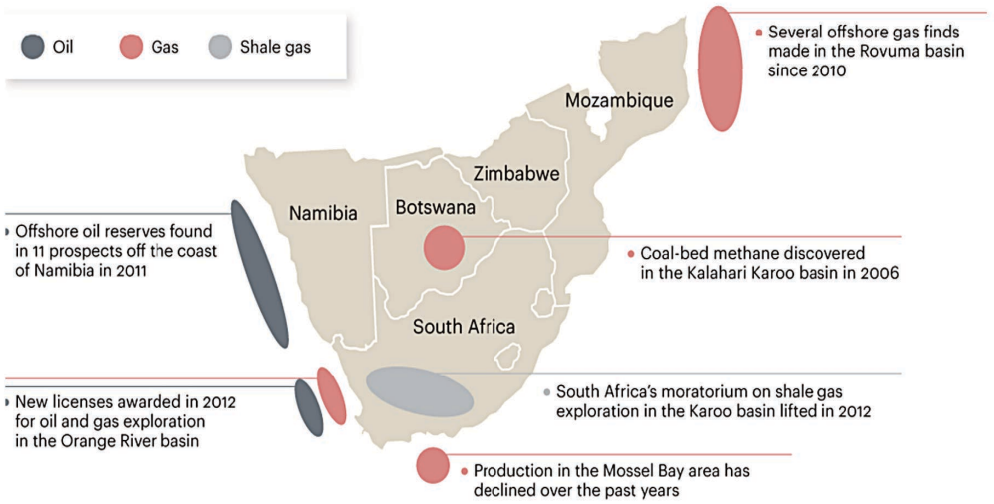
Source: SAPP presentation at SADC ETG Meeting in October 2018

2.2.1 A new oil and gas frontier

Up until the around 2010, all that southern African countries seemed to offer in terms of oil and gas resources were scattered pockets of such resources off the coasts of South Africa and Mozambique. However, all that has changed in recent years with the discoveries of new resources in other countries. In fact, oil and gas are gradually becoming more significant to the region's energy sector as a number of other SADC Member States develop their respective gas-fields, including Angola, Democratic Republic of Congo, Madagascar, Namibia and the United Republic of Tanzania.

Figure 2.3 shows recent oil and gas discoveries in selected SADC countries.

Recent Oil and Gas Discoveries in Selected SADC Countries Figure 2.3



Source: A.T Kearney Analysis

The main producers of oil and gas in the SADC region are Angola, Tanzania, DRC and Mozambique, although Namibia has recently discovered significant reserves of natural gas offshore and South Africa is rich in shale gas and coal-bed methane gas. Efforts are underway to begin exploitation of coal-bed methane in Botswana and Zimbabwe. The east coast of the SADC region has emerged as one of the brightest spots in the global energy landscape, with large natural gas finds offshore in Mozambique and Tanzania. Exploration has taken place in other SADC Member States although the exact amounts of reserves are unknown for these countries.

New offshore natural-gas finds along the Mozambique coast are expected to be a "game changer" for the country and the region. The country has estimated recoverable natural gas reserves of between 15 trillion and 30 trillion cubic feet (tcf), enough to meet one year's gas consumption by the United States of America. Tanzania has also identified natural gas reserves of more than 10 tcf from its deep-water offshore region. Angola has natural gas reserves estimated at 11 trillion cubic feet (tcf), while Mozambique has more than 180 tcf of gas discovered and there is potential for this to be doubled by 2030. In Namibia, there is about 1.3 tcf of proven gas reserves with an estimated potential of 9 tcf.

2.3 Harnessing the Oil and Gas Potential

Oil and gas has various potential uses in SADC. It can be used to generate electricity or as chemical feedstock in industrial processes or as fuel for vehicles. Another potential use of gas is in the production of fertilizers.

One of the advantages of gas it that is has a low carbon emission profile, making it a cleaner energy source when compared with other fossil fuels. It is also affordable, secure and reliable. However, the full potential of oil and gas in the region remains a challenge, mainly because most of the

fields are in the early-exploration phase and most of the discoveries are not proven reserves (Alberich et al. 2013). In addition, gas and oil sources have relatively high extraction costs. Hence, SADC has come up with innovative ways to ensure that it fully harnesses its oil and gas potential.

To fully realize the gas potential in the region, SADC is developing innovative methods of exploring gas and oil reserves. SADC is in the process of developing the requisite gas processing, transportation and distribution infrastructure to supply the regional market so that SADC will not only limit itself to being a gas exporter. SADC must also put in place viable and vibrant policy and regulatory frameworks to make the development of this infrastructure a reality and attract investment in the gas sector.

Angola has created a National Oil and Gas Agency (ANPG) which will take on the role of the national concessionaire in place of the state oil company Sonangol, to coordinate the exploration for oil. South Africa is finalizing its oil and gas law that could encourage more foreign investment. The Minerals and Petroleum Resources Development Act Amendment bill has been before parliament for 5 years, and the new President Cyril Ramaphosa has called for its finalization.

Another important strategy for the region to harness its huge oil and gas potential is to learn from other successful gas projects in the region, and in Africa and the rest of the world. These include the gas pipeline from Mozambique (Temane/Pande) to South Africa (Secunda) as well as the West African Gas Pipeline, involving Nigeria, Benin, Togo and Ghana.

2.3.1 Regional gas master plan

At the regional level, SADC ministers have approved plans to develop a regional master plan that will guide the exploitation of the vast natural gas resources that exist in the region. This was agreed by the SADC Council of Ministers that met ahead of the 38th SADC Summit of Heads of State and Government held in August in Windhoek, Namibia.

The SADC Regional Gas Master Plan will be aligned to other regional strategic documents such as the SADC Regional Infrastructure Development Master Plan (RIDMP) and the Revised SADC Regional Indicative Strategic Development Plan (RISDP) 2015-2020. The RIDMP is the region's strategy for the development of integrated regional infrastructure to meet projected demand by 2027, while the RISDP is a strategy that seeks to achieve major economic and technological transformation at national and regional levels to accelerate economic growth through industrial development.

2.3.2 SADC establishes regional gas committee

The SADC Council of Ministers meeting ahead of the 38th SADC Summit of Heads of State and Government held in August in Windhoek, also directed the SADC Secretariat to operationalize the SADC Regional Gas Committee. The decision to establish a regional gas committee is in line with a directive made by the 37th SADC Summit held in August 2017 in Pretoria, South Africa, which said there is need for the region to create a committee that will be charged with ensuring the inclusion and promotion of natural gas in the region.

SADC Member States would nominate members to sit on the SADC Regional Gas Committee. In the long term, the committee is expected to facilitate an increase in universal access to energy as well as to promote industrial development in SADC. The committee is expected to commission and coordinate all studies to investigate options and plans related to the development and financing of natural gas projects in the region, as well as play an advisory role to the SADC Energy Ministers on approaches, strategies, policies and implementing actions for the development of the regional gas market and infrastructure. The objectives of the SADC Regional Gas Committee include the provision of:

- sound, comprehensive guidance and recommendations based on best practices regarding the development of the gas market and infrastructure for the region; and
- advice on policies and strategies to be developed and implemented in pursuit of a sustainable gas market for the benefit of all Member States.

2.4 Investment in Oil and Gas Infrastructure

SADC is investing significant resources in developing its oil and gas industry. However, as shown in Table 2.1, most of the investment is being made by individual Member States with support from traditional oil and gas partners such as Total, Sonangol and Chevron.

DRC announced in March 2017 the first production of oil from the Moho Nord project, which lies 75 kilometres off Pointe Noire. The US$10 billion Moho Nord, which is the largest oil project ever undertaken in the DRC, has a production capacity of 100,000 barrels of oil equivalent per day. The development of the Moho Nord project involved the drilling of 34 wells tied back to a new tension leg platform, the first for Total Offshore Africa, and to Likouf, a new floating production unit.

In South Africa, the country and its various sectors are preparing for the high-potential Brulpadda-1AX well scheduled to be drilled on the block by December 2018, and infrastructure is not a concern as there is existing oil and gas production next to Block 11B/12B. Brulpadda could be the start of a world class development offshore in South Africa and the rest of the SADC region.

Investment in Oil and Gas Development in SADC Table 2.1

Country	Project	Description	Funders	Amount
Angola	N'Zeto Offshore Project	Expected to produce 230,000 barrels of crude oil per day when fully operational	Total Sonangol	US$16 billion
	Soyo Gas Plant	This is a 200MW plant that is under construction and is expected to be commissioned by the end of 2018		
DRC	Moho Bilondo	Investment in the project includes the installation of a floating production unit with a daily processing capacity of 100,000 bpd	Total Chevron	US$10 billion
Mozambique	Oil, liquefied and petroleum gas	Sasol plans to develop an integrated oil and liquefied petroleum gas project adjacent to its existing petroleum facility. The project includes 13 wells and an LPG production facility.	Sasol	US$1.4 billion
	Coral South LNG	It is estimated that the Coral field holds upwards of 450 billion cubic metres of gas. With such sizeable reserves on offer it's no wonder that oil majors have rushed to get involved.		US$4.67 billion
Mauritius	St Louis Power Station	The project consists of the construction of a new powerhouse for the installation of four Heavy Fuel Oil diesel-generating sets to achieve a total power generation capacity of 67.2 MW. The project also comprises a 66kV gas-insulated substation, a tank farm of two heavy fuel oil storage tanks and a fuel oil treatment plant.		US121 million
	Fort George Combined Cycle Gas Turbine Station	Mauritius plans to commission 120 MW Combined Cycle Gas Turbine (CCGT) plant by 2020, initially with 80 MW in open cycle running on diesel and converted to LNG when operational in combined cycle mode. The project consists of the development of a combined power plant at Fort George. By 2019, work on the installation of the two gas turbines should begin and these should be operational in 2021. The second phase of the work consists of the installation of a steam generator and the installation of the third turbine.		
Namibia	The Aziza Project	Proceeds from the onshore Kalahari asset, which has had more than 700 oil and gas seeps, would be used to develop community solar projects via a hybrid gas-to-solar strategy. This would start the electrification of Namibia as well as surrounding countries	Global investors	US$6 million
	Kudu Gas Project	The Namibian government is considering resizing the project to 442MW, a development which could reduce the expected budget from initial US$1.2 billion to US$600 million. Currently the project is at financing stage but planned for commissioning in 2021.	Namibia	-

continued...

Investment in Oil and Gas Development in SADC Table 2.1

Country	Project	Description	Funders	Amount
Seychelles	Natural Gas Power Plant	It will be cheaper to use LNG to generate electricity than heavy fuel oil.	Private sector, loans	US$200 million
South Africa	Gas Pipeline Project	The 260-kilometre gas pipeline from the Rovuma Basin in northern Mozambique to Gauteng province in South Africa is expected to deliver gas to towns in Mozambique along the pipeline's route.	South Africa, Mozambique	US$6 billion
Tanzania	Tanzania and Uganda Sign Oil Pipeline Project	The crude oil pipeline will have a total length 1443km of which 1115 km in Tanzania	Tanzania, Uganda	US$3.55 billion
	Tanzania's Liquefied Natural Gas (LNG) Project	The Tanzanian government has recently acquired 2070 hectares of land at a total investment of TZS 12 billion (US$6 million) in Lindi town in Tanzania's coastal south region for the construction of a Liquefied Natural Gas (LNG) terminal to supply and tap rising demand from Asia		US$6 million
Zimbabwe	Ethanol	Pipeline transportation of petroleum products as well as storage and handling in the company's depots		US$6 million
	Muzarabani Oil and Gas Project	Government announced the discovery of oil and gas in the greater Muzarabani area by an Australian Company, Invictus Energy, stretching over 200km	Invictus Energy	US$20 million (exploration)

Source: Compiled from news articles, 2018

The Aziza Project in Namibia has also set itself a US$60mn target to fund a 10-well drilling programme in the Kalahari Desert. The plan is that proceeds from the onshore Kalahari asset, which has had more than 700 oil and gas seeps, would be used to develop community solar projects via a hybrid gas-to-solar strategy. This would start the electrification of Namibia as well as surrounding countries.

In Tanzania, Shell in collaboration with Statoil and Tanzanian Petroleum Development Corporation (TPDC) has announced development plans based on their deep offshore discoveries. The consortium intends to build a US$30 billion, two-train, 15-million-tpy onshore LNG export terminal in Tanzania's Southern Lindi region. A new heavy oil refinery has been set up in the industrial park in Bagamoyo area of Tanzania established under the Special Economic Zones (SEZ) by the company. Apart from the production of furnace oil, one of the cheapest fuels available for industrial use, the refinery will also produce lubricants (Oil Review, 2016).

The National Oil Infrastructure Company of Zimbabwe (NOIC) is targeting to complete the construction of two ethanol storage tanks with capacity of 6 million litres at its Mabvuku Depot in Harare by end December 2018.

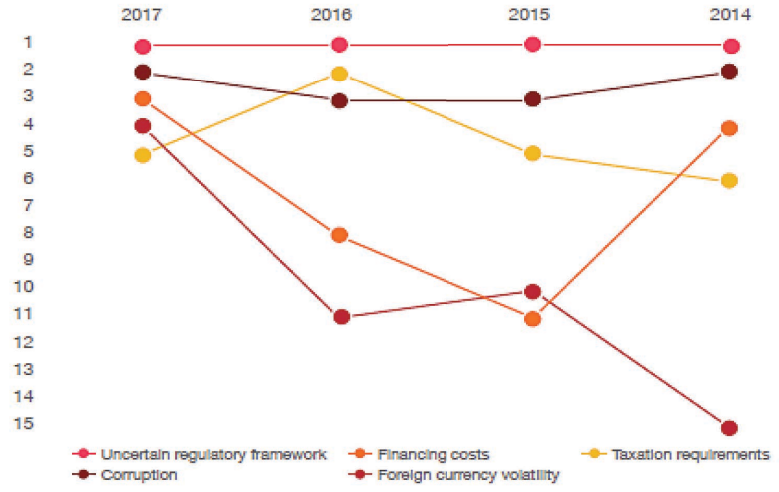
Zimbabwe has plans to drill for oil after a new survey announced the discovery of potential oil and gas deposits in the north of the country. Australian mining firm Invictus Energy, in partnership with government, is to determine whether commercial drilling is feasible. An exploration well would be sunk by Invictus in Muzarabani district within the next two years, by 2020. The estimated cost of drilling the well is expected to be about US$20 million (The Herald, 2018). Once operational the well is expected to change the oil and gas landscape in Zimbabwe and the SADC region.

2.5 Challenges of Harnessing Oil and Gas in SADC

The development of oil and gas solutions in southern Africa is subject to several constraints, one of which is location because most of the source market for oil and gas in the region is Mozambique and Tanzania, several hundred miles from the major consuming countries, particularly South Africa. This therefore, requires the construction of pipelines to transport the oil and gas from the source to market, resulting in the resource becoming more expensive

The discoveries made in most SADC countries have been in remote areas, far from the coast and thus difficult to provide reliable transportation from the oil fields to the export point on the coast. The maintenance of old fields is now costly, while access to new fields involves stiff competi-

Main Challenges Affecting Oil and Gas Development in Africa Figure 2.4



tion among potential partners, resulting in long tender procedures that led to delays in exploring the resource.

Figure 2.4 shows some of the main challenges affecting oil and gas development in Africa.

Uncertain regulatory frameworks remain the major challenge affecting oil and gas development in Africa, as can be noted from Figure 2.4. For example, South Africa is finalizing its oil and gas law – the Minerals and Petroleum Resources Development Act Amendment — to encourage more foreign investment. However, in most African countries, the regulatory environment remains stringent and uncertain despite the promulgation of the petroleum or oil and gas acts. This uncertainty has hindered development since most investors prefer a clear and conducive regulatory environment.

Another challenge is related to the highly volatile prices. Low oil prices had led most global operators to defer Final Investment Decisions on over US$300 billion of projects. However, in recent years, there has been some recovery in the pricing environment, and this has started to increase investor confidence. Closely linked to highly volatile prices is the challenge of producing crude oil and refined products at a lower cost to stay competitive.

The oil and gas industry is a major consumer of water and energy resources and is therefore subject to increasingly stringent environmental standards. This constrains investors in their extraction, production and distribution methods in order to obtain or maintain their licence to operate as investors need to provide guarantees and ensure transparency in the environmental management of their activities.

2.5 Conclusions and Way Forward

The potential for natural gas and oil reserves in SADC is significant. However, a collaborative and interdependence approach, which is supported by a regionally focused regulatory and fiscal environment is required to ensure that the SADC is able to fully harness its potential. In this regard, the decision by SADC to establish a technical committee consisting of experts, primary producers, and other key operators to constitute and initiate work of the Regional Gas Committee, as well as to develop a regional gas master plan is commendable. However, to fully harness the potential of natural gas and oil, SADC and Member States could consider the following key policy options:

- Improve regulatory environment to encourage more investors into the sector;
- Invest in technology and skills development because the oil and gas sector is highly skilled and depends on hi-tech; and,
- Improve access to finance to promote investment in the sector.

CHAPTER 3

INVESTMENT IN INDUSTRIAL ENERGY EFFICIENCY

3.1 Introduction

Investment in energy efficiency is one of the key enablers for the successful implementation of the SADC Industrialisation Strategy and Roadmap (2015-2063). This roadmap seeks to double the share of manufacturing value added in the region's Gross Domestic Product (GDP) to 30 percent by 2030 and to 40 percent by 2050.

The anticipated industrial development and projected economic growth places a huge demand on energy within the SADC region. The industrialisation strategy assumes an average economic growth rate of eight percent per annum, which means that the forecast peak load for electricity is expected to rise to more than 77,000 MW by 2020 and to over 115,000 MW by 2030.

Anticipated investment in energy-intensive industries such as mining and manufacturing needs consistent supply of cost-effective energy and, while noteworthy steps are being taken to increase the region's energy capacity in order to meet growing demand, stakeholders recognise that significant energy potential can be unlocked through strategic investments in energy efficiency solutions. This chapter looks at some of the initiatives being undertaken, and the support received, by SADC to improve industrial energy efficiency as the region embarks on a journey towards industrialisation.

3.2 The Case for Industrial Energy Efficiency

Energy efficiency refers to measures taken to reduce the losses in generation, transmission and distribution networks on the supply side and to reduce the consumption of energy in demand sectors that include household, industry, commerce. Industrial energy efficiency specifically looks at the extent to which small, medium and large enterprises are implementing energy saving strategies within their processes in a manner that makes industrialisation more sustainable.

Technology policies are one of the options available for the reduction of carbon emissions and the usage of energy. At the global level, around 37 percent of primary energy is converted to useful energy, meaning that nearly two-thirds is lost (SARDC, 2018). The next 20 years will likely see energy efficiency gains of 25-35 percent in most industrialised countries and more than 40 percent in transition economies. Therefore, energy efficiency is seen as one of the main technological drivers of sustainable development worldwide.

Energy policy has traditionally underestimated the benefits of end-use efficiency for society, the environment and employment. Achievable levels of economic efficiency depend on a country's industrialisation, motorization, electrification, human capital, and policies. But their realisation can be slowed by sector- and technology-specific obstacles — including lack of knowledge, legal and administrative obstacles, and the market power of energy industries.

Some of the benefits of running industrial energy efficiency programmes include the following:

- Improved security of energy supply;
- Improved international competitiveness, resulting from lower energy costs and technology innovations;
- Improved national key indicators such as GDP, direct climate-related and -induced investment, consumption and employment;
- Reduced energy costs and in many cases minimised life cycle costs of end-use technologies for consumers;
- Provision of the least-cost approach to green-house emissions;
- Reduced demand on electricity supply systems such as during peak times.

3.3 Regional Initiatives on Industrial Energy Efficiency

There are number of initiatives at regional level to promote industrial energy efficiency. There is no data available on actual investments in industrial energy efficiency programmes.

3.3.1 SADC Industrial Energy Efficiency Programme

The SADC Industrial Energy Efficiency Programme is implemented by the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) as part of its mandate to oversee the implementation of the Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP). The centre, which is based in the Namibian capital Windhoek, is strongly focusing on the development and implementation of a holistic regional energy efficiency programme that involves the following demand-side management measures and energy efficiency options:

- Awareness raising, including implementation of energy efficiency labels and Minimum Energy Performance Standards;
- Promotion of more efficient technologies – including lighting, industrial equipment, efficient cooking;
- Fuel Switching such as the use of Liquid Petroleum Gas;
- Promotion of load management, including the introduction of ripple control and time-of-use-tariffs;
- Electricity grid losses mitigation such as promotion of the use of pre-paid and smart metering;
- Promotion of building codes to improve energy efficiency; and
- Promotion of efficient lighting in buildings.

SACREEE in conjunction with the European Union Technical Assistance Facility (EU-TAF) has developed a regional SADC Industrial Energy Efficiency Programme (SIEEP), which is intended to support the implementation of the SADC Industrialization Strategy and Roadmap, 2015-2063.

The intention is for SIEEP to contribute to the competitiveness of the industrial sectors of SADC Member States by utilising energy efficient technologies and practices. The objectives of the programme include energising SADC towards adequate, reliable, least cost and environmentally sustainable energy service.

The design and implementation of SIEEP focusses on addressing the barriers and gaps and seizing opportunities identified in the scoping and assessment study. The programme will be based on the following six pillars:

- Formulation of appropriate policy, regulatory and institutional frameworks;
- Capacity building and skills development;
- Demonstration or pilot programmes and projects and awareness raising;
- Financing of Energy Efficient/Renewable Energy interventions;
- Application of RE in industries;
- Domestication of RE/EE technologies in the SADC region.

3.3.2 SOLTRAIN solar heating for industrial application programme

The Southern African Solar Thermal Training and Demonstration Initiative (SOLTRAIN), funded by the Austrian Development Agency, is running a training programme to improve industrial processes through the integration of solar heating in factories. This is intended to encourage companies to use less grid electricity and reduce their cost of production.

SOLTRAIN is a regional initiative on capacity building and demonstration of solar thermal systems in the SADC region. The main objective of the programme is to promote the use of renewable energies, with focus on solar water heating, and help to move the SADC region away from the use of environmentally unfriendly fossil fuels. The focus on solar thermal or heating systems is deliberate because solar radiation levels in SADC are high, and these systems can be manufactured or assembled in the region Solar thermal systems such as water heating have a huge potential to alleviate problems of unemployment, power supply shortages, high energy costs and pollution.

3.4 Challenges in Implementing Industrial Energy Efficiency Initiatives

One of the major drawbacks to investment in industrial energy efficiency at the regional level has been the lack of appropriate policy and regulatory frameworks within SADC Member States. This has meant that energy efficiency initiatives are being implemented randomly without clear targets in many instances.

There remains a limited level of awareness of the benefits of industrial energy efficiency, and economic incentives to conserve electricity or invest in energy efficiency often inhibit a vibrant private-sector energy efficiency market. Instituting cost-reflective tariffs with lifeline tariffs for the poor will help to ensure that power utilities have a sustainable business model and that vulnerable populations retain access to electricity.

In some companies, there is little technical knowledge with which to implement energy efficiency projects. In addition, many commercial and industrial businesses face a lack of access to funds required to implement energy efficiency projects.

3.5 Conclusions and Way Forward

For the region to reap the benefits that can be derived from industrial energy efficiency, SADC Member States must establish clear policy and regulatory frameworks at the national level. Such policy documents should contain an incentive framework to encourage private sector investment in industrial energy efficiency. The adoption of cost-reflective tariffs within the region will promote investment and help to create a market more conscious of the need to save energy.

In addition, the awareness campaigns need to be accelerated in order to ensure that stakeholders within the region fully appreciate the benefits of investment in industrial energy efficiency. Investment in relevant training can equip industries with the much-needed human capital required to drive industrial energy efficiency projects.

Funding solutions for industry and commerce need to be established to mitigate constraints inhibiting industry from implementing desired energy efficiency initiatives.

Chapter 4
Off-Grid Investment Initiatives

4.1 Introduction

The SADC region has vast potential for off-grid investment, particularly into mini-hydro and mini-grid power generation. The development of off-grid power generation is critical for SADC as the region faces major challenges in improving access to modern energy services.

According to a report presented during the Joint Meeting of SADC Ministers responsible for Energy and Water held in June 2018, there are more than 190 million people who live without access to electricity in the region (SADC, 2018). The weighted regional average access to electricity in the urban areas is estimated at 64 percent while access in rural areas is around 34 percent although the majority of Member States have access levels below 20, according to the report. Critically, the electrification rate for rural households is as low as 3-4 percent in several countries, and only a few countries such as Mauritius and South Africa have rural connection rates higher than 50 percent.

In most SADC Member States, many rural communities are expected to remain unconnected to the national power grids for the foreseeable future unless there is concerted effort to accelerate the development of mini-grids to serve remote centres. However, progress towards achieving this is being hindered by issues around attaining economic viability of such projects. Solving such issues is at the core of unlocking that opportunity.

Investment in off-grid electricity generation comes in the form of investment in mini-hydros or investment in mini-grids. Mini-hydro power plants are plants developed on a scale suitable for local community and industry. They often have generation capacity below 10 megawatts, according to the United Nations Industrial Development Organization (UNIDO).

According to the EUEI Mini-Grid Policy Toolkit, mini-grids are systems that involve small-scale electricity generation with capacity of up to 10 MW that serve a limited number of consumers via a distribution grid and can operate in isolation from the national transmission networks. The toolkit was jointly produced by the Africa-EU Renewable Energy Cooperation Programme (RECP), Alliance for Rural Electrification, the EU Energy Initiative Partnership Dialogue Facility (EUEI PDF) and the Renewable Energy Network for the 21st Century (REN 21) in 2014.

Mini-grids can operate independently of national grids or can be connected to the national grid. They are a way for private companies to offer services more quickly and reliably than state-owned incumbents. Mini-grids can use either hydropower, solar or wind technology. They provide round-the-clock electricity capable of powering machinery, irrigation systems and freezers, as well as lighting. In many cases mini-grids are the most effective way to provide access to energy to rural communities as they are flexible, easy to install and can be connected to the main grid if and when the national network expands (RERA, 2014). Mini-grids also offer long-term development impact by reducing carbon emissions and creating new jobs and business opportunities.

This chapter will seek to look at current initiatives in off-grid investment as well as the challenges faced in terms of the policy landscape and unlocking financial resources.

4.2 Legal and Institutional Provisions to Promote Off-Grid Energy Investment

A number of SADC Member States have put in place strategies to promote private sector investment in off-grid electricity infrastructure. Some of these national strategies are outlined in this section.

Namibia

The Namibian government approved the Off-Grid Energisation Master Plan in 2007. This is a 20-year plan to promote the roll-out of a programme to bring energy solutions closer to the off-grid communities across the country (Namibia Energy Institute, 2016). The master plan has three components:

- Establishment of a Solar Revolving Fund;
- Electrification of public institutions; and
- Establishment of "energy shops".

The main objective of the master plan is to provide access to appropriate energy technologies to everyone living or working in one of three types of areas:

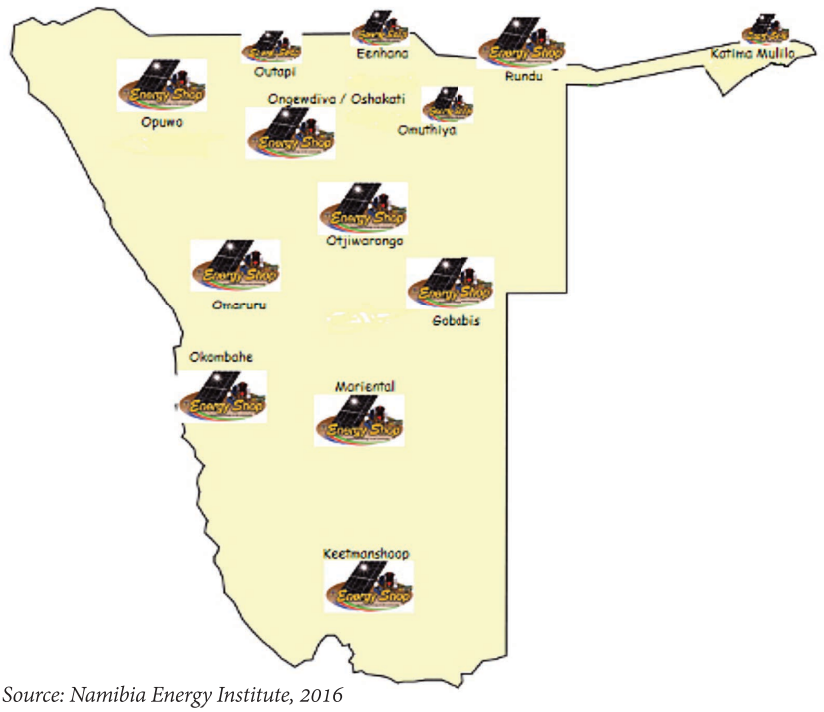
- off-grid areas, or areas that will not have electricity within 20 years;
- pre-grid areas, or areas that will not have access to electricity within 5 years; and,
- "grey" areas or areas such as informal settlements where it is not clear how or if electricity will be provided.

For electrification of public institutions, the Namibia government has introduced "containerized solar systems" at schools, teachers' houses, hostels, clinics, veterinary offices and police stations that are in off-grid areas. The amount of solar energy from these systems can supply electricity to computers, copy machines, fridges and lights.

Some 17 "energy shops" have been established in 13 regions countrywide, with the aim of bringing services closer to the homes of renewable energy system owners.

There is one energy shop in each of the following regions: Eehana, Gobabis, Katima Mulilo, Keetmanshoop, Mariental, Okombohe, Omaruru, Omuthiya, Opuwa, Oshakati, Otjiwaronga, Outapi, and Rundu. The target is to have 180 such facilities in total.

Distribution of Energy Shops in Namibia Figure 4.1



Source: Namibia Energy Institute, 2016

Two solar mini-grids have so far been established. These are the Tsumkwe Solar Photovoltaic Hybrid Mini-Grid and GAM mini-grids. The Tsumkwe Solar PV-diesel hybrid power plant was the first off-grid public power supply of its kind in Namibia (RECP, 2014). Its main purpose is to generate and distribute electric power for the Tsumkwe Settlement Area.

Originally the plant was planned as a purely solar PV system, but due to a surge in customer growth and to reduce costs, make the kWh price more affordable, and still allow for an increase in client numbers, it was redesigned as a PV-diesel hybrid system.

Although the regulatory framework relating to Independent Power Producers allows for private sector participation in Namibia, in practice the country's electricity supply is generated primarily by NamPower and distributed by regional electricity distribution companies or municipalities. The Tsumkwe solar PV hybrid mini-grid was, therefore, the first attempt to promote private involvement in the sector.

South Africa

In South Africa, the government initiated a programme in 1999 to grant private companies the rights to establish off-grid energy utilities in designated concession areas. Although the concessions were essentially based on dissemination of solar home systems, concessionaires were expected to adopt a delivery model promoting a range of fuels and appliances.

Tanzania

According to the SADC Regional Energy Access Strategy and Action Plan, which was approved in 2010, the key components of Tanzania's mini-grid regulatory framework are that it provides for standardised power purchase agreements for small power projects that are connected to the main grid and it stipulates that all small power projects should be paid a standard tariff for feeding into the main grid, subject to minimum and maximum prices established during the year of execution of the agreement and adjusted for inflation every year.

4.3 Status of Mini-Hydro in SADC Region

A number of initiatives have been undertaken by SADC Member States. These include the Mozambique Rural Electrification Project, which aims to provide access to off-grid electricity to more than 500 families in rural Mozambique (Table 4.1). The target is to build more than 300 mini-hydro power plants around the country.

Planned Mini-Hydro Power Plants 2018 Table 4.1

Country	Project	Capacity	Funder	Amount invested/ Estimated investment	Status
Mozambique	Rural Electrification Project	1-3MW	Fundo de Energia	US$500 million	
Zimbabwe	Odzani Mini-Hydro	3.6MW	IDBZ		At feasibility studies stage
Zimbabwe	Tokwe Mukorsi Mini-Hydro	15MW	IDBZ Salini Impregilo	US$25 million	Raising project resources

4.4 Status of Mini-Grids in the SADC Region

One of the key players in the development of mini-grids in the SADC region is the Energy and Environment Partnership (EEP) whose project portfolio extends to 10 countries in Southern and East Africa: Botswana, Burundi, Kenya, Mozambique, Namibia, Rwanda, South Africa, Tanzania, Uganda and Zambia. Tanzania is the dominant country in the mini-grid portfolio, with 17 projects or 40 percent of the total EEP portfolio. According to EEP, the high number of projects in Tanzania reflects a regulatory and economic environment that is favourable to small-scale energy producers.

4.5 Challenges and Opportunities for Mini-Grids

According to a report on opportunities and challenges in the development of mini-grids in Africa published by the Energy and Environment Partnership (EEP) Southern and East Africa in 2018, many countries in SADC and East Africa still lack specific policies for mini-grids in their national electrification plans. This makes planning difficult for private developers. The lack of clarity on regulatory issues impacts on the selection of sites for mini-grid projects as well as affects procedures for getting licenses and permits, future grid integration, and the access of developers to national subsidy schemes.

Projects are often delayed due to the long lead time required to apply for concessions, licenses and environmental approvals. Closely tied to this is that fact that in the majority of cases the regulatory requirements imposed by governments often come with fixed costs that are independent of the size of the project and can be very expensive.

However, the above challenges can be surmounted by strengthening the role of national and regional associations. These associations have an important role to play in improving coordination and closing the information gap between practitioners, investors and policymakers. They offer valuable platforms for private and public-sector stakeholders to consult and collaborate on building enabling regulatory and financial frameworks for the sector. In countries where the processes are clear such as in Tanzania, the development of mini-grids tends to proceed more quickly and smoothly.

In the case of Tanzania, there is also widespread support from local governments and rural electrification agencies, including some co-funding for infrastructure.

Another hindrance to the development of mini-grids in southern Africa is that the consumer cost of electricity from such grids is usually higher than tariffs charged by national utilities (EEP, 2018). National grid tariffs are generally cross-subsidised and not cost-reflective. The advent of smart metering, remote monitoring and demand-side management technologies has, meanwhile, helped to reduce costs and improved the efficiency of mini-grids in rural areas. However many developers still find it difficult to become profitable and seek grants or subsidies to cover capital costs and sometimes operational costs.

4.6 Critical Success Factors for Off-Grid Investment

There is need for clear and transparent guidelines outlining mini-grids to be connected to the national grid and compensated accordingly. To reach financial sustainability, most mini-grid developers are focusing on productive use of energy – such as providing energy efficient appliances or forming local business hubs – as a means to increase demand and generate sufficient revenue.

The most financially sustainable mini-grids use an "ABC" strategy:

- First identify and negotiate an agreement with an anchor-load client (often in agro-processing);
- Then identify, or help to develop, small local businesses; and,
- Finally, target domestic consumers.

Targeting business clients offers a more secure customer base and attracts private investors, but many donor agencies focus more on the number of households connected in the short-term rather than long-term viability.

One of the barriers to the development of mini-grids is lack of access to affordable financing. There is, therefore, need for programmes that will support project developers, especially those entering new markets or testing new strategies or technologies. Most of the projects are run by non-profit organisations, government institutions or universities and usually do not have adequate funds to guarantee sustainability.

Another factor that is critical for success of mini-grids is the need for training of a skilled and dedicated local team and to build strong relationships in the community. Most developers are making an effort to increase employment opportunities, especially for women and youth, spur local economic activity and support small businesses. Thus the development impact goes well beyond rural electrification.

Rapid technological development and operational efficiencies in recent years have made mini-grids a practical and viable solution to electrifying rural areas. Mini-grids fill an important space between individual solutions, such as solar home systems, and extensions of the national grid. By utilising renewable energy sources including solar, wind, hydro and biomass, they reduce pollution and combat climate change. They can also generate sufficient capacity to support industrial and agro-processing operations and stimulate local economic development.

As a result, mini-grids offer an appropriate and cost effective way to provide electricity for rural and low-income communities.

CHAPTER 5

ENERGY FINANCING MECHANISMS

5.1 Introduction

The SADC region has during the past few years been seized with the process of developing a mechanism for financing its integration agenda. The region has since 2015 been engaged in an intense discourse aimed at interrogating the current infrastructure financing mechanism, with a view to identifying opportunities for sustainable financing. There is broad agreement that some of the measures to enhance financing include the following:

- Establishing partnerships with private sector in the context of Public Private Partnerships (PPPs) to spread the burden of infrastructure financing, operations and management;
- Establishment of Regional Infrastructure Development Financing Institutions (DFIs) and mechanisms;
- Operationalisation and resourcing of the SADC Project Preparation and Development Facility (PPDF) as a window of the Regional Development Fund, which is expected to facilitate the packaging of transboundary projects, feasibility studies and environmental impact assessments, and subsequently market such projects to investment partners and consortia;
- Allowing the private sector to come on board and share risk with the state, and bring the commercial culture into such institutions;
- Tap non-traditional sources such commercial banks, insurance companies, pension funds, among others.

There is regional convergence that the sooner infrastructure is funded from domestic and regional resources, the more progress and sustainable the programme will be. This chapter will outline the available/possible financing mechanisms in the SADC energy sector, and the opportunities available to the region as it seeks to finance energy projects.

5.2 Challenges to Funding SADC Energy Projects

Despite the existence of a long list of energy projects in the SADC region, the barrier is usually in accessing funding. The main challenges to speedy implementation of energy projects are as follows:

- Limited capacity to package bankable projects. In the electricity sub-sector this challenge has been addressed through the establishment of the SADC PPDF and the SAPP Project Advisory Unit (PAU);
- Long gestation periods in the preparation and implementation of energy and other infrastructure projects, resulting in most projects missing their targets;
- Member States' prioritiy affected by competing demands, socio-economic services and imperatives such as health (HIV and AIDS), food security, which cannot be put on hold, hence putting infrastructure behind;
- Difficulties in securing power purchase agreements for power projects;
- Complex project financing deals driven by traditional lenders;
- Lack of cost recovery measures discouraging investors and lenders from concluding deals with recipient countries;
- Lack of enabling environment in some Member States discouraging investment in the region;
- Weak partnerships between governments and private sector;
- Lack of appropriate balance between regulation and deregulation;
- Differences in priorities among Member States slowing down investment on transboundary projects;
- Lack of, or perceived lack of, transparency in bidding processes discouraging would-be investors.

5.3 Funding Initiatives

A number of initiatives are being developed to improve the ability of the SADC region to respond to its energy infrastructure needs.

5.3.1 SADC Regional Resource Mobilisation Framework

According to a report presented at the SADC Council of Ministers meeting in Windhoek, Namibia in August 2018, work on the Regional Resource Mobilisation Framework (Alternative Sources of Funding SADC Regional Programmes) is progressing well. The framework proposes a number of alternative sources of funding for regional programmes. Under the framework, the region is exploring six options for alternative and innovative sources of funding.

These are the introduction of an Import Levy; a Tourism Levy; a Financial Transaction Tax; a Regional Lottery System; philanthropy; and regional events. According to the report to Council, studies to undertake in-depth economic impact assessment studies on the viability of the proposed options have been done and are now being reviewed. The in-depth studies have been done on the Import Levy, Tourism Levy, Transport Levy and Financial Transaction Tax.

In order not to negatively impact on some Member States, it has been agreed to adopt an "à la carte" approach to implementing the proposed alternative funding sources. It has been agreed that there is need for flexibility so that Member States are not compelled to adopt any of the proposed options, depending on their economic situation. The options would also require review of relevant legislation at Member State level.

5.3.2 SADC Regional Development Fund

Work is underway to operationalize the SADC Regional Development Fund, which was approved during the 36th SADC Summit held in August 2016 in Eswatini. Once operational, the fund should allow the region to take full charge of its integration agenda by funding its own development plans. Currently, less than 10 percent of regional projects are funded by SADC Member States while the balance comes from ICPs. This situation has compromised the ownership and sustainability of regional programmes.

The Fund will be designed to leverage grants from donors, private sector and Member States' contributions and blend these with long term investment and capital, thus reducing the weighted average cost of capital. While the process of operationalizing the SADC Regional Development Fund is underway, a Project Preparation and Development Facility (PPDF) has been established under the first window of the SADC Development Fund, to address the deficiency in project preparatory financing. The PPDF is managed by the Development Bank of Southern Africa.

5.3.3 Government Funding

Member States have continued to support SADC programmes with resources for coordination functions managed by the Secretariat. While the level of funding has remained consistent over the years, the share of Member States' resources to the total envelope has remained lower than that of International Cooperating Partners (ICPs). However, there is no framework in place to measure the contribution of Member States and the private sector in funding programmes of regional dimension and implemented at national level.

5.3.4 Development Finance Institutions

Public sector investment in SADC also comes from a variety of sources, including the World Bank, the Global Environment Facility (GEF), the African Development Bank (AfDB), the Development Bank of Southern Africa (DBSA), South Africa's Industrial Development Corporation (IDC), as well as public utilities such as Eskom. The AfDB has been particularly active in the renewable energy field, both through its own funding mechanisms and through various specialised funds such as the Sustainable Energy Fund for Africa (SEFA) and the Climate Investment Funds, in particular the Clean Technology Fund (CTF). The AfDB together with the World Bank are strong players in the Scaling Up Renewable Energy in Low Income Countries Program (SREP), for which Lesotho, Malawi, Mozambique and Zambia have been selected as second-phase pilot countries (REN21, 2016).

5.3.5 Private Sector

Private investment is emerging as a significant source of funding within the energy sector, particularly for renewable energy projects. The World Bank tracks private participation in infrastructure projects through its Private Participation in Infrastructure (PPI) Project Database. The database captures publicly available information on private participation in infrastructure projects. Annex 1 maps the trend in private participation in energy sector projects within the individual SADC countries from 1990 to 2015. The indication is that the bulk of the investment has been in the electricity subsector.

Private sector participation in the form of Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), Build-Own-Operate-and-Transfer (BOOT) and Public Private Partnerships (PPP) are feasible modes of financing large infrastructure projects. Lately, infrastructure bonds and pension funds have been mobilised to finance infrastructure projects or leverage more financing from other sources such as commercial banks or multilateral banks such as the European Investment Bank, World Bank and the AfDB. Utilities should also use their balance sheets to borrow from the banks for their equity share. Close cooperation with the emerging economies of China, India and Brazil are also yielding new financial resources.

5.3.6 International Cooperating Partners

ICPs have been a major source of financing "soft" projects such as studies, policy/regulatory framework formulations, planning and capacity building projects (Annex 2). Their resources can also be used to leverage financing from the banks. The soft projects will need to be implemented in the short-term to facilitate implementation of the physical projects. The costs of implementing these strategic options will be determined on a case-by-case basis.

5.4 Conclusion and way forward

For SADC to scale up investment in energy infrastructure, there is need for a number of aggressive measures to be taken. These include, but are not limited to the following:

- Strengthen the national and regional structures that mobilise resources or implement energy and other infrastructure projects;
- Establish appropriate multi- disciplinary project structures to coordinate and oversee projects in order to assist participating governments to speed up implementation of these cross border projects;
- Member States and the region should allocate adequate budgets for the coordination as well as investment in energy projects;
- There is need to create an enabling environment to attract the private sector to invest in energy as well as to encourage it to partner with governments within the framework of Public Private Partnerships to share risk on investment in this area. This should involve identifying and reviewing all instruments and initiatives that create a conducive environment for investment, key among these initiatives are protocols and inter-Governmental Memoranda of Understanding signed at appropriate levels so that they are binding;
- Accord priority to projects preparation (both early stage preparation and preparation to bankability) to ensure availability of a pipeline of bankable projects for would-be investors;
- Develop multilateral agreements to jointly plan, mobilize resources and implement cross-border projects that involve two or more Member States;
- Recognise the crosscutting nature of infrastructure projects and adopt an integrated approach to the design and implementation of infrastructure projects;
- Create Special Purpose Vehicles to implement projects at the level of Member States, including cross-border projects;
- Removal of political interference to facilitate collective design of projects, joint planning, joint resource mobilisation and joint implementation by Member States.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Significant advances have been achieved by the SADC region as it moves to improve its energy security. The positive impact of years of cooperation among Member States has begun to show results, particularly in the electricity sub-sector which, for the first time in about a decade, experienced a surplus in generation capacity in early 2017, through the first half of 2018. However, it must be noted that this comes at a time when most economies in the region are depressed, including the major consumer, South Africa. As economies recover, the electricity supply could slip back into deficit unless the current generation is expanded.

Another important observation is that a number of legal documents, policies, institutional frameworks and strategies are out-dated and need to be reviewed in line with the changing environment to remain relevant and useful. This is very pertinent at this moment in time as SADC has reviewed it RISDP and has adopted a new strategy and roadmap for industrialisation.

Studies have confirmed that development assistance is not panacea for the financing and development of the energy sector in the SADC region. There is need to explore the efficacy of using Direct Resource Mobilisation (DRM) strategies to raise money in the local markets through the development of capital markets and use of private sector funds.

Investment and financing are hampered by a number of barriers, which include low tariffs, poor project preparation, no off-takers that can sign Power Purchasing Agreements (PPAs) under single buyer models and other required policy/regulatory frameworks. The capacity for project preparation and implementation at utility and Member State levels is still very low.

6.2 Policy Options

Below is summary of key policy options for consideration by SADC Member States to promote the development of the energy sector in the region.

- The "regional project" concept needs to be clarified, and there is a need for the development of a framework for the coordination, implementation, championing and financing of these projects. Existing frameworks such as the SAPP need to be fully utilised in this regard.
- The SADC region should create an enabling environment for investment in the energy sector at both the regional and national levels as investors look for stability, sustainability and returns. The environment should address the unique aspects that characterise energy sector projects such as long lead times and high start-up costs.
- New strategic approaches to regional cooperation are needed with a clear regional financing framework to raise funds for project implementation. This should result in coordinated approaches to fundraising at regional, national and utility levels.
- There is need to promote private sector investment in the energy project sector. This can be done through direct investments, syndication with multilateral development banks or PPP arrangements.
- There is need to develop a mechanism that will allow access by the energy investments to long-term funds and development of a diversity of funds through innovative credit structures and co-financing arrangements.
- Energy-related legal documents, policies, institutional frameworks and strategies which are out-dated and need to be reviewed in line with the changing environment to remain relevant and useful.

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