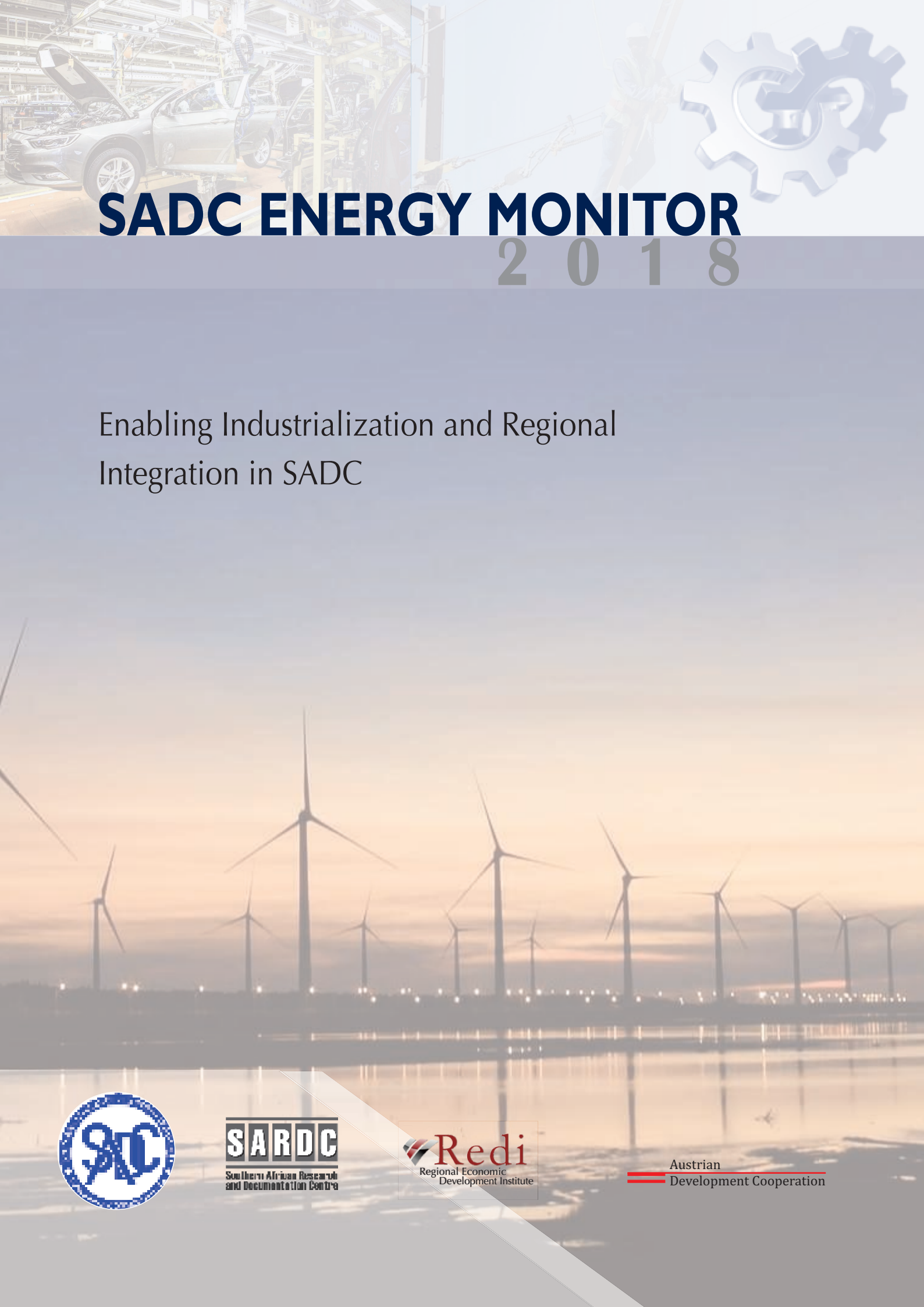
SADC ENERGY MONITOR 2018

Enabling Industrialization and Regional Integration in SADC

SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
SADC
TOWARDS A COMMON FUTURE



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SADC

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FOREWORD

In July 2017, SADC convened a High-Level Ministerial Workshop and an Investment Forum on Regional Energy Projects to discuss sustainable energy development as well as to present its multi-billion-dollar energy infrastructure development plan to potential funders. This workshop and investment forum, held in Ezulwini, the Kingdom of Eswatini, highlights the importance of energy in the integration agenda of southern Africa, since energy access and availability is one of the key enablers of sustainable development.

In this regard, I am very pleased to present the second edition of the SADC Energy Monitor, which presents a comprehensive regional perspective of the progress made towards implementation of various SADC energy policies including activities, programs and projects. This is an important and historic report that provides a solid reference source on energy development in the SADC region in a bid to transform our economies to enhance economic growth and create empowerment.

The main objective of the publication is to ensure that progress made towards the implementation of the SADC energy commitments in line with the SADC Protocol on Energy and other regional strategies and policies, is documented and distributed. The publication also tracks implementation by Member States of the various energy commitments they have made at the regional level. The first edition of the SADC Energy Monitor was launched at the 36th SADC Summit of Heads of State and Government held in Eswatini in 2016.

The SADC region is generously endowed with energy resources that range from solar to wind, and hydro to gas. If these sources are fully harnessed, the region has the potential to achieve universal access to modern energy services. According to the African Development Bank, the overall hydropower potential in SADC Member States is estimated at about 1,080 terawatt hours per year (TWh/year) but capacity being utilised at present is just under 31 TWh/year. A terawatt is equivalent to one million megawatts.

However, most SADC Member States have harnessed only a small fraction of their hydropower resources — less than three percent of the total potential in the region has been harnessed. The low share of natural gas in the regional energy mix also belies the fact that southern Africa has some of the largest deposits of gas in the world.

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

There is also need for the region to focus more on increasing the uptake of renewable energy to ensure that SADC is able to achieve a sustainable energy mix. The regional energy generation mix is still largely dominated by non-renewable energy, particularly coal, which contributes about 62 percent. The target is to achieve a contribution of renewable energy in the regional energy mix of at least 32 percent by 2020 and 35 percent by 2030.

Plans are also under way 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 masterplan was approved by the Council of Ministers during the 38th SADC Summit of Heads of State and Government held in Windhoek, Namibia in August 2018.

Another critical measure to develop a viable and vibrant energy sector in SADC is the need to build more transmission interconnections across Member States borders. More transmission lines would enable Member States to benefit from new generation capacity installed in other countries in the region. The power infrastructure in mainland SADC is not fully integrated yet as Angola, Malawi and Tanzania are not connected to the regional electricity pool.

With the recent approval of various regional documents such as the 2015 Revised Regional Indicative Strategic Development Plan (RISDP) and SADC industrialization Strategy and Roadmap, it is also important for various stakeholders involved in the SADC energy sector to align their support to the two documents. Alignment of support to the two regional documents will ensure the smooth implementation of agreed activities and programs, thereby promoting socio-economic development and deeper integration.

It is my hope that the publication will assist Member States and other players in the energy sector to track implementation of commitments made at the regional level pursuant to the broad objectives of regional integration in Southern Africa. I applaud the long-standing partnership of the SADC Secretariat, through its Energy Division, with the Southern African Research and Documentation Centre (SARDC) in producing this unique publication.

I take this opportunity to thank the Austrian Development Agency for their consistent support and contribution to sustainable development in Southern Africa through funding this important initiative. This publication reflects the spirit of cooperation and partnership that strengthens our efforts to raise the standard of living of people in Southern Africa and achieve SADC's vision of a shared future within a regional community.

Dr Stergomena Lawrence Tax
SADC Executive Secretary
October 2018

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Boxes

ACRONYMS

AfDB	African Development Bank
AU	African Union
CFL	Compact Fluorescent Lamps
CHP	Combined Heat and Power Production
DSM	Demand Side Management
ESC	Environmental Sub-Committee of SAPP
FIT	Feed In Tariff
GW	GigaWatt
GWh	GigaWatt hours
HWLC	Hot Water Load Control
IAEA	International Atomic Energy Agency
IPP	Independent Power Producer
kV	kiloVolt
kWh	kiloWatt hour
LEDs	Light Emitting Diodes
LNG	Liquid Natural Gas
MDGs	Millennium Development Goals
MW	MegaWatt
NEPAD	New Partnership for Africa's Development
NNR	National Nuclear Regulator
PPA	Power Purchase Agreements
PPP	Public Private Partnerships
PV	Solar Photovoltaic
REEESAP	Renewable Energy and Energy Efficiency Strategy and Action Plan
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
REFiT	Renewable Energy Feed In Tariff
RERA	Regulators Association of Southern Africa
RISDP	Regional Indicative Strategic Development Plan
SACREEE	SADC Centre for Renewable Energy and Energy Efficiency
SADC	Southern African Development Community
SARDC	Southern African Research and Documentation Centre
SAPP	Southern African Power Pool
SCF	Standard Cubic Feet
SDGs	Sustainable Development Goals
SE4ALL	Sustainable Energy for All
SWH	Solar Water Heater
TCF	Trillion Cubic Feet
TWh	TeraWatt hours
USTDA	US Trade and Development Agency
VAT	Value Added Tax
WNA	World Nuclear Association
ZAMCOM	Zambezi Watercourse Commission

ACKNOWLEDGEMENTS

Production of the *SADC Energy Monitor* has been a collaborative effort. The Regional Economic Development Institute (REDI) of the Southern African Research and Documentation Centre (SARDC) worked with various organizations, experts and individuals in producing this publication. Key among them is the SADC Secretariat through its Energy Division.

The process of producing this publication was informed and guided by the valuable support of SADC Member States through their timely submission of questionnaires that have informed the second edition *SADC Energy Monitor*.

SARDC REDI coordinated the development of the publication. The team of authors and contributors, which comprised SARDC REDI head Joseph Ngwawi, Professor Godfrey Dzinomwa, Egline Tauya, Kizito Sikuka, Admire Ndhlovu, Kumbirai Nhongo, Danai Majaha and Tanaka Chitsa, worked hard to put together this publication.

Gratitude to the SADC Energy Division, the Regional Electricity Regulators Association of Southern Africa (RERA) and the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) for their invaluable input in reviewing the publication.

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, 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 our gratitude to the Austrian Development Agency for its generous financial assistance offered for the research, development and publication of the *SADC Energy Monitor*.

The contribution of all institutions and individuals who supported the preparation of this publication is gratefully acknowledged. Thank you for your essential support.

SARDC

INTRODUCTION

Sustainable energy solutions are essential for southern Africa to achieve its aspirations for economic growth and development, and as the region industrialises, energy production and distribution will increase in importance.

Recognising the fundamental role of energy in achieving its goals, SADC has developed a number of legal and institutional tools such as the Protocol on Energy (1996) which provides a basis for cooperation on energy policy among SADC Member States.

While most of these documents offer a strong legal framework to develop the energy sector, a major concern raised by SADC Energy Ministers at their various fora is that the documents are now outdated and need to be revised to reflect the changing dynamics in the region and continent as well as globally. The successful implementation of these policies depends on the commitment of Member States and other stakeholders in the regional energy sector.

The *SADC Energy Monitor 2018* is a reference source that presents a picture of the progress made towards implementation of the SADC energy policies. The main objective of the publication is to ensure that implementation of the SADC energy commitments is in line with the region's developmental plans such as the SADC Industrialization Strategy and Roadmap and the Revised Regional Indicative Strategic Development Plan (RISDP). The second edition of the *SADC Energy Monitor* focuses on energy as an enabler for industrialization and regional integration in SADC.

Chapter 1 – Energy and Industrialization — looks at the importance of energy in the implementation of the SADC industrialization strategy and roadmap, drawing from the outcome of the Energy Investment Conference held in the Kingdom of Eswatini in July 2017. The chapter analyses the challenges faced by the region in improving energy infrastructure to support industrialisation, and highlights some policy options that the region could adopt to attract investment in new energy infrastructure, which is a prerequisite for industrial development.

Chapter 2 – Electricity Sub-sector — discusses the key trends in the electricity sub-sector, highlighting how the available resources are being utilised or explored, as well as the mechanisms in place to promote development of the sector and the challenges. The analytical framework of the chapter also assesses the current generation mix for the region including the level of access to electricity and progression towards cost-reflective electricity tariffs, as well as the implementation status of some priority energy projects.

Chapter 3 – Renewable Energy — focuses on renewable energy resources and reviews efforts by the SADC region to promote the uptake of renewable energies, highlighting the progress made, the challenges encountered and the institutional or other mechanisms in place or being developed to ensure that renewable energies occupy a greater position in the SADC energy mix. This chapter also considers the growth in capacity and the challenges in harmonising national policies and legislation.

Chapter 4 – Oil and Gas — provides a sectoral analysis focusing on the oil and gas sub-sector. This reviews measures put in place by the SADC region and Member States to advance the development of trans-boundary infrastructure for development of petroleum

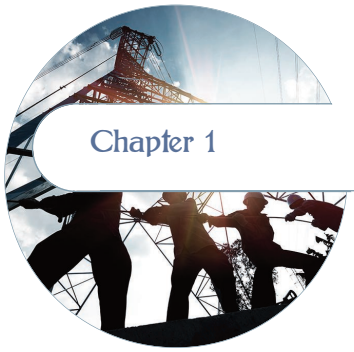
and natural gas resources, and to attract investment to the sector, as well as the key role of this sector in the implementation of the industrialization agenda.

Chapter 5 – Energy Efficiency and SADC Industrialization — discusses issues of energy efficiency and the impact on the SADC industrialization strategy and roadmap. Energy efficiency has become an important consideration and an innovative way of reducing energy consumption and use. This is particularly critical for SADC which is facing crippling challenges in meeting its energy requirements due to a combination of factors that has resulted in rising energy costs and low access to clean and affordable energy across the region. Ultimately, inadequate access and supply of energy has affected the pace of regional integration and industrial development.

Chapter 6 – Trends and Scenarios – This chapter highlights key trends in various sub-sectors and possible scenarios that may come as a result of regional action towards addressing issues raised or if current situations prevail. This is crucial in flagging key issues the region should focus on in making energy a "key enabler" for industrial development. Presented are trends and scenarios from the electricity sub-sector, renewable energy, energy efficiency, tariffs and financing of power projects. Other cross-cutting issues including gender are mainstreamed in all chapters.

Chapter 7 – Conclusions and Recommendations — Efficient and affordable energy infrastructure is an important driver for regional integration in southern Africa. Energy security is inextricably linked to industrialisation. Availability of affordable and reliable energy infrastructure reduces transaction costs for industry and trade, as well as for enhancing the economic and social wellbeing of society. The analysis in this report looks at both "hard" and "soft" energy issues. The "hard" aspects relate to the physical infrastructure, while "soft" issues encompass the necessary policies/strategies, institutional capacity and financial mechanisms that need to be addressed. The final chapter offers some recommendations and policy options for SADC and Member States.

The contents of the publication are directed to the governments, policy makers and private sector of SADC Member States; the SADC Secretariat and its subsidiary organisations; international cooperating partners; investors, researchers and academic institutions, as well as media houses. It is our hope that this publication will be useful to those involved in the SADC energy sector as well as the regional integration agenda in southern Africa.



Chapter 1

ENERGY AND INDUSTRIALIZATION

1.0 Introduction

Industrialization is inextricably linked to energy security, but the Southern African Development Community (SADC) has some of the lowest rates of access to electricity (SADC and SARDC, 2016), along with other regions of Africa. Intermittent power shortages have been experienced across the region for the past decade and, if not permanently addressed, this could hinder the regional roadmap towards higher industrial production (EPF and SAIIA, 2015).

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 reduce poverty and set their economies on a more sustainable growth path. Efficient and affordable energy infrastructure is a crucial enabler for economic activity as well as for efforts to attain sustainable development. It is crucial to acknowledge that energy affects all aspects of development – social, economic, and environmental, including livelihoods, access to water, industrial development, agricultural productivity, health, education and gender-related issues.

The important role of energy is reflected by the prominence accorded to energy issues in recent regional, continental and global processes. These include the Revised SADC Regional Indicative Strategic Development Plan (RISDP), Agenda 2063 of the African Union, and the United Nations Agenda 2030. These processes identify the availability of affordable and sustainable energy as key to the realization of sustainable development.

The importance role of energy in the SADC has never been more accentuated than now, given the decision by the region to front-load industrial development in its economic integration agenda. Energy is a critical area of the infrastructure pillar of the Revised RISDP and considerable preparatory work has been done in this area to develop enabling policies, systems and processes that will greatly facilitate project preparation as well as help to attract private sector investments and further promote public-private partnerships.

This chapter looks at the importance of energy in the implementation of the SADC industrialization drive. It analyses the nexus between the availability of reliable and affordable energy sources and the current industrialization drive by the region. It highlights the challenges faced by the region in improving energy infrastructure in support of industrialization, and outlines some policy options that SADC could adopt in order to ensure increased investment in new energy infrastructure, which together with improved management, performance and additional spending on maintenance, is a prerequisite for industrial development.

1.1 SADC Industrialization Strategy and Roadmap

The approval of the SADC Industrialization Strategy and Roadmap 2015-2063 during an Extraordinary Summit of Heads of State and Government held in Harare, Zimbabwe in April 2015, represented a huge step towards economic liberation in the region and is expected to ensure that Member States harness the full potential of their vast and diverse natural resources. The strategy aims to provide the framework for major economic and

technological transformations at the national and regional levels within the context of deepening regional integration.

The long-term transformation of the SADC economies requires focused qualitative and quantitative shifts in industrial structure, its enabling environment and the interdependence with other sectors to maximize the direct and indirect value addition in the industrial sector broadly defined to include related support services (SADC, 2015). In so doing, industrialization will need to be situated within the global dynamics of competitiveness, quality of products as well as flexibility to respond to internal and external demand dynamics. The positive spillovers from industrialization will stimulate employment and substantially raise income levels. A sustainable industrial sector of the future should be resilient and with high propensity for continuous modernization.

Implementation of the industrialization strategy is planned in three phases spanning from 2015 to 2063:

- Phase I: 2015-2020
- Phase II: 2021-2050
- Phase III: Years 2051-2063.

The first phase covers the remaining period of the RISDP until 2020. The second phase of 30 years constitutes a period of "heavy lifting development" and establishing strong momentum for competitiveness (SADC, 2015). This will involve efforts to ensure that all Member States have developed some level of industrial development. The third and final phase, covering 13 years, builds up for the convergence with the long-term vision of the African Union, Agenda 2063.

The strategy and roadmap is anchored on three interdependent strategic pillars:

- ***Industrialization*** as a champion of economic transformation;
- Enhanced ***Competitiveness***; and
- Deeper ***Regional Integration***.

Various strategic interventions are proposed under each of these pillars. Interventions proposed under the Industrialization pillar include the creation of an improved policy environment for industrial development, increased volume and efficiency of public and private sector investments in the SADC economy, creation of regional value chains and participation in related global processes, as well as increased value addition for agricultural and non-agricultural products and services.

Reduction or removal of structural impediments to industrialization is another target being pursued by SADC under the Industrialization pillar. In this regard, there is need to improve power generation capacity and facilitate an increase in the development and use of renewable sources of energy as well as ensure adequate water supply.

Interventions under the Competitiveness pillar are aimed at strengthening of both the macroeconomic and microeconomic environments in the region. Initiatives proposed include the development of industrial investment programs to support small-to-medium enterprises by 2018; training for skills, entrepreneurial and managerial development; and centres of specialization for priority sectors. The SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) is one such centre of specialization. SACREEE began operations in 2016 and is hosted by Namibia.

The Regional Integration pillar aims to widen the economic space for development and create incentives for industry to expand, thus providing opportunities for economies of scale, clustering and economic linkages.

Specific interventions under this pillar include (i) full implementation of the SADC Free Trade Area to cover all Member States; (ii) a common external tariff by 2025; (iii) gradual phasedown and abolition of rules of origin by 2025; (iv) liberalization of exchange controls to allow free movement of capital within SADC by 2030; and (v) ratification of the SADC Protocol on Trade in Services for implementation by 2020.

These interventions are outlined in a Costed Action Plan of the SADC Industrialization Strategy and Roadmap that was approved by an Extraordinary Summit of SADC Heads of State and Government held in the Kingdom of Ewatini in March 2017.

1.2 Regional Initiatives

Various initiatives are being pursued by the region to ensure the energy sector responds to the demands of the industrialization agenda.

1.2.1 Electricity

In order to promote development of least-cost power generation and power trading, the region has made progress in linking its various national generating plants through inter-connectors and transmission systems (SARDC, 2017). To date, nine power utilities on the southern African mainland are interconnected, except Angola, Malawi and Tanzania. Some degree of integration of power networks involving Botswana, DRC, Eswatini, Lesotho, Malawi, Mozambique, South Africa, Zimbabwe and Zambia has been accomplished. This inter-connectivity has facilitated the establishment of the SAPP trading platform, enabling Member States with power shortfalls to purchase power from those with surplus power within the framework of the regional energy security framework.

To illustrate the importance that SADC attaches to energy development as an enabler for rapid industrialisation, the region identified the revision of the Southern African Power Pool (SAPP) Plan as one of the priority interventions needed to address constraints to industrialization.

Institutional reorganization and strengthening has allowed the region to collectively work towards creating an environment that is conducive to making SADC an attractive investment destination for energy projects.

There are, however, still challenges as most SAPP member utilities are struggling to move towards adoption of cost-reflective tariffs to levels that justify private capital injections while at the same time ensuring that low-income households continue to access electricity at affordable charges. According to a report presented by the Regional Electricity Regulators Association of Southern Africa (RERA) during the SADC Energy Thematic Group (ETG) meeting held in April 2018 in Gaborone, Botswana, only Namibia has achieved a cost-reflective tariff.

1.2.2 Oil and Gas

In addition to efforts to improve the availability of electricity in southern Africa, the 37th SADC Summit held in Pretoria, South Africa in August 2017 agreed to establish a regional natural gas committee to promote the inclusion of gas in the regional energy mix and in the promotion of industrial development in the region. The Terms of Reference (TORs) for the proposed Inter-State Gas Committee were agreed by the SADC Energy (Electricity and Petroleum Gas) Subcommittees in Johannesburg, South Africa, in May 2018. The TORs were presented to a joint meeting of SADC Ministers responsible for Energy and for Water that was held in South Africa ahead of the 38th SADC Summit in Windhoek, Namibia in

August 2018. The joint ministerial meeting was preceded by the Ministerial Workshop on Regional Gas Infrastructure and Market Development.

The formation of a regional gas committee is an important step for the SADC region, given that the region has witnessed significant findings of natural gas in a number of countries, notably Mozambique and Tanzania. In Mozambique in particular the gas-to-power industry is gaining momentum as is evident from Sasol's planned development of a 400MW gas-to-power plant in Maputo. This comes on the back of clear indications of a very healthy supply of gas in Mozambique.

South Africa will soon start pursuing the exploration of shale gas resources in the Karoo basin. A report by the World Energy Council in partnership with Accenture showed that South Africa has significant potential for shale gas development, having the eighth biggest reserve of shale gas in the world. In addition, a new Liquefied Petroleum Gas import and storage facility was recently launched near Saldanha Bay, which would alleviate South Africa's gas shortage and broaden its energy mix.

Investor interest is also growing in Namibia's developing offshore oil and gas frontier, with some of the big companies showing interest, but producing limited volumes of hydrocarbons to date. The main project is the much-anticipated Kudu Gas-to-Power Project, involving a joint venture with the National Petroleum Corporation of Namibia.

Mozambique commissions offshore gas terminal Box 1.1

Mozambican President Filipe Nyusi on Monday inaugurated an oceanic terminal for domestic gas (butane or Liquefied Petroleum Gas) in the central port of Beira.

The terminal has the capacity to fill 5 000 bottles of gas and 12 trucks a day. It will supply cooking gas to the central and northern provinces of Mozambique and to neighbouring countries.

The terminal is the initiative of the publicly owned fuel company, Petromoc, and cost US$38 million. About US$31 million was financed by the Export-Import Bank of India, while the remaining seven million came from Petromoc's own funds.

According to the chairperson of Petromoc, Fernando Uache, the terminal contains three reservoirs, each of which can hold 1 000 tonnes of gas. The operational costs of importing and distributing gas will now be greatly reduced, he said.

Speaking at the inauguration ceremony, President Nyusi said the consumption of domestic gas rose to 34 000 tonnes in 2017. He stressed the importance of gas in replacing firewood and charcoal as a domestic fuel, and thus reducing the pressure on Mozambique's forests.

"In the context of the fight against deforestation, the government is encouraging the Mozambican private sector to expand the distribution chain for domestic gas, so as to facilitate massive use of this fuel", he stressed. "This terminal will reduce the cost of the logistics involved in placing gas in the cities and towns of central and northern Mozambique."

President Nyusi added that one of the challenges facing the government is to install a refinery that will serve, not only Mozambique, but the southern African region, and will improve efficiency in importing, storing and consuming petroleum products.

This, he said, would requires the collaboration of the Mozambican business class, which he regarded as a "privileged partner" in sustainable development.

Mozambique News Agency *AIM*

The Kudu gas field was discovered in 1974, about 170km off the Namibian coast, and began limited production in 2013, as the gas needs to be produced by a floating production unit before being exported by pipeline to an 885MW gas-to-power plant onshore. The Kudu gas project is expected to play a fundamental role in shaping the energy dynamics of Namibia and strengthen its international standing in this regard.

Kudu gas-to-power project strategic for Namibia Box 1.2

The managing director of the National Petroleum Corporation, Immanuel Mulunga, said, "The Kudu Gas-to-Power project is a key strategic power generation project for Namibia, which will significantly reduce reliance on imported power while at the same time accelerating economic development."

1.3 Policy Considerations

Current plans for hydro-power network connectivity and proposed new generation and transmission projects should be fast-tracked including regional joint ventures. In this regard, there is urgent need to accelerate the design and implementation of an appropriate institutional framework for the early development of the Inga Dam project which has enormous potential for the supply of low-cost electricity to the SADC region.

The current Regional Infrastructure Development Master Plan (RIDMP) should be fast-tracked and aligned to meet the needs of the SADC Industrialization Strategy and Roadmap as well as to ensure that the use of existing infrastructure capacity is optimized. Adequate measures should be put in place to ensure that implementation of the RIDMP does not lag behind. Such measures could include a coordinated mechanism to track implementation of priority energy projects.

A strategy for leveraging the RIDMP should be developed to catalyze industrial development and reduce current high costs of doing business, including those related to non-tariff barriers and local procurement of inputs for energy infrastructure development. In addition, there should be an infrastructure support program developed specially for industrialization. Such a program would ensure that there is a constant pipeline of financial resources to support the development of energy infrastructure and, therefore, industrialisation.

It has been noted that the poor quality and inefficiency of existing energy (and other) infrastructure in the SADC region is largely due to the neglect of standards in asset procurement and operation and inadequate maintenance and management. It will, therefore, be critical for the region to ensure there is regular maintenance of existing energy infrastructure. New funding should include adequate provision for repair, maintenance, rehabilitation, reconstruction and asset replacement costs. Member State national budgets should include increased allocations for operational and maintenance expenditure.

On a related note, Member States should increase public investment in energy provision both for domestic use and export to regional partners through the Southern African Power Pool. Attention should be paid to the reliability, efficiency and cost-effectiveness of energy supply. Simultaneously, governments should step up the involvement of independent power producers to ease the burden on government investment spending.

In addition, alternative sources of energy should be exploited with a particular focus on renewables, while considering the competitive advantage of existing natural energy resources. The region should take advantage of its extensive renewable energy sources such as wind and solar by building its electricity generation capacity.

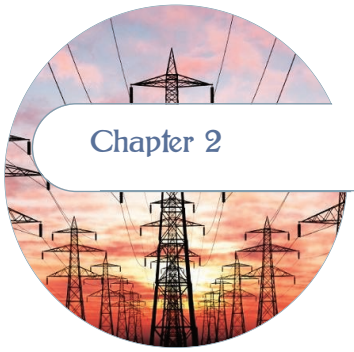
Focus should also go towards the development of the oil and gas sector, given the huge reserves that have been identified in the region. This would call for the fast-tracking and adequate resourcing of the proposed Inter-State Gas Committee. Similar attention should be paid to harnessing the benefits derived from the massive oil reserves that reside in the region.

SADC should exploit the enormous potential offered by its ocean resources under the Blue Economy Initiative in order to catalyse industrialization and economic transformation. The opportunities under the Blue Economy Initiative include renewable energy, fishing, shipping, oil and mineral exploration. In this regard, the Blue Economy Initiative should be mainstreamed in developing infrastructure required to accelerate industrialization.

To close financing gaps, action will be needed across the policy spectrum. Governments will need substantial funding for infrastructure development of energy and soft infrastructure as well as funding for human capital development and access to technology. Almost certainly this will require greater private-sector participation than in the past, with potentially far-reaching implications in respect of public-private projects and the commercialization or privatization of infrastructure industries.

A well-resourced Regional Development Fund is a pre-requisite for accelerated regional industrialization. The planned SADC Development Fund should be urgently operationalized as a regional development bank with the capacity to attract international funding.

Finally, there is need to strengthen efforts to tap into domestic sources of funding. Possible sources include taxes, the domestic banking sector, private equity funds, public-private partnerships, sovereign wealth funds, remittances, and pension funds. Mechanisms could be put in place to access funding for energy infrastructure development from these domestic sources.



Chapter 2

ELECTRICITY SUB-SECTOR

2.0 Introduction

Access and availability of energy is one of the key enablers of sustainable development in southern Africa. Electric power, commonly known as electricity is one of many sources of energy in the Southern African Development Community (SADC), along with fossil fuels and biofuels. Most of the electricity in the region comes from both renewable and non-renewable energy sources. While most SADC Member States are endowed with vast energy resources, a number of countries still lack the technical capacity to fully harness their potential. As a result, energy production and consumption as well as development varies widely throughout the region.

For example, in 2016, the electricity demand in SADC increased by 2.6 percent, according to the Southern African Power Pool (SAPP), with a total of 4,180 megawatts (MW) of new generation capacity installed in the same period. However, the World Bank anticipates that the demand for electricity in southern Africa will increase by 40 percent over the next 10 years, highlighting the need for the region to invest in the sector to ensure sustainable development.

According to information shared during the Joint Meeting of Ministers Responsible for Water and Energy in the SADC Region held in June 2018, electricity demand in the region increased by a weighted average of — 6.8 percent in 2015; 2.6 percent in 2016; and 2.9 percent in 2017. Although demand continues to increase by a small margin, the increase is much less than in 2015 due to decreasing energy-intensive economic activities in the region. This chapter looks at how much of the available resource is being utilized or developed as well as the mechanisms put in place to promote development of the electricity sector and the challenges faced in developing the sector.

2.1 Legal, Regulatory and Institutional Framework

In order to keep pace with the increasing demand for electricity as well as the need to support and promote sustainable development and regional integration, SADC has put in place various legal, regulatory and institutional frameworks to facilitate the growth of the energy sector including the electricity sub-sector. However, the SADC Treaty is the primary foundation that sets out the integration agenda in southern Africa and is built on the premise of creating an enabling environment for economic cooperation among SADC Member States in various sectors. Any other regional frameworks build on the SADC Treaty.

2.1.1 Legal Frameworks on Electricity

The legal framework governing electricity generation and development in southern Africa has largely remained the same in the past two years. Table 2.1 gives a summary of the main SADC instruments for the electricity sub-sector. For example, the 2015 Revised Regional Strategic Development Plan (RISDP) emphasises energy security and access to energy services to meet rural energy needs and development. The other energy instruments aim for the following:

Table 2.1 Summary Objectives of SADC Energy Instruments for the Electricity Sector

Revised RISDP	SADC Energy Protocol	SADC Energy Cooperation Policy and Strategy	Regional Energy Access Strategy and Action Plan
Energy security	Harmonise national and regional policies	Effective power system management	Electricity associations
Access for rural needs and development	Cooperate in development of energy	Extensive use of hydropower resources	Harmonization of policies, laws and regulations
	Pooling R&D for low cost technologies	Commercialization of public utilities	Investment for regional interconnectors, hydropower development
		Power interconnections to Improve reliability and security of supply	Energy planning Infrastructure

Source Energy Sector Plan of the RIDMP

- "Hard" infrastructure — exploiting and developing the huge hydropower resources in the region; and developing regional interconnectors and hence energy pooling to improve reliability and security of supply.
- "Soft" infrastructure — harmonised policies; cooperation in energy development and trading; electricity planning; and institutional associations.

However, the main legal document on energy development in the region is the SADC Energy Protocol adopted in 1996. The most recent documents include the Energy Sector Plan of the SADC Regional Infrastructure Development Master Plan (2012) and the 2015 SADC Industrialization Strategy and Roadmap (2015). While most of these documents provide a strong legal framework to develop the energy sector, a major concern raised by SADC Energy Ministers at their various fora is that the documents are now outdated and need to be reviewed to reflect the changing dynamics in the region and continent as well as globally (SARDC, 2016).

At the national level, these documents are complemented by various other legal frameworks. In Zambia, for example, the National Energy Policy was revised in 2017 to diversify the energy mix by including renewable energy and the country also developed a Renewable Energy Feed-in Tariff (REFIT) Strategy aimed at accelerating private investments in small- and medium-sized renewable energy projects in Zambia (*Zambia Daily Mail*, 2018).

2.1.2 Institutional Framework

In terms of institutional arrangements, the Committee of SADC Ministers of Energy is the apex policy body in the overall energy sector. Below it is the SADC Energy Ministers Taskforce with ministers from Angola, Namibia, South Africa and Zimbabwe which was constituted in 2004 in response to the then impending power shortages and was therefore given the immediate mandate to develop a roadmap to address the looming shortages in consultation with all Member States.

An Intergovernmental Memorandum of Understanding signed by Member States in 1995 gave effect to the Southern African Power Pool (SAPP), a 12-member regional body that coordinates the planning, generation, transmission and marketing of electricity on behalf of Member State utilities in SADC. Table 2.2 shows the SAPP member utilities.

Table 2.2 SAPP Member Utilities

Member Utility	Status	Abbreviation	Country
Botswana Power Corporation	OP	BPC	Botswana
Electricidade de Moçambique	*OP*	EDM	Mozambique
Electricity Supply Corporation of Malawi	NP	ESCOM	Malawi
Empresa Nacional de Electricidade de Angola	NP	ENE	Angola
Eskom	OP	Eskom	South Africa
Eswatini Electricity Company	OP	SEC	Eswatini
Hidroeléctrica de Cahora Bassa	IPP	HCB	Mozambique
Lesotho Electricity Corporation	OP	LEC	Lesotho
Mozambique Transmission Company	ITC	MOTRACO	Mozambique
NamPower	OP	NamPower	Namibia
Société Nationale d'Eléctricité	*OP*	SNEL	DRC
Tanzania Electricity Supply Company Limited	NP	TANESCO	Tanzania
Zambia Electricity Supply Corporation Limited	OP	ZESCO	Zambia
Copperbelt Energy Corporation	ITC	CEC	Zambia
Lunsemfwa Hydro-Power Company	IPP	LHPC	Zambia
Zimbabwe Electricity Supply Authority	OP	ZESA	Zimbabwe

Source *SAPP*
OP Operating Member **NP** Non-Operating Member **ITC** Independent Transmission Company
IPP Independent Power Producer

Table 2.3 RERA Members

Full Name	Abbreviation	Country
Institute for Electricity Sector Regulation	IRSE	Angola
Botswana Energy Regulatory Authority	BERA	Botswana
Eswatini Energy Regulatory Authority	SERA	Eswatini
Lesotho Electricity and Water Authority	LEWA	Lesotho
Malawi Energy Regulatory Authority	MERA	Malawi
National Electricity Advisory Council	CNELEC	Mozambique
Electricity Control Board	ECB	Namibia
National Energy Regulator of South Africa	NERSA	South Africa
Energy & Water Utilities Regulatory Authority	EWURA	Tanzania
Energy Regulation Board	ERB	Zambia
Zimbabwe Energy Regulatory Authority	ZERA	Zimbabwe

Source *RERA presentation at ETG meeting in September 2015*

The power utilities in mainland SADC Member States, with the exception of Angola, Malawi and the United Republic of Tanzania, are interconnected through SAPP, allowing them to sell electricity to one another through a competitive market.

In 2002, the Ministers of Energy agreed to form the Regional Electricity Regulators Association of Southern Africa (RERA) to harmonise the regulatory framework as well as provide a conducive environment for investment in the region's power sector. In 2002, SADC Energy Ministers also approved the RERA's Guidelines for Regulating Cross-Border Power Trading in southern Africa. Table 2.3 shows members of RERA.

At the national level, a number of countries in the region are working towards creating new institutional arrangements to ensure improved access and availability of electricity. For example, the Botswana Energy Regulatory Authority (BERA) was established in 2016 with a sole mandate to make sure that there was competition in the energy industry (*Daily News*, 2018). Previously, the Botswana Power Corporation (BPC) had been the only company allowed to generate and sell electricity, while Energy Minister oversaw the licencing of electricity companies. Therefore, the creation of the BERA is expected to bring transparency to the sector as the authority will license and regulate companies seeking to generate power for both own use and for commercial purposes.

2.1.3 Electricity Regulatory Environment

As indicated in the Institutional Framework, a regional energy market is operational through the SAPP, and power trading within SADC takes place between utility members only. However, all the SADC Member States have national regulators that oversee energy issues in the respective countries and are members of RERA. However, as the national

regulatory agencies develop and begin to assert their authority, there is a risk that they have not been sufficiently attuned to the needs of the regional market. Experience in other countries shows that although a pool can operate where regulatory regimes differ, as they do among SAPP countries, possibilities for gaming or unfair advantage created by differences in regulatory systems can undermine members' willingness to participate.

RERA has responded to regulatory impediments to cross-border power trading by developing "regulatory guidelines" that were approved by the SADC Energy Ministers in April 2010 to ensure that efficient cross-border deals are not constrained by unclear or complicated processes for making regulatory decisions. The regulatory guidelines represent a first concrete step towards harmonization of national regulatory systems to encourage large cross-border transactions by ensuring that regulatory arrangements in the region are compatible.

2.2 Electricity Generation Capacity

SADC has made progress in addressing power shortages that have been experienced since 1999 and became more pronounced after 2007. This is thanks to a rigorous campaign to improve electricity generation capacity and strengthen the transmission network across the region, which started to pay off in 2017 when the region reported a surplus electricity generation capacity for the first time (SAPP, 2017). The surplus electricity has mainly been generated from a variety of energy sources including coal, wind and hydro.

According to SAPP, excess generation capacity was about 2,616MW as of October 2017. Table 2.4 shows the demand and supply balance of energy in mainland SADC. As noted in the Table, the excess generation capacity increased to 2,957MW by the end of 2017. The installed capacity in SADC is more than 40 percent of the total installed generation capacity in Africa. The installed capacity in the region is still dominated by coal-fired plants, mainly in South Africa.

Table 2.4 Demand and Supply Balance with Current Peak Demand (2017)

Country	Utility	Installed Capacity MW	Operating Capacity MW	Current Peak Demand MW	Peak Demand plus Reserves	Capacity Excess/ Shortfall including Reserves
Angola	RNT	3129	2 500	1 869	2 149	350
Botswana	BPC	927	459	610	702	(243)
DRC	SNEL	2457	1 076	1 359	1 563	(487)
Eswatini	LEC	70	55	232	267	(212)
Lesotho	SEC	74	70	156	129	(109)
Malawi	ESCOM	352	351	326	375	(24)
Mozambique	EDM/ACB MOTORAC	2724	2 279	1 780	2 047	232
Namibia	Nampower	538	354	652	750	(396)
South Africa	Eskom	50 774	48 463	38 897	44 732	3,731
Tanzania	Tanesco	1 375	1 078	1 051	1 209	(131)
Zambia	ZESCO/CEC/LHPC	2 734	2 734	2 194	2 523	211
Zimbabwe	Zesa	2 048	1 555	1 615	1 857	(302)
Total All		**67 200**	**60 923**	**50 241**	**58 016**	**2 957**
Total Operating Members Only		62 343	**57 045**	**47 495**	**56 283**	**2 762**

Source SAPP presentation to the April 2018 SADC Energy Thematic Group meeting in Gaborone, Botswana

The positive trend on increased surplus electricity generation is likely to continue in the future as SAPP will commission an average of 5,000MW per year in the next six years. However, some introspection is critical due to factors that led to the improved electricity generation in southern Africa. For example, SAPP notes that the current excess in electricity supply is partly a result of an economic slowdown in SADC. This is because most SADC economies have experienced a slowdown since the global financial crisis of 2008 due to a fall in agriculture, mining and manufacturing production. In this regard, it is important for the region to continue strategizing on regional power development to ensure that the demand for electricity is met when most SADC Member States recover from the economic slowdown.

Table 2.5 Generation Capacity in Oceanic Member States

Country	Installed Generation Capacity, MW
Mauritius	782
Madagascar	246
Seychelles	106
Total	**1 134**

Source SAPP presentation to the October 2017 SADC Energy Thematic Group meeting in Gaborone, Botswana

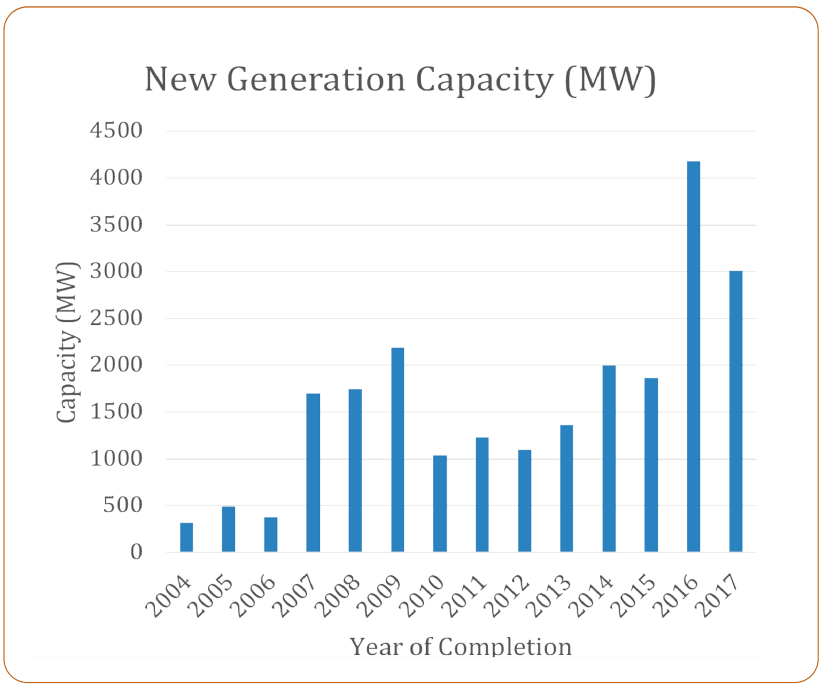
Generation capacity in Oceanic Member States is also positive as the three combined states of Mauritius, Madagascar and Seychelles stands at 1 134MW. Table 2.5 shows the installed capacity in the three Islands. However, it should be noted that the three Island countries are not part of the SAPP regional grid and therefore, any new generation capacity installed in any of the three countries is not enjoyed by the other nine SAPP members – Botswana, DRC, Kingdom of Eswatini, Lesotho, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. Hence it is critical to develop a viable and vibrant energy sector in SADC and there is need to build more transmission interconnections across borders. More transmission lines would enable Member States to benefit from new generation capacity installed in other countries in the region.

2.2.1 Power Generation Projects Commissioned

A number of new power generation projects have been commissioned in the last two years to improve access and availability of energy in the region. As shown in Table 2.6, a combined total of 7,188MW was commissioned in 2016 and 2017. This shows a significant increase

Table 2.6 Commissioned Generation Projects (2004-2017)

Completed Generation Projects	
Year	**Capacity MW**
2004	320
2005	490
2006	375
2007	1 696
2008	1 747
2009	2 187
2010	1 040
2011	1 230
2012	1 099
2013	1 361
2014	1 999
2015	1 864
2016	4 180
2017	3 008
Total	**22 596**



Source SAPP presentation to the October 2017 SADC Energy Thematic Group meeting in Gaborone, Botswana

in the total commissioned per year. According to SAPP, a total of 22,596MW was commissioned in the 14 years from 2004 to 2017. More than 4,700MW of new generation capacity were expected to be commissioned in 2018, with around 20,000MW more planned for commissioning in the period 2019 to 2022.

A total of 3,008MW of new generation capacity was commissioned in 2017. This power was commissioned in Angola (1,155MW); Botswana (120MW); DRC (150MW); Malawi (6 MW); Mozambique (40MW); Namibia (70MW); South Africa (1,234MW); the United Republic of Tanzania (28MW); Zambia (55MW) and Zimbabwe (150MW).

The power plant projects were commissioned by Public Utilities and Independent Power Producers (IPPs). The power came from both renewable and non-renewable energy. Most of the power was commissioned in Angola and South Africa, with the least from Malawi.

In 2018, the mainland Member States are planning to commission 3,516MW from Angola, 1,727MW, Botswana 120MW, Democratic Republic of Congo 150MW, Malawi 36MW, Mozambique 40MW, Namibia 60MW, South Africa 1,128MW, Tanzania 120MW, Zambia 15MW and Zimbabwe 120MW.

Table 2.7 Generation Projects Commissioned in 2017

No	Country	Type	Capacity MW
1.	Angola	Hydro and Gas	1 155
2.	Botswana	Coal	120
3.	DRC	Hydro	150
4.	Malawi	Diesel	6
5.	Mozambique	Gas	40
6.	Namibia	Solar	70
7.	South Africa	Coal	1 234
8.	Tanzania	Gas	28
9.	Zambia	Gas	55
10.	Zimbabwe	Hydro	150

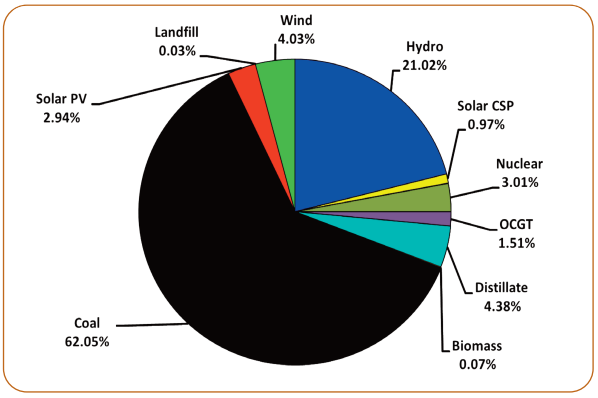
Source Joint Meeting of Ministers Responsible for Water and Energy in the SADC Region, June 2018

2.3 Generation Mix

The regional generation energy mix is still largely dominated by non-renewable energy, particularly coal. However, the last two years has witnessed a significant increase in the use of renewable energy. For example, when taking into account the commissioned capacity, hydropower in the form of conventional and pumped storage accounted for 43 percent, gas 24 percent, solar systems (Photovoltaics and Concentrated Solar Power) 11 percent, wind 10 percent and coal occupied only seven seven percent.

The recent investments in the renewable energy technologies and commissioned gas-fired power plants increased a share of other primary energy sources in regional power generation. As a result, the share of coal dropped from 74 percent to 62 percent from 2013 to 2017 while hydropower remained constant at 21 percent. Figure 2.1 shows the SAPP installed generation mix.

Figure 2.1 SAPP Installed Generation Mix (2017)

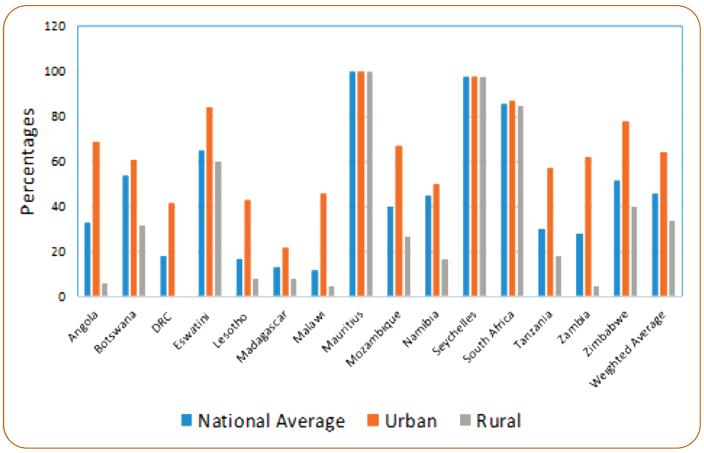


Source SAPP

2.4 Electricity Access

Access to electricity in SADC is still very low, especially in rural areas, with a weighted regional average electrification rate of 48 percent by May 2018. Access to electricity refers to the percentage of people in a given area that have stable access to electricity. Figure 2.2 shows the electricity access in southern Africa.

Figure 2.2 Electricity Access in SADC



Source RERA 2018

2.5 Electricity Pricing

The price of electricity, sometimes referred to as electricity tariff, varies widely from country to country and may vary significantly from locality to locality within a particular country. Many factors go into determining an electricity tariff, such as the price of power generation, government subsidies, local weather patterns, transmission and distribution infrastructure, and industry regulation. Electricity prices generally reflect the cost to build, finance, maintain, and operate power plants and the electricity grid.

To ensure the region has the correct pricing of electricity, SADC Energy Ministers decided in July 2014 to adopt the principles of cost-reflective electricity tariffs. Cost-reflective tariffs enable utilities to raise adequate capital to expand generation and transmission networks and provide the right signals for investment in the sector. Further, it promotes economic efficiency as consumers can make better consumption decisions when the true cost of power supply is reflected.

As part of the decision, RERA was directed to produce on an annual basis, a publication on the annual developments in electricity tariffs and their cost-reflectivity in Member States and to promote a comparative analysis of such tariffs for the SADC region. However, RERA noted in October 2017 at the SADC ETG Meeting held in Gaborone, Botswana that they are lagging behind in producing the Tariffs Publication due to in-house capacity constraints, and were thus seeking support to implement all SADC Ministerial decisions to ensure that the annual tariff publication is current and relevant. This would ensure that it is an effective tool to monitor the real time process of migrating towards cost-reflective tariffs.

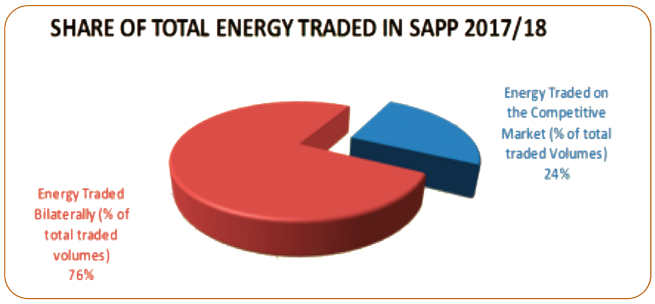
2.6 Power Trading

One of the main objectives of the Southern African Power Pool (SAPP) is to facilitate the development of a competitive electricity market in the SADC. In this regard, SAPP established the Short-Term Energy Market in April 2001. From January 2004, SAPP started the development of a competitive electricity market for the SADC region. The Day Ahead Market (DAM) was established in December 2009. In 2015 the SAPP started upgrading the market trading platform (MTP) in preparation for the intra-day market and forward physical markets. The SAPP MTP opened for live trading Intra-Day Market (IDM) from the December 2015, followed by Forward Physical Monthly (FPM-M) and Forward Physical Weekly (FPM-W) markets in the month of April 2016.

Significant progress has been made with regard to the implementation of the power trading system in the region. For example, a total of 2,779,223MWh was matched with only 1,023,056MWh or 34 percent being traded on the market in 2016 /17. Furthermore, US$ 75,5 million was exchanged via the competitive market and the competitive market share stood at 11 percent. Power traded on the market has minimized load shedding, by offering some flexibility for countries to be able to switch off some of their power generation stations to carry out maintenance work without cutting off power for its consumers since they can buy surplus power from other regional countries.

In the long run, the competitive electricity market for the SADC region has allowed SADC Member States to easily sell and buy surplus electricity from each other, thereby helping some Member States to meet their growing demand for energy. In 2017/18, a total of 1.91 TWh was matched with 1.88 TWh or 99 percent being traded on the market. Figure 2.3 shows the amount of electricity traded on the competitive market in 2017/18, and the volume traded in the same period.

Figure 2.3 Competitive Market Share 2017/18

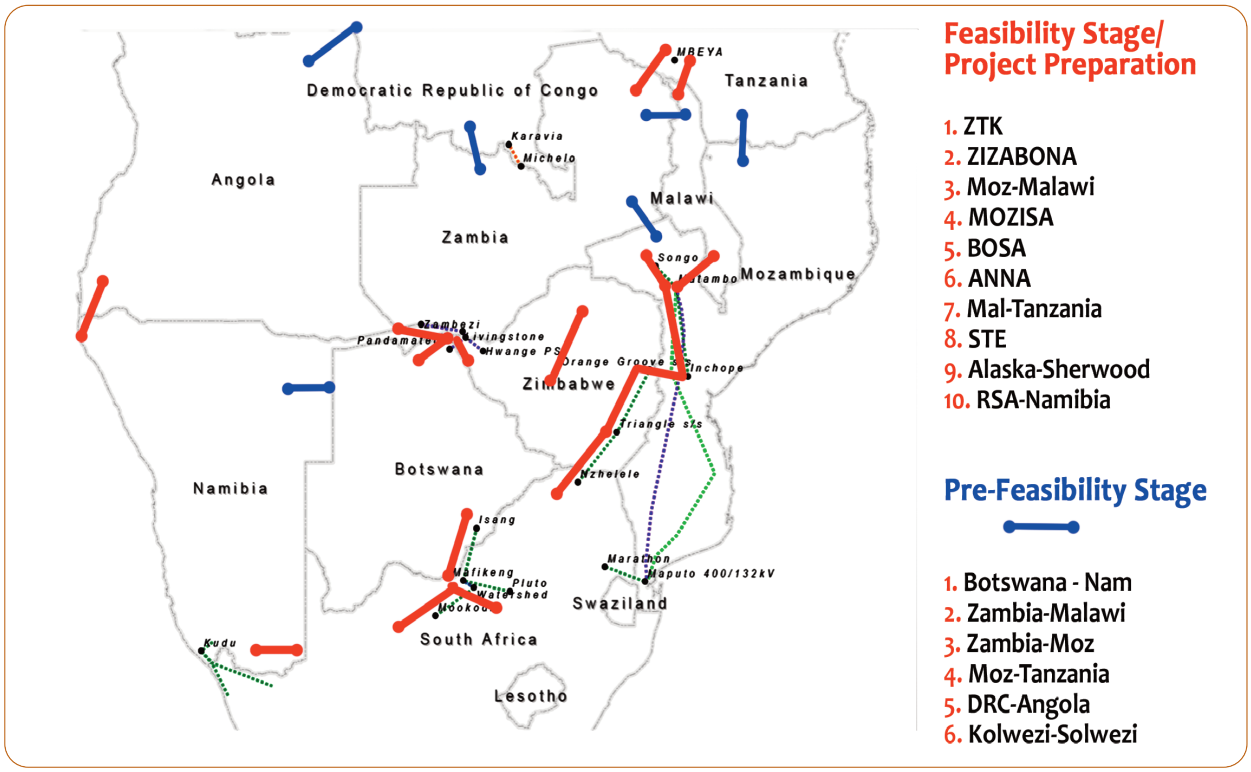


Source SAPP presentation to the October 2017 SADC Energy Thematic Group meeting in Gaborone, Botswana

2.7 Power Sector Investment

In the past two years, SADC has identified a number of priority projects for implementation to improve the supply of energy in the region. The section below gives the status of key transmission projects, and Figure 2.4 shows some of the planned projects.

Figure 2.4 Planned Transmission Projects



Source SAPP

2.7.1 Zimbabwe-Zambia–Botswana–Namibia Interconnector

The Zimbabwe-Zambia-Botswana-Namibia Interconnector (ZiZaBoNa) transmission project, which links four countries, has the capacity to increase power trading among the participating utilities, as well as provide an alternative route and help to decongest the existing central transmission corridor that passes through Zimbabwe. Under the ZiZaBoNa agreement, the power utilities of all four countries are expected to finance parts of the project that fall within their national boundaries.

The project is to be implemented in two phases, with the first covering construction of a 120-kilometre line from Hwange Power Station to Victoria Falls where a switching station will be built on the Zimbabwe side. The line will extend to a substation at Livingstone in Zambia. The second phase involves construction of a 300 km line from Livingstone to Katima Mulilo in Namibia, through Pandamatenga in Botswana. 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. The ZiZaBoNa project has now been repackaged into three main components as indicated.

- Component A: Hwange – Victoria Falls (101km) and Victoria Falls – Livingstone 330 kV lines (14km). This is estimated at US$37 million.
- Component B: Victoria Falls – Pandamatenga 330 kV line (79km). This is estimated at US$30 million.
- Component C: Livingstone – Zambezi 330 kV line (231km). This is estimated at US$127 million.

The project has been set up in the three components to facilitate ease of securing funding. A consultant has been engaged to focus on the business case development and to finalize the preparation of technical specifications and the Engineering, Procurement and Construction (EPC) tender documents.

2.7.2 Zambia–Tanzania–Kenya Interconnector

The ZTK interconnector is a high-voltage power transmission line connecting Zambia, Tanzania and Kenya. The project aims to connect the power grids and create a link between SAPP and the East African Power Pool (EAPP), making it possible to transmit power from Cape to Cairo. The project's main objective is to provide opportunities to conduct power trade in the eastern and southern Africa region and facilitate the creation of a Pan-African power market from Cape Town in South Africa to Cairo in Egypt.

Covering a distance of 2 206 kilometres, the interconnector will have a capacity of 400MW, and will be constructed as a double circuit 400 kilovolt (kV) line in sections from Pensulo in Zambia to Isinya in Kenya. A 400kV line from Mbeya to Iringa in Tanzania will also be built to provide the strong path for power to be delivered to the northern load centres. The ZTK interconnector will connect the United Republic of Tanzania to the SAPP regional grid. Ultimately, the interconnector is expected to link Tanzania to the SAPP, meaning that Tanzania will now be able to sell and buy electricity from the participating utilities in the region. The interconnector will thus connect the EAPP to SAPP, allowing countries in eastern Africa to share surplus electricity with those in southern Africa, and vice versa. The following is the project status:

- EPC contract awarded in Zambia. Construction of Mbeya-Kasama line underway.
- Kasame-Nakonde contract in Zambia was awarded and construction will take 18 months.
- Mbeya–Border (100km) and Mbeya–Iringa (292km) feasibility study completed and seeking funding in progress
- Iringa-Singida-Shinyama construction was completed and project under commissioning
- Iringa-Dodoma-Singida-Shingana (647km) line currently operated at 220kV

- Singida-Arusha-Namanga (Kenya) – funding secured for the transmission and substation segments. In this regard, the entire ZTK project is expected to be commissioned by December 2019.

2.7.3 Mozambique-Zimbabwe-South Africa

The Mozambique-Zimbabwe-South Africa (MoZiSa) project involves the three countries that are all linked to the regional grid and the project is therefore aimed at complementing other regional transmission lines and facilitating power transfers within the SAPP network. Furthermore, it will increase stability in the power pool through additional interconnection between the strong network in the South and the weak network in the North of the region, which has been a source of SAPP grid instability.

As part of the MoZiSa project, there will be various separate developments to complement the project to ensure that the MoZiSa interconnector is a success. For example, in Zimbabwe there will be a new substation at Triangle and another one at Orange Grove. The proposed transmission route would be from Nzhelele (South Africa) — Triangle (Zimbabwe) over a distance of approximately 262km via the 266km Triangle – Orange Groove line in Zimbabwe to connect over a distance of 185km from Orange Groove — Inchope in Mozambique. From Inchope the line would connect to Cataxa (380km) then to Songo (115km). The interconnector is being developed with the objective of moving power in both directions. The project is now being developed in two components:

- Component A of the project will focus on developing the interconnector between Zimbabwe and South Africa (ZISA);
- Component B will develop infrastructure to interconnect Mozambique and Zimbabwe (MOZI).

Phasing will assist to de-risk the project and allow development to be fast-tracked to facilitate the already available surplus generation capacity in South Africa. Component B is dependent on several factors including the completion of planned generation projects within Mozambique which are still under development. The steady state model has been developed.

2.7.4 Central Transmission Corridor in Zimbabwe

The Central Transmission Corridor in Zimbabwe will increase the North-South Corridor reliability and transfer capacity through Zimbabwe from a position of virtually non-existent capacity to 650MW in light load conditions. The CTC transmission facilities will enable power from predominately hydro sources in the Northern part of southern Africa to be traded at an affordable price and in a sustainable manner in the southern part which is predominately thermal based. The following is the status of the project:

- Alaska – Sherwood: DBSA funding secured for detailed feasibility study, ESIA and legal work streams where a Transaction Advisor is to be appointed.
- Bindura – Mtoroshanga: Finance being sought.
- Orange – Grove Triangle: Tender for EPC and financing. Adjudication finalised.
- Marvel – Insukamini: To be financed together with the Hwange project. Financial closure is expected in the 1st quarter of 2017.

Table 2.8 Status of other Key Priority Projects in SADC

Project	Description	Status
Mozambique-Malawi Interconnector	Construction of Malawi section approximately 200 km of 400 kV (initial operation at 220 kV) Mozambique-Malawi transmission interconnector, which will connect Malawi to the Southern African Power Pool.	The project is now being considered at a higher transmission voltage to facilitate higher power transfers. The project is planned for commissioning in 2020.
Botswana-South Africa Interconnector	The project comprises approximately 210km of 400kV transmission line from Isang in Botswana to Watershed B Substation in South Africa. The project will include construction of the transmission line and associated substations in the two countries.	The scoping stage was completed and the final inception report produced. The market and economic assessment has started including the environmental work and line route selection as part of the feasibility studies.
Namibia-Angola Interconnector	This is a proposed 400kV Ruacana–Xangongo–Cahama interconnection, which is highly likely to be linked to the proposed Baynes Hydro-Power Station (600MW), downstream on the Lower Cunene River Basin to evacuate power into the Angolan network and also for future export of power from Angola.	A consultant was engaged and project scoping has started.
Malawi-Zambia Interconnector	The Inter-Governmental Memorandum of Understanding (IGMOU) and Inter-Governmental Memorandum of Utility (IUMOU) on the Malawi-Zambia 330kV Interconnector Project were signed by the two Governments and their respective utilities in May 2015.	Feasibility studies are in progress.
Malawi –Tanzania Interconnector	The Malawi-Tanzania link aims to interconnect the SAPP with the Eastern African Power Pool.	Feasibility studies, Environmental and Social Impact Assessment (ESIA) studies and Engineering designs for the 400kV interconnector have been completed. The next step is for the two Member States to develop and sign IGMOU and IUMOU. The two Governments are in the process of soliciting funding for the joint project.
Mozambique-Tanzania Interconnector		The IUMOU has been finalized and signed between the two utilities, TANESCO of Tanzania and, EDM of Mozambique. SAPP has applied for project preparatory funding.

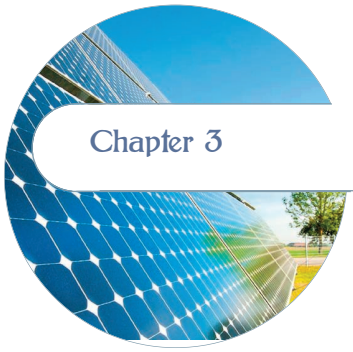
Source Adapted from SAPP presentation to the October 2017 SADC Energy Thematic Group meeting in Gaborone, Botswana

2.8 Conclusion and Policy Considerations

The improved electricity generation in southern Africa is a welcome development for the region as energy supply is a key enabler for industrialization. Energy shortages experienced over the past few years had constrained development and forced most countries to introduce demand-side management measures such as load shedding. However, it is critical for SADC to do some introspection since most of the factors that led to the improved electricity generation in southern Africa are not positive. For example, the current excess in electricity supply is partly a result of an economic slowdown in SADC.

In this regard, it is important for the region to continue strategizing on regional power development to ensure that the demand for electricity is met as SADC member states are recovering from the economic slowdown. The drive towards energy self-sufficiency should also focus on how southern Africa could harness its vast array of renewable energy resources that include solar, hydro and wind. Another critical measure to develop a viable and vibrant energy sector in SADC is the need to build more transmission interconnections across member state borders. More transmission lines would enable member states to benefit from new generation capacity installed in other countries in the region.

With regard to the legal, regulatory and institutional framework, it is critical to review some of the outdated documents to align them with new and emerging realties in the global community such as climate change. There is also need to capacitated RERA to ensure that the annual publication on electricity tariffs and their cost-reflectivity is produced on a regular basis. The publication is critical as it provides a comparative analysis of tariffs for the SADC region.



Chapter 3

RENEWABLE ENERGY

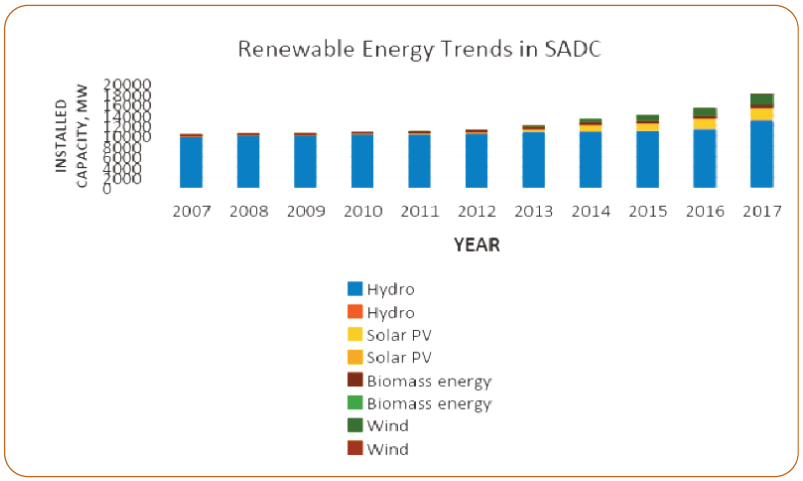
3.0 Introduction

Renewable Energy resources comprise all sources of energy that are naturally replenished on a human timescale, and these include wind, hydro, tidal, solar, biomass and geothermal, all of which are generally abundant in southern Africa. Technological advances and falling costs are driving the adoption of renewable energy around the world, with the power generation sector making significant progress in this direction. For example, the reduction in cost of Solar Photovoltaic (PV), which now cost half of what they were in 2010 and could fall by another 60 percent over the next decade, have opened new markets for the rapid growth of solar technology. Solar PV is poised to revolutionise the electricity subsector, enabling consumers to produce power for their own needs and feed surplus energy into the main grid.

As battery storage facilities continue to increase in capacity and reduce in cost, renewable energy is becoming attractive. Ever more compelling is the potential to slow down global warming and combat climate change, since most of the renewable resources, except for biomass, generate near zero emissions of greenhouse gases. Figure 3.1 shows the phenomenal increase in installed power generated from renewable energy resources during the ten-year period from 2007 to 2017.

SADC has set a target to achieve a renewable energy mix in the regional grid of at least 32 percent by 2020 and 39 percent by 2030, and Member States have been making notable progress towards implementing projects (SADC and SARDC, 2016).

Figure 3.1 Growth in Installed Capacity from Renewable Sources (2007-2017)



Source IRENA

3.1 Renewable Energy Regulatory and Institutional Framework

SADC has a number of legal and policy instruments to guide the development of renewable energies in the region. These include: SADC Energy Protocol (1996); Revised RISDP (2015-2020); SADC Industrialization Strategy and Roadmap (2015); Regional Infrastructure Development Master Plan: Energy Sector Plan (2012); Regional Energy Access Strategy and Action Plan; and AU Agenda 2063. The *SADC Energy Monitor* (2016) available on www.sardc.net gives a detailed account of these instruments.

In addition, SADC started developing the Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) in 2011 to regulate and co-ordinate renewable projects within the region. One key milestone achieved in line with this action plan was the setting up of the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) in Namibia in 2016. Its mandate is to monitor the implementation of REEESAP and contribute towards increased access to modern energy services and improved energy security across

the SADC region through the promotion of market-based uptake of renewable energy and energy efficient technologies and energy services.

Other institutions established in SADC to regulate the renewable energy subsector as well as implement various renewable energy programs, projects and activities are the Regional Electricity Regulators Association of Southern Africa (RERA), and the Southern African Power Pool (SAPP). To complement the major regulating institutions, most SADC Member States continue to adopt renewable energy policies and strategies. Table 3.1 shows the recently adopted policies and strategies by country.

Table 3.1 Recently Adopted Policies by Country

Country	Policy/Strategy	Year Adopted
Angola	New Renewables Strategy	2017
Botswana	Botswana Regulatory Energy Authority	2017
Lesotho	Renewable Energy Feed In Tariff (REFiT) Country Partnership Framework (CPF) National Strategic Development Plan	2016 2016 2016
Malawi	Independent Power Producer (IPP) Framework for Malawi	2016
Mozambique	REFiT	2014
Namibia	National Renewable Energy for Namibia Namibia REFiT	2017 2016
Seychelles	Small Island Developing State (SIDS) Dock Support Exemption from goods and services tax	2016 2016
South Africa	Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) Regulatory Framework PPAs and IPPs	2016
Tanzania	Sustainable Use of Natural Resources and Environment Finance Small Enterprise Finance Agent (SEFA)	2017 2016
Zambia	REFiT Office of Promoting Private Power Investment (OPPI) Scaling Up Solar project	2015 2015 2016

3.1.1 SADC Renewable Energy and Energy Efficiency Strategy and Action Plan

The SADC Renewable Energy and Energy Efficiency Strategic Action Plan (REEESAP) spans the period 2016-2030 and provides a framework for SADC Member States to develop renewable energy strategies, leading to greater uptake of renewable energy resources as well as mobilization of financial resources for the sector (SARDC, 2017).

REEESAP has been established within the framework of the overall SADC development agenda of regional economic integration and poverty eradication, and the key strategic objectives for REEESAP are to:

- Achieve energy security by closing the current supply/demand deficit largely in the power sector and enabling future economic growth and industrialization;
- Increase availability, accessibility and affordability of modern energy services, particularly to those who depend on traditional forms of energy;

- Offset the risk associated with energy imports in the form of large import bills and uncertainty of supply aggravated by the impact of currency fluctuations;
- Mobilize financial resources for investment for both renewable energy and energy efficiency projects and the manufacturing of renewable energy and energy efficiency equipment in the SADC region, thus contributing to the industrialization agenda of SADC; and
- Achieve low carbon development paths and climate resilient energy systems in Member States and hence the region.

3.1.2 SADC Centre for Renewable Energy and Energy Efficiency

The SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) was established in Windhoek, Namibia in September 2016 charged with the responsibility to monitor the implementation of the SADC REEESAP.

The establishment of the centre was a major milestone by SADC towards attaining the United Nations Sustainable Development Goal No.7 (SDG7) which aims at access to affordable, reliable, sustainable and modern energy for all. The main objectives of SACREEE are to contribute towards increased access to modern energy services and improved energy security across the SADC region through the promotion of market-based uptake of renewable energy and energy efficiency technologies and energy services.

Within the last decade, regional communities in Africa have established four sustainable energy centres of which SACREEE is one of them. The other three are: ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) based in Praia in Cape Verde; the East African Centre for Renewable Energy and Energy Efficiency (EACREEE) based in Uganda; and the Regional Centre of Renewable Energy and Efficient Energy established by 10 Arab States and based in Egypt. The Global Network of Regional Sustainable Energy Centres is coordinated by United Nations Industrial Development Organization (UNIDO).

Sustainable energy centres respond to the urgent need for increased regional cooperation and capacities to mitigate existing barriers to renewable energy and energy efficiency investment, markets and industries. They complement and strengthen ongoing national activities in the areas of policy and capacity development, knowledge management and awareness raising, as well as investment and business promotion. The establishment of SACREEE is an indication that SADC is on the same path with other African regional communities and recognises the importance of renewables in the energy supply mix as well as for tackling climate change impact.

One of the objectives of SACREEE is to improve the legal regulatory framework and ensure policy coherence and alignment of renewable energy and energy efficiency activities with national, regional and international policies.

The SACREEE mandate is to support:

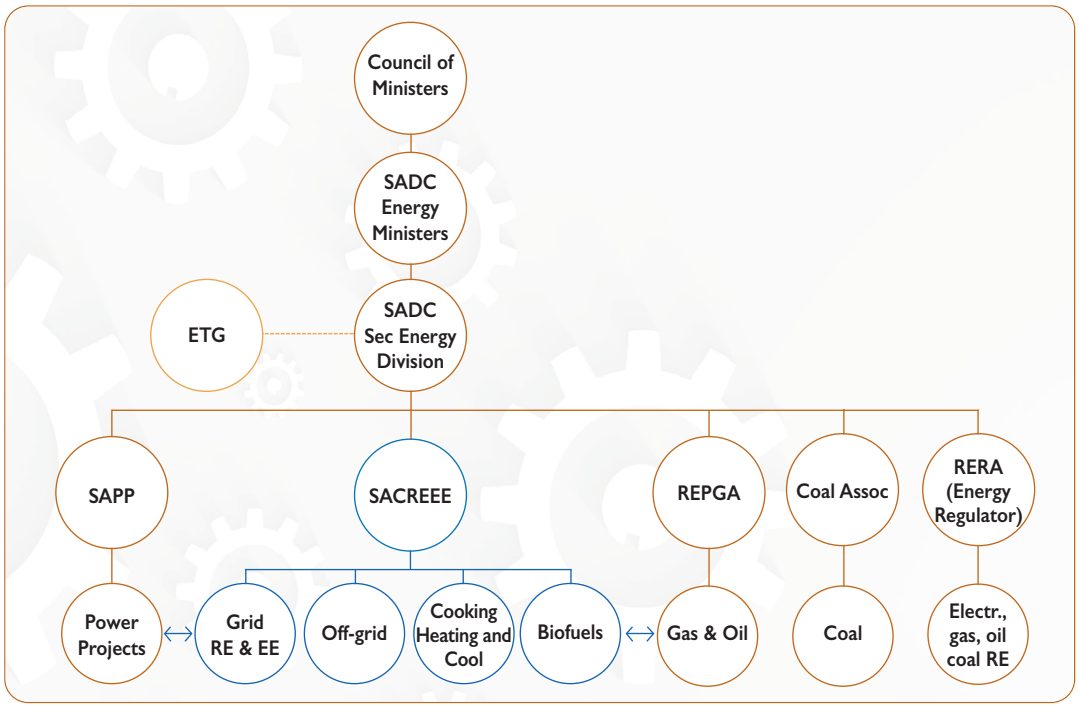
- The achievement of the sustainable development objectives of SADC Member States by promoting the use of renewable energy and energy efficiency technologies and energy services;
- The region's sustainable development objectives through resource mobilisation, policy, quality assurance, capacity building and knowledge management, communication, promoting investments in energy and energy efficiency projects and programs.

The SACREE objectives are to:

- Strengthen national and regional institutions to adopt and implement energy and energy efficiency projects;
- Create policies, strategies, plans and other frameworks to ensure an enabling environment for energy and energy efficiency investments;
- Have appropriate regulation and standardization frameworks for energy and energy efficiency projects and investments;
- Attract private sector participation in investments for energy and energy efficiency;
- Build capacity to design, develop, build, implement and maintain energy and energy efficiency projects;
- Attract financing for energy and energy efficiency projects;
- Develop projects, technologies and transfer skills to meet demand targets;
- Promote adoption of energy and energy efficiency through information, advocacy and awareness; and
- Consider cross-sectoral and crosscutting issues when implementing energy and energy efficiency projects

SACREEE works closely with SAPP and RERA. The institutional structure, and the centre's linkages to the other energy-related institutions within SADC, are shown in Figure 3.2.

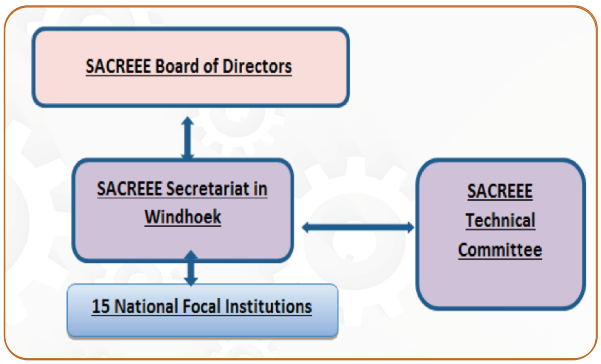
Figure 3.2 SADC Organisational Structure Incorporating SACREEE



Source SACREEE **ETG refers to the SADC Energy Thematic Group*

The SACREE Secretariat is guided by an Executive Board and a Technical Committee as shown in Figure 3.2, which are expected to meet at least once a year as the centre works on the basis of a long-term business plan and annual work plans and budget.

Figure 3.3 SACREEE Institutional Structure



Source SACREEE

The institutional set-up of SACREEE reflects the principles of maximising the impact, avoiding duplication of efforts, strengthening and up-scaling of already existing local capacities. The Centre positions itself as a regional renewable energy and energy efficiency promotion agency rather than an implementer at micro and grassroot levels.

SACREEE develops and executes regional programs and projects through a network of National Focal Institutions from all SADC Member States. The programs are focused in the following output areas:

- Sustainable Energy Policy
- Capacity Building
- Knowledge Management
- Promotion of Investment, Innovation and Entrepreneurship.

Since its establishment, SACREEE has undertaken a number of activities and hosted workshops to formulate harmonised policies and regulatory framework for the SADC region. SACREEE's overall approach is to develop a harmonized policy, regulatory, and institutional framework conducive to broaden and accelerate uptake of renewable energy and energy efficient technologies and practices in the region.

SACREEE also assists countries to develop national policies, strategies and regulations, and action plans to promote the uptake of renewable energy and energy efficient technologies and energy services. Gender mainstreaming in energy policies and program is also a key focus area for the Centre.

Since its establishment SACREEE has launched the following programs and activities:

- SADC Renewable Energy Entrepreneurship Support Facility, to enhance and strengthen the capacity of small to medium entrepreneurs in assessing the business potentials of sustainable energy, develop viable business plans and loan requests, and managing and maintaining their businesses successfully;
- Gender mainstreaming and Women in Sustainable Energy Program, which aims to advance the economic empowerment of women through sustainable energy access;
- Review of Renewable Energy Zones and Initiation of Project Sites Analysis, to identify updates to the solar and wind zones under the Africa Clean Energy Corridor and incorporate new developments on the ground;
- SACREEE Energy Efficiency Program, focused on the development and implementation of a holistic regional energy efficiency program, as part of implementation of REEESAP;
- SADC Industrial Energy Efficiency Program (SIEEP) to support the implementation of the SADC Industrialization Strategy and Roadmap 2015-2063 by contributing to the competitiveness of the industrial sectors of SADC Member States;
- Scaling up the Africa Clean Energy Corridor project, to accelerate the expansion of renewable electricity production, and helping to sustain future growth through renewable power development zoning, planning processes.

3.2 Challenges in Harmonising National Legislation and Policies

As SADC moves to implement its agenda and to harmonise national policies, regulations, rules and standards, several challenges are being experienced and efforts to resolve them

continue to be pursued. SADC REEESAP identifies the main challenges and gaps reported across the region. These include:

- **Socio-economic barriers** such as high poverty levels which make renewable energy technologies unaffordable for at least 40 percent of the population who live in extreme poverty;
- **Institutional gaps** characterized by understaffed and under-resourced agencies such as RERA, SAPP, SACREEE, etc;
- **Regulatory gaps** especially the absence in many SADC Member States of dedicated renewable energy and energy efficiency policies and strategies with clear targets;
- **Regulatory gaps** including inadequate regional harmonization and standardization of grid codes and Power Purchase Agreements (PPAs), monitoring and verification systems for utility transmission and distribution losses;
- **Investment and financing gaps** arising in part from under developed financial sector which is unable to fully support Public Private Partnerships (PPP) and Independent Power Producers (IPP) frameworks;
- **Projects, technology development and transfer, and capacity gaps** including inadequate capacity for reengineering of renewable energy technologies to support technology development or adaptation of existing technologies to the local environment, as well as inadequate project development skills for project development/preparation and for accessing various financing opportunities;
- **Information, knowledge and awareness gaps** manifested by inadequate processed information and verifiable data to assist planning and project implementation, and guide investments in renewable energy and energy efficiency projects. Challenges are also caused by insufficient awareness on potential economic, social and environmental benefits of renewable energy and energy efficiency amongst governments and the citizens;
- **Crosscutting and cross-sectoral gaps** which encompass insufficient climate change and gender mainstreaming in energy planning and development, and limited efforts to introduce low-carbon development policies/strategies to adapt to imminent climate change impacts, as well as limited integration of land use, food security, water, forestry, biodiversity and social issues in energy planning.

3.3 Mainstreaming Gender in Renewable Energy Policies or Strategies

The Revised SADC Protocol on Gender and Development which was adopted in 2008 and came into force in 2013 demonstrates southern Africa's commitment to incorporate women in all aspects of development and monitor the Member States activities on addressing challenges that affect women and girls.

According to the *SADC Energy Policy Brief No.12* on mainstreaming gender in the SADC energy sector, the Botswana Power Company recently adopted a gender mainstreaming program for rural electrification, following a pilot audit for collecting gender disaggregated data and strengthening expertise in the energy sector.

In Zimbabwe, the establishment of the Gender and Energy Network of Zimbabwe is aimed at engendering energy access issues and empowering women on issues of energy. Zambia is also promoting gender issues in energy and has formulated a Zambia Gender and Mainstreaming Strategy which has resulted in Zambian women playing a more effective role as economic agents using rights-based development approaches that focus on increasing the economic opportunities and the freedom to work in security and dignity.

SADC SACREEE is working with the National Renewable Energy Laboratory (NREL) to develop a strategy to address gender disparity and promote women in the value chain of the sustainable energy sector.

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3.4 Renewable Energy Resources in SADC

SADC is endowed with an abundance of renewable energy resources which are hydro-power, solar, wind, ocean, biomass and geothermal. According to the Global Wind Energy Council the SADC region is becoming a key player in the international trend towards development of renewable energy resources and energy efficiency where renewable energy sources accounted for 23.5 percent of power generation in 2016. The potential power capacity that could be developed from renewable resources is shown in Table 3.2.

Table 3.2 Renewable Energy Potential in SADC

RE Source	Potential	Total Installed Capacity
Hydro-power	40 874 MW	12 000 MW
Solar	20 000 TWh/year	1% generated electricity
Wind	800 TWh / year	Less than 1% wind generated
Biomass generated electricity	9 500 MW based on agriculture waste	2 500 MW generated electricity
Geothermal	4 000 MW	

1 TWh = 1 000 000 MWh

Source SADC - REEESAP 2016

Although some SADC Member States have extensive coastlines, the region has not made any notable strides in harnessing wave energy due to the cost of constructing power plants other competing uses of the ocean such as commercial fishing.

3.4.1 Hydro-Power

Hydropower is the major contributor of renewable energy in most of southern Africa with some communities dependent on hydropower only. Traditionally, it has been the cheapest form of renewable power generation in the SADC region and globally. Hydropower reached 1,064 Gigawatts (GW) of installed capacity in 2016 and was the leading renewable source for electricity generation globally, supplying 71 percent of all renewable electricity and constituting 16.4 percent of the world's electricity from all sources.

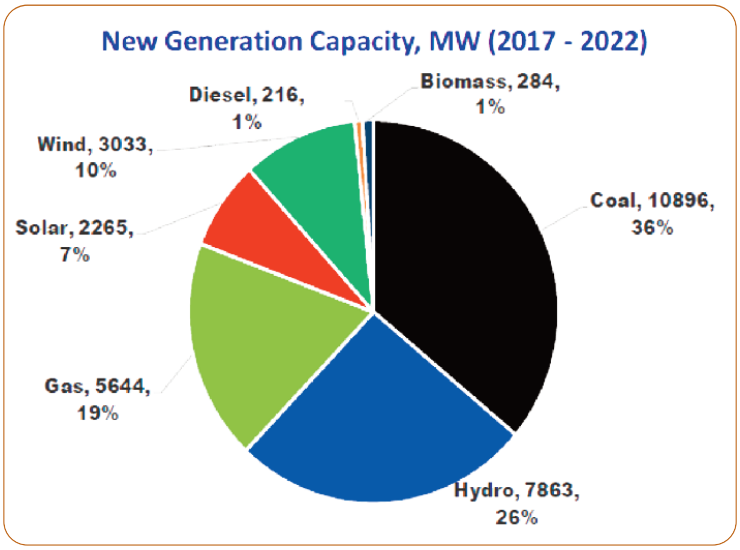
The current potential of hydropower resources in the SADC region amounts to just under 41,000MW. According to SAPP, installed hydro capacity in mainland SADC was 13,223.5MW in 2017, representing about 21.01 percent of total regional electricity capacity. With 2,442MW, Democratic Republic of Congo (DRC) has the largest operational capacity. The major contributors to hydropower in the region are Angola, DRC, Malawi, Mozambique, South Africa, Tanzania, Zambia and Zimbabwe (SAPP, 2017).

One of the most recent hydroelectric power projects to be completed in the SADC region is the 300MW Kariba Power Station extension in Zimbabwe, which was brought online at the

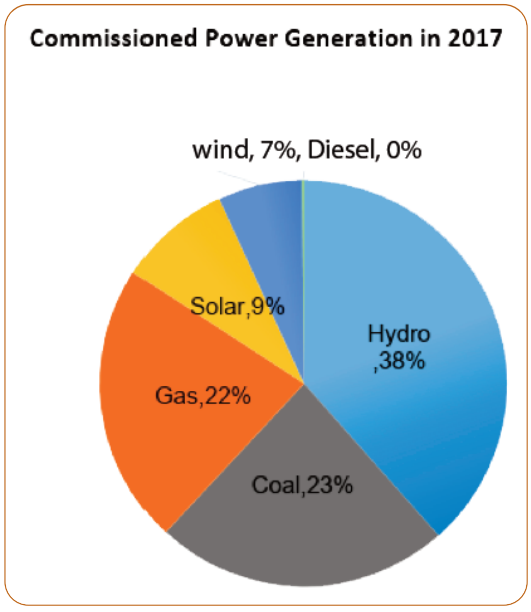
end of 2017 and officially commissioned on 28 March 2018.

Large low-cost hydroelectric dams, especially the Inga Reservoir in the DRC and the Kariba Dam on the Zambia-Zimbabwe border, have the potential to generate up to 150 GW of electricity, against the current 12 GW of installed capacity. SADC has the potential to generate 1080 TWh/year of electricity from hydroelectric dams. However, only 31 TWh/year is being utilised. Of the new generation projects commissioned in 2016, hydropower had the highest capacity installed, with Angola commissioning a total of 780MW. The planned new electricity generation capacity by resource during the period 2017 to 2022 is summarised in Figure 3.4.

Figure 3.4 New Electricity Generation Capacity planned in SADC (2017 – 2022)



Angola projected that by the end of 2018 the country's power generation mix would consist of 64 percent hydropower, or about 4GW. This is expected to come to fruition once the 700MW Cambambe 2 and the 2 070MW Lauca hydroelectric projects are fully commissioned. Cambambe 2 and Lauca projects are part of a wider plan by the Angolan government to produce a total of 9GW of energy from hydropower and other energy sources by 2025.



Source Joint Meeting of Ministers Responsible for Water and Energy in the SADC Region, June 2018.

The Batoka Gorge Hydro Electric Scheme, on the border between Zambia and Zimbabwe, is projected to produce 2 400 MW with the two neighbouring countries expected to each produce 1 200MW (Madondo, 2018).

In Tanzania, construction of the Stiegler's Gorge hydropower project, the largest dam in Tanzania, along the Rufiji River in the Selous Game Reserve is expected to begin in July 2018 and to be operational in 2021 *(Africa Power Journal, 2016)*.

Although hydropower projects are still favoured by the SADC region, the main setback is the rainfall pattern in southern Africa which has become unpredictable, posing a hydrology risk during increasingly frequent drought periods. The average rainfall across the SADC region is 948mm per year, which is above the world average of 860mm per year (SADC, 2016). However, there is significant annual variation in quantity and distribution of the rainfall with the north and east of the region being wetter than the south and west. Consequently, water resources availability and usage across the SADC region varies and there is need to redistribute the water resource across the region.

3.4.2 Solar

The SADC region benefits from abundant solar radiation with 2,500 hours of sunshine per year, translating into a generation capacity potential of 20,000TWh annually. According to SAPP, Namibia and South Africa are the only two SADC Member States that produce

on-grid solar power. In 2016, 360MW of Photovoltaic (PV) and 100MW of Concentrated Solar Power (CSP) were commissioned by South Africa. The total solar PV power generated for the grid in SADC was 1,841MW (2.93 percent) of which 1,821MW was generated by South Africa and the other 20MW was generated by Namibia. A total of 600MW CSP generated in 2016/2017 was contributed by South Africa alone (SAPP 2017).

However, there is a lot of activity happening off grid in the SADC region with Independent Power Producers (IPPS) making a significant contribution in renewable energy. Solar is expected to contribute 7 percent (2,265MW) of the new generation capacity by technology (2017 - 2022).

According to the Renewables 2017 Global Status Report by REN21, countries are turning to the sun across Africa, with projects ranging from very small to large-scale, both on- and off-grid. The global off-grid solar PV market was estimated at US$300 million annually, with the strongest growth in sub-Saharan Africa, followed by Asia.

Namibia's Renewable Energy Feed-In Tariff (REFiT) program added a total of 70MW to the grid in 2017. Two solar power plants were feeding into the national grid, while several other plants were under construction all over the country and the procurement process of a 37MW Solar PV plant near Mariental had been completed and would be operational by 2018, while a 20MW Solar PV and 44MW wind power plants from independent power producers have concluded all agreements with the power utility, NamPower. A total of 18MW power plants from Regional Electricity Distribution companies were also at advanced stages of completion (Nampower Annual Report, *Windhoek Observer* July 2017)

Solar off-grid home systems have become prevalent in the SADC region, and Namibia houses the largest rooftop solar PV plant in Africa with a total output of 1.1MW *(SADC Energy Monitor 2016)*.

In December 2016, the Government of Malawi issued a competitive tender in the power sector to develop 70MW of new solar capacity which set Malawi on a path to diversify its generation mix, bring down costs, and open its door for future rounds of private investment. Malawi, through the Global Fund Project Implementation Unit, has embarked on a US$3.7-million project to install solar energy at 85 health facilities nationwide in the face of prolonged power outages across the country.

A US$10million loan from Abu Dhabi Fund for Development (ADFD) was approved for Mauritius, to help the Central Electricity Board install solar PV systems on rooftops of 10,000 households, contributing to the national target of achieving 35percent of renewable electricity in the energy mix by 2025. The project will bring 10MW of new renewable energy capacity online, resulting in savings of over US$35 million in fossil fuel imports over the project lifetime. A 15MW solar PV farm by a local firm in Mauritius was started in 2016 (IRENA).

In Mozambique, construction was scheduled to start in March 2018 for the first large solar power plant which will be situated at Mocuba in the Zambesia Province. The 40MW Mocuba power plant is expected to deliver 80,000 MWh per year of much-needed electricity to the northern regions. The project is a Public Private Partnership with Mozambique's publicly-owned electricity company and is expected to be operational in the first quarter of 2019. The electricity will be sold to Electricidade de Moçambique (EDM) under a 25-year Power Purchase Agreement.

The Rural Electrification Agency in Zimbabwe has installed a total of 372 solar-powered systems of 0.9 kilowatt (kW) each to provide power to limited essential services at schools and clinics. They represent an equivalent power-generating capacity of 334.5kW.

Botswana, already a leading safari attraction, is becoming one of the world's leading ecotourism destinations. Chobe Game Lodge launched Africa's first ever CO2 emission-free silent electric fleet of four game-viewers and safari boats in 2014.

3.4.3 Wind

The potential for wind-based generation is mostly constrained to the coastal regions, reaching around 800TWh, with installed capacity of less than one percent. However, the wind renewable resource, unlike solar, is not evenly distributed *(SADC Energy Monitor 2016)*. The SADC Member States that have meaningful wind potential are South Africa, Namibia, Angola, Lesotho, Mozambique, Tanzania, DRC, Mauritius, Madagascar and Seychelles.

In SADC and the continent, South Africa is the major contributor with the success of the globally lauded Renewable Energy Independent Power Producers Procurement Programme (REIPPPP). The only wind project commissioned in SADC in 2016 was contributed by a South African IPP with a capacity of 414MW (SAPP 2017). South Africa is the highest and only producer of on-grid wind with a total of 2,492MW (3.96 percent) contribution to the SAPP in 2016. According to SAPP (2017), wind energy is estimated to contribute 10 percent (3,033MW) of the new total energy generation capacity in the period 2017 to 2022.

Nampower signed a 25-year power purchase agreement with a private company which is expected to produce 44MW. The wind farm is expected to be operational in 2019. The energy output of 200 million kilowatt hours per year will supply at least 10,000 households with electricity.

Mozambique's wind resource is believed to be considerable with average wind speeds of 6-7 m/s in some areas. A mapping project, under the remit of State-owned power utility, the National Energy Fund of Mozambique (FUNAE), is underway to better understand the wind resource. The U.S Trade and Development Agency (USTDA) has awarded a grant for a feasibility study to assess the viability of a 120MW wind power plant to be developed in the Namaacha District in southern Mozambique (USTDA website).

In its effort to promote green energy, Mauritius started a wind farm in 2016, with a total capacity of 9MW, developed by a French company.

Two companies were commissioned to conduct a feasibility study for Zambia's planned 500GWh wind power plant following USTDA approval of a US$1.05 million grant to finance a feasibility study for the first wind plant in Zambia (Zambia Business Times, 24 August, 2017).

3.4.4 Geothermal

Although there is a considerable geothermal potential within the SADC region, exploitation has been minimal compared to hydro, solar and wind.

It is estimated that about 4,000MW of electricity is available from geothermal sources along the Rift Valley of Tanzania, Malawi and Mozambique (SADC/SARDC 2014). According to the *SADC Energy Monitor 2016*, Tanzania's geothermal potential is 650MW. A dedicated geothermal company was established in 2013, the Tanzania Geothermal Development Company Limited (TGDC), which is a subsidiary of TANESCO and 100 percent owned by government.

Tanzania targets that geothermal will contribute 200MW to the national power system by 2025 from four flagship sites – Ngozi, Songwe, Kiejo-Mbaka and Luhoi have been iden-

tified for development. To date, TGDC has advanced all those four sites to the level of test drilling to confirm the resources. Ngozi and Songwe projects are set to commence test drilling programs in the financial year 2018/19, while fund mobilization is underway for the same programs in Kiejo-Mbaka and Luhoi sites with implementations scheduled in 2019/20. The Tanzanian Government is taking initiatives to formulate the legal and regulatory framework for geothermal development and a draft bill for institutional set up and regulatory framework has already been prepared.

Studies show that there are 130 geothermal natural outcrops in Madagascar. According to the World Energy Council, Madagascar has an installed capacity of 2.81MW while South Africa has an installed capacity of 2.3MW. Madagascar is believed to have an estimated potential geothermal power of 350MW, with five thermal water spas used for balneology, sports and recreation and as tourist centres.

Out of the 85 hot springs in Zambia, 35 were rated highly in terms of surface temperature, flow rate and proximity to power lines indicating easy access and relative energy potential. There is one geothermal power plant in the country which was installed in the 1980s. Two 120kW turbines were installed at Kasiya Hot springs in 1987. Recent estimates indicate that the plant could be upgraded to produce 2MW of electricity.

Namibia has a number of hot springs across the country indicating availability of geothermal resources, which could potentially be used for electricity generation, process heat, or other applications. There has been very little development of these resources to date and limited data is available on the country's resource potential.

Malawi has a total of 21 hot springs and geothermal application (other than power generation) at hot springs in Malawi has been practised for a long time. Notable use has been in Mawira in Nkhotakota, which was used to supply hot water through pipes that run two kilometres to the district administrative centre where it supplied St Anne's hospital (Gondwe, 2015).

3.4.5 Biomass

Biomass potential within the SADC region is estimated at 9,400MW based on agriculture waste. Although biomass potential is plentiful in southern Africa, biomass-based power generation is very low with only two utilities contributing a total of 52.5MW to the grid in the 2016/2017 period. These are TANESCO (Tanzania) with 10.5MW and Eskom (South Africa) having contributed 42MW (SAPP 2017).

Modern biomass consumption in SADC accounts for only 12.4 percent while traditional biomass consumption accounts for 57 percent. As a result, more than 153,000 people die each year from household air pollution due to upper respiratory infections caused by indoor burning of solid fuels for cooking and heating (SADC and SARDC 2016).

Approximately 40 million tonnes of sugarcane are produced in southern Africa, mainly in South Africa, Kingdom of Eswatini, Mauritius, Zimbabwe, Zambia, and Mozambique (Souza et al, 2016). By using its current molasses for ethanol production, Kingdom of eSwatini could increase electricity generation by 40 percent using bagasse and replace 60 percent of cooking fuel or 30 percent of liquid fossil fuel. Large-scale biomass combustion plants to produce heat (and by extension, cooling) and power are commercially mature technologies, reflected in the South African Mkhuze (16MW) and the Ngodwana (25MW) biomass power stations which both comprise boilers and steam turbines (Ngodwana Energy, 2015 and Building Energy, 2014).

The main contributors of bagasse-based power in Zimbabwe are Triangle and Hippo Valley sugar manufacturers, with a capacity of 44MW and 33MW each respectively. Green Fuel also produces 18MW in addition to ethanol for blending into vehicle fuel, while Border Timbers (a timber manufacturing company) produces 0.5MW from wood waste.

Mauritius achieved 100 percent electrification with 37 percent of this energy generation from renewable energy, largely due to the use of bagasse, which provides most of the energy needs of the sugar industry. The country's potential for expansion of renewable energy lies in wind, solar, hydropower and biomass. Mauritius is in some ways a unique case, with its small population and high Gross Domestic Product per capita, yet it seems that many SADC countries could learn some valuable lessons from the country's experience (Saifei, 2014).

In Angola, Biocom located in the municipality of Cacuso in the province of Malanje, is the first company to produce and sell sugar, ethanol fuel and electrical energy derived from biomass. The electrical energy is supplied to the Angolan national energy company, Rede Nacional de Transporte de Electricidade, while the hydrous ethanol is bought by beverage industry and for cleaning products. In 2016 the company produced 14 000 cubic meters of ethanol and 100 gigawatts of power, and this is expected to ramp up until it reaches peak in 2020/2021.

Nampower is considering hybrid power installations where electricity is generated from solar during the day, and from wood during the night, proposing five possible tracts of land near current sub-stations for the biomass plants. The national power utility is in the planning phase to establish an extended wood-driven power plant project which is expected to be fully operational by 2020. A Danish international consulting company was appointed to do preparatory work after a 2012 pre-feasibility study found sufficient bush biomass available to supply 10 plants of 20MW each for several years.

3.4.6 Biofuel

Some countries in southern Africa have acquired significant experience in the production of biofuel. However, biofuel energy production remains limited. In Zambia and Tanzania investors are using jatropha, a drought-resistant genus of flowering plants, in the development of biodiesel plants while Madagascar is recognised as one of the largest producers of jatropha-based biodiesel.

Zimbabwe has a history in using ethanol/petrol blends of up to 20 percent, the ethanol being produced from sugarcane. Bioethanol is produced from Triangle/Hippo Valley (40 million litres/annum) and Green Fuel (Chisumbanje) with an estimated capacity of up to 120 million litres per annum. There is potential for more ethanol production and Green Fuel are projecting 450 million litres per annum by 2020. With the completion of a major irrigation dam, Tokwe-Mukosi, at the end of 2016, sugar cane production in the Lowveld of Zimbabwe is expected to receive a boost and Zimbabwe could become a hub for bioethanol, supplying the region.

An important by-product from ethanol is the ethanol gel which is currently being sold in shops as a fuel for cooking. Cooking stoves specially designed for use with ethanol gel have been developed.

A biodiesel plant at Mt Hampden near Harare, with a capacity to produce 100 million litres per year using jatropha curcas, has been left to lie idle due to lack of suitable feedstock. Plans are under way to promote production of jatropha under different strategies including small holder out-growers and plantation as part of the National Biofuels Policy.

Given the prevalence of invader bush in Namibia, dry biomass-based biofuel may be the most promising option for increased investment (with one source estimating yields of 190 litres of yield from one ton of dry biomass). Blackthorn has also been shown to be a viable bioenergy source in Namibia, providing thermal energy in the form of wood chips for cement manufacturers, such as Ohorongo Cement (Namibia RE policy 2017).

Mozambique has an E10 ethanol blending target, the blending of 5-10 percent (v/v) bioethanol with petrol, while South Africa has both E2 ethanol and B5 biodiesel mandates.

These are being met mainly by conventional biofuels such as ethanol from cassava and sugarcane and biodiesel from jatropha and other oil seeds. Such biofuel crops have substantial residues that can be used to provide process heat for biofuel refining. Various biofuel production initiatives have also been implemented in the country over the past few years.

The Ndzilo Production Plant has a capacity of two million litres of ethanol processed from cassava. Biodiesel production from jatropha oil seeds has been gaining increasing attention in Mozambique due to their advantages, which include sustaining harsh dry conditions. Companies, such as Petromoc and SunBiofuels, have established biodiesel production factories.

In Malawi, a plant was commissioned in 2006 to process up to 250 tons of jatropha oil seeds to produce 5,000 litres per day of biodiesel in Lilongwe. Thousands of farmers were contracted to plant millions of jatropha trees. Other biofuel initiatives include the bioethanol production plants in Dwangwa Estate, which produce 15-20 million litres of bioethanol from sugarcane molasses, and the Nchalo Plant, which has a production capacity of 12 million litres per annum. These plants jointly blend 10 percent (v/v) of bioethanol with petrol.

Biofuels are among the highest renewable energy contributors in South Africa, with an estimated contribution of 9-14 percent. In 2013, The Department of Energy in South Africa announced plans to begin a mandatory blending of petrol and diesel with biofuels (bioethanol and biodiesel) as of 1 October 2015, as the country moved towards strengthening its biofuel sector, helping in reducing its reliance on imported fuel. The country also proposed a five-year pilot phase plan, which was aimed at achieving two percent biofuel in the country resulting in five companies being granted licenses to generate bioethanol and biodiesel in South Africa.

In Tanzania, a number of companies, NGOs, and small-scale farmers are implementing biofuel programs in the country especially providing assistance to farmers involved in growing of jatropha, and oil processing (Sekoai and Yoro, 2016)

Table 3.3 Regional Renewable Energy Targets

Targets	2020 %	2025 %	2030 %
Access to electricity		71	85.5
Renewable energy mix in the grid	33		39
Off grid share of renewable energy as per total grid electricity capacity	5		7.5
Cooking or heating efficient devices penetration	10		15
Biodiesel blending ratio with diesel	5		10
Ethanol blending ratio with gasoline	10		20
Energy efficient percent saving achieved from grid consumption	10		15
Efficient charcoal production share in charcoal market	5		5

Source SADC-REEESAP 2016

3.5 Regional Renewable Energy Targets

SADC has set some ambitious but achievable targets for renewable energy development and utilization as tabulated below.

The regional targets have been set up to 2030, with the aim to increase energy access and security, fuel socio-economic development and enhance environmental sustainability. SADC Member States also set their targets that will feed into the regional plan (SADC REEESAP 2016).

3.6 Renewable Energy Products and Technologies

There is limited data on companies that manufacture renewable energy products and technologies in SADC. However, there are several distribution/wholesale, consultancy, engineering companies for renewable energy in most SADC Member States.

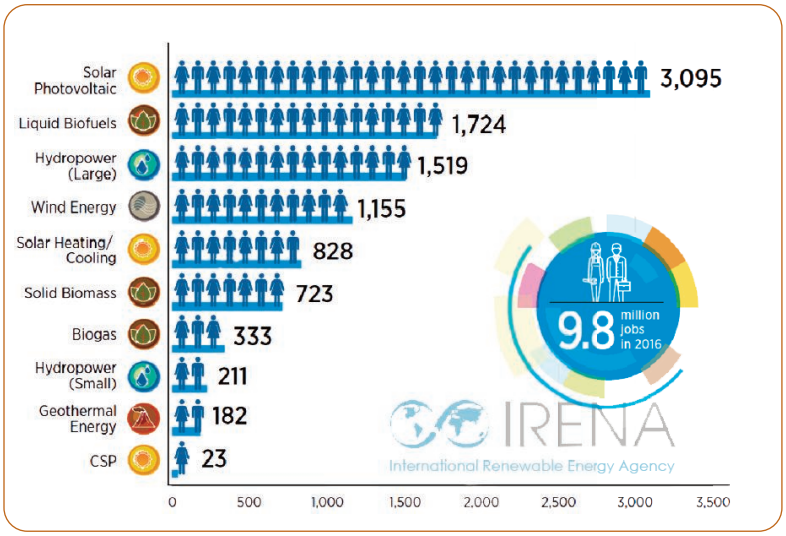
ArtSolar, a South African company founded in 2011 and based in Durban, is one of the pioneers of the South African Photovoltaic solar panel manufacturing industry. It is the first company to produce significant quantities of solar panels for the Renewable Energy Independent Power Producer Programme (REIPPP).

The State-owned power utility National Energy Fund of Mozambique (FUNAE), recently floated a US$13 million tender for construction of a photovoltaic manufacturing plant. The new factory will start by manufacturing flat-plate PV panels then expand in future to manufacture concentrator PV panels. The project is expected to substantially reduce solar equipment imports, most of which have been sourced from India (Sun and Wind Energy).

The number of renewable energy related jobs associated with each technology globally is shown in Figure 3.5.

According to IRENA, the total estimate of renewable energy jobs in Africa is 62,000, and almost half of the jobs are in southern Africa and a quarter in north Africa. The jobs in Africa are rising with increased efforts to boost electricity access, with about half of them being earmarked for women.

Figure 3.5 Renewable Energy Jobs by Technology (thousands)



Source IRENA, 2017

3.7 Incentives to Promote Renewable Products and Technologies

Many SADC Member States have put incentives for manufacturing RE products, with at least two of the following fiscal incentives in place: capital/subsidy, grant rebate, investment and tax rebate credit, reduction in sales, energy, vat or other taxes and energy production payment *(SADC Energy Monitor 2016).* The various renewable energy incentives offered by SADC Member States are summarised in Table 3.4

South Africa has the following incentives to promote manufacturing of renewable products: reduced tax rate of 15 percent, employment tax incentives to encourage employers to recruit young and less experienced jobseekers, building allowance for the building of factories and VAT relief.

Table 3.4 SADC Renewable Energy Incentives

	Regulatory Incentives						Financial	
Type/Country	Feed-in-tariff/ Payment	Net Metering	Biofuel Obligation	Grid Code Revisions	Tradable Credits	Auctions	Subsidy, Grant, Rebate	Tax Breaks
Botswana	✓					✓		
Mozambique			✓	✓				
Namibia		✓				✓		
South Africa	✓	✓	✓	✓	✓	✓	✓	✓
Tanzania	✓						✓	
Zambia	✓		✓	✓			✓	✓
Zimbabwe	✓	✓	✓	✓		✓	✓	

Source Renewable Energy Policy of Namibia 2017

Madagascar's government introduced VAT and customs duty exemption for the imports of PV components and a 50 percent reduction in tax on the revenue generated by residential and commercial PV systems.

The Energy and Water Utilities Regulatory Authority (EWURA) of Tanzania introduced the "Development of Small Power Projects Rules 2016", which laid out licensing and tariff regulation requirements for mini-grids. As a result, mini-grids with a capacity below 1MW are exempt from applying for a licence and need only to register with the regulator for informational purposes. In addition, these small power producers can sell electricity to the main grid at standardised tariffs (Small Power Producer Rules 2015). The government has also established a standard Power Purchase Agreement and tariff methodology for any electricity that these producers feed into the main grid. Tanzania's Rural Energy Agency offers results-based funding (performance grants) of around US$500 per household or business connection. This is funded through a levy on electricity sales and donor contributions (IRENA, 2017).

3.8 Gender Participation in Renewable Energy Products and Technologies

Much of the focus on gender in renewable energy has focused on addressing gender efforts at the household and community levels, for example, through improving women's access to renewable energy and clean cooking stoves, as well as enhancing women's economic benefits and entrepreneurship. Large-scale renewable energy conversely, has received less attention from a gender perspective than small-scale, off-grid renewable energy. Participation of women and youths in this sector needs to be promoted through continuing incentives.

3.9 Connecting Renewable Energy Plants to the Regional Grid

Hydropower contributes most of the renewable on-grid power connections to the SAPP regional grid, and other renewable energy sources, although limited, are steadily going up.

There is a significant percentage of wind and solar connections to the grid, thanks to regulations and policies that encourage Member States to connect the renewable plants to the grid. REEESAP (2016-2030) is an important landmark in forging a regional coherent commitment towards developing renewable energy and energy efficient technologies and services.

Another important milestone is the creation of the SACREEE, which will implement REEESAP, harmonize and coordinate efforts, act as a regional renewable energy and energy efficiency promotion agency and a knowledge hub. Evidence shows that even if the region is very heterogeneous, there are several and common barriers that can benefit from a regionally coordinated approach. The new policy concepts, such as Feed-in Tariffs (FIT), Power Purchase Agreements, Net Metering, and auctioning of power supply from Independent Power Producers (IPPs) have led to an increase in renewable energy investments and they need to be scaled up and widely implemented throughout the region.

FIT programs exist in Namibia (for wind, solar and biomass projects less than 5MW) and Tanzania (for small hydro less than 10MW), and they will soon be introduced in other countries, e.g. Mozambique and Zimbabwe (SADC REEESAP 2016).

South Africa switched from a Renewable Energy Feed-in Tariff (REFiT) to competitive auction in 2011 to enable more competition in its procurement of utility scale renewable energy. Through consistent commitment from government, the auction system successfully helped to reduce costs for new projects especially solar PV and wind.

The participation of the private sector in renewable energy in SADC is phenomenal with the following project investments in 2016. Hydro and solar are the main contributors with only one investment in Biomass (Table 3.5).

Table 3.5 Private Sector Participation in SADC Electricity Generation (2016)

Country	Project	Funders	Capacity	Technology Type
Angola	Lubango and Matala Caculo Cabaca Dam	Industrial and Commercial Bank of China	2.2GW	Hydro
DRC	Busango	Sino Hydro and China Railway	450 MW	Hydro
Kingdom of Eswatini	Montigny	Montigny	35 MW	Biomass
Malawi	Tenzani IV	Japanese Government and Egenco	18 MW	Hydro
Mozambique	Scatec Solar	Scatec Solar	40MW	Solar
Namibia	Ejuva 1 and 2	South Africa Company Consolidated Infrastructure Group	10 MW	Solar
South Africa	L'Ormarins Power Project		I MW	Hydro
South Africa	Port Elizabeth Solar PV1	Clean Energy Africa (Pty) Lt	5 MW	Solar
Zambia	Ngonye Photovoltaic Project	Enel Green Power	34 MW	Solar
Zambia	Solar Project		100 MW	Solar
Zimbabwe	Off Grid Rooftop Solar Project	African Development Bank	20 MW	Solar

Source SADC Energy Investment year book 2017

3.10 Conclusion

Renewables are becoming the first-choice option for expanding, upgrading and modernising power systems around the world due to falling costs and favourable outcomes with regard to emissions of greenhouse gases and the resultant impact of global warming.

The International Energy Agency (IEA) estimates that 55 percent of all new power between 2017 and 2030 will have to come from decentralized energy sources, with 90 percent of it being renewable, if universal energy access goals are to be met (REEESAP 2016).

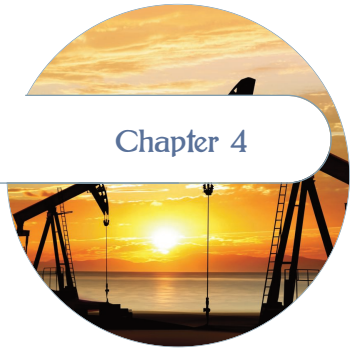
SAPP acknowledges the increasing penetration of renewable energy technologies and the critical role Independent Power Producers are expected to play by supplying 22 percent of the new generation capacity in the period 2017-2022.

The persistent droughts and unreliable rainfall patterns in the SADC region due to climate change make hydropower generation unreliable. As a result, the SADC region is actively looking at other renewable energy resources, particularly solar and wind energy as complementary alternatives with South Africa leading the way in this regard. Although hydro plants are capital intensive, the cost of operation and maintenance of the equipment is low.

Wind and solar power, which accounted for about 90 percent of 2015 investments in renewable power, are now competitive with conventional sources of electricity, as their costs have plunged in recent years. The cost of wind turbines has fallen by nearly a third since 2009 and that of solar photovoltaic (PV) modules by 80 percent (IRENA *Rethinking Energy 2017).* These developments are reflected in the levelised cost of electricity with some renewable technologies having reached grid parity. Currently, onshore wind, biomass, geothermal and hydropower are all competitive or cheaper than coal, oil and gas-fired power stations, even without financial support and despite relatively low oil prices (IRENA *Rethinking Energy 2017).*

By providing basic energy needs in a clean and sustainable manner, renewables bring wider benefits for health, gender equality and educational opportunity. 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 39 percent by 2030.

However, traditional methods of biomass consumption still cause the death of several thousands of people in SADC through respiratory complications. It is critical that policies and technologies be developed to ensure that modern consumption methods are promoted in the region. Capacity building in this and other sectors is of paramount importance.



Chapter 4

OIL AND GAS

4.0 Introduction

Over the last two years crude oil and gas prices took an upturn, driven by economic recovery and increased demand across the globe. This has spurred significant activity across the SADC Member States aimed at developing the respective oil and gas industries. The *SADC Energy Monitor 2016* highlighted that:

- Angola, Mozambique and Tanzania are extracting natural gas commercially;
- Angola is the only one extracting crude oil commercially;
- DRC, Madagascar and Namibia had discovered large deposits of natural gas but were still in the process of developing towards commercial extraction;
- South Africa has discovered large deposits of shale gas;
- Botswana, Mozambique and Zimbabwe had discovered large deposits of Coal Bed Methane (CBM) gas but were still in the process of developing towards commercial extraction; and
- DRC and Madagascar had discovered significant deposits of oil but were still developing towards commercial extraction.

Efforts to create synergies across Member States are pre-occupying the regional body, with the goal of harmonising these developments and promoting regional integration and economic growth. In this direction, SADC has initiated the establishment of an Interstate Petroleum and Gas Sub-Committee to ensure the inclusion of petroleum and gas in the regional energy mix and to facilitate an increase in universal access to energy as well as industrial development in the region (*SADC Today,* August 2018).

In addition, the SADC Council and Summit directed the Secretariat to work in collaboration with the implementing agencies and private sector to coordinate development of natural gas facilities and to promote utilization of gas as an alternative source for power generation (Joint Meeting of SADC Ministers Responsible for Water and Energy, June 2018).

The possible value chain from Natural Gas will be realised in the exploration and processing through separation activities, liquefaction through condensation process, Liquefied Natural Gas (LNG) transportation through special LNG Vessels, regasification, storage, transmission and distribution through pipelines, and finally marketing or conversion of gas-to-liquid refineries.

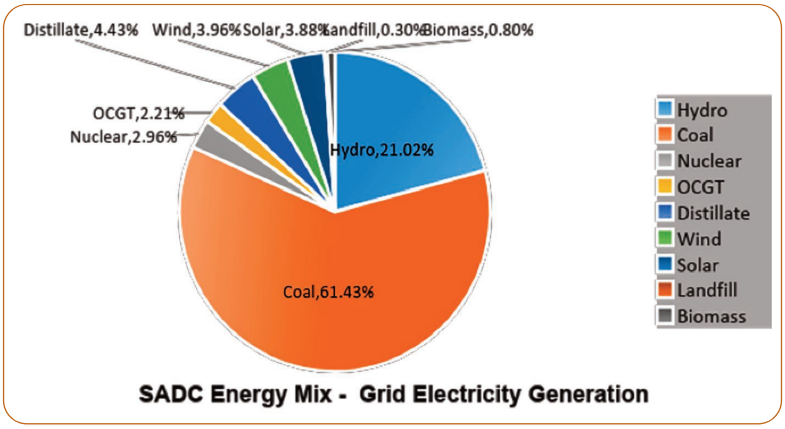
The Secretariat is mobilising the private sector and key stakeholders with the objective to establish a Regional Gas Taskforce and to develop a Gas Strategic Plan for the region in collaboration with the NEPAD Business Foundation and USAID Southern Africa Energy Program (SAEP).

4.1 Contribution of Petroleum and Gas to the Energy Mix

According to SAPP annual reports of 2014 and 2017, the total electricity generation capacity in the region increased from 58,337MW to 62,928.4MW in the respective years, with gas contribution also increasing from 776MW (1.3 percent) to 1,393MW (2.21 percent).

In the same period the share of oil to electricity generation in the region remained essentially unchanged. Figure 4.1 shows the electricity generation energy mix and the share of oil and gas available in the region in 2017.

Figure 4.1 SADC Regional Generation Mix



Source SAPP Annual Report 2017

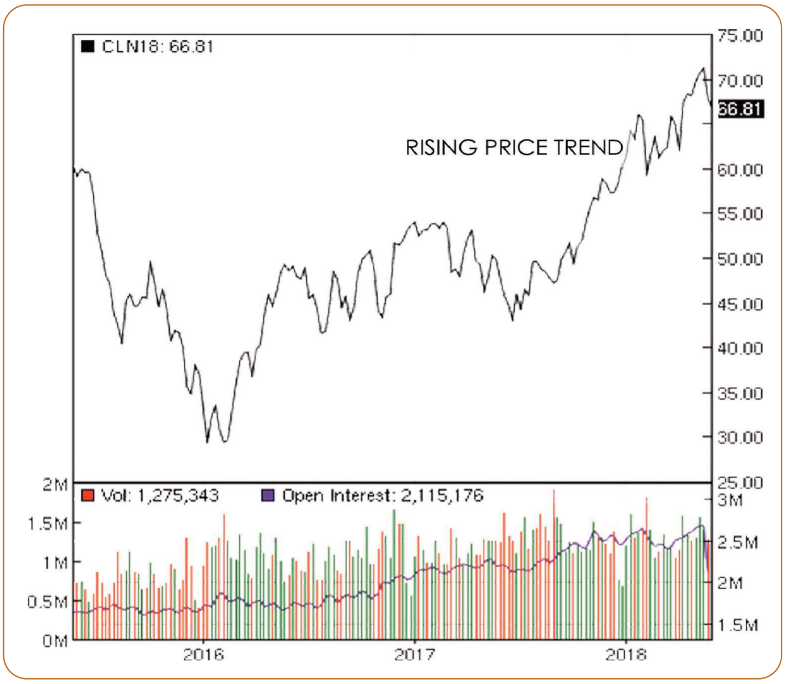
4.2 Crude Oil Price

The crude oil and gas prices experienced a severe downward trend during the years leading to early 2016, from which period the prices picked up and have generally been on the upward trend up to date as shown in Figure 4.2 for crude oil prices. Oil prices increased lately due to:

- greater than expected global demand for oil driven by strong economic growth around the world;
- smaller than expected oil production in the United States of America (USA) due to a slowdown in oil extraction investment;
- instability in some oil-producing regions; and
- the OPEC agreement along with Russia to cut production.

However, markets anticipate a reversal in this trend in the coming months mostly because production in the USA and elsewhere is expected to increase as producers take advantage of the higher oil prices. The market participants expect the current crude oil price of US$79 per barrel (Brent) to decrease over time and reach about US$75.5 per barrel by May 2019. Volume represents the total amount of trading activity or contracts that have changed hands in a given commodity market for a single trading day. The greater the amount of trading during a market session the higher will be the trading volume. Open Interest is the total number of outstanding contracts that are held by market participants at the end of each day and it measures the flow of money into the futures market. A seller and a buyer combine to create one contract. Both volumes and open contracts in Figure 4.2 show positive business sentiment. In the long term, however, there is not much scope for significantly higher prices.

Figure 4.2 Crude Oil Price



Source Nasdaq Commodities: NYMEX: Crude Oil, May 2018

Although there is growing demand for petroleum products from emerging markets, the demand in developed countries is declining as environmental standards get tougher and electric vehicles spread. Also, demand in the emerging markets would probably taper off as cleaner technologies become cheaper and more accessible. Hence, the World Energy Council expects oil consumption to peak in 2030. That is also the year when Germany and India plan to switch entirely to electric cars. The Saudi Vision 2030 initiative also targets 2030 as it tries to shift away from Saudi Arabia's dependence on oil revenues to other industries.

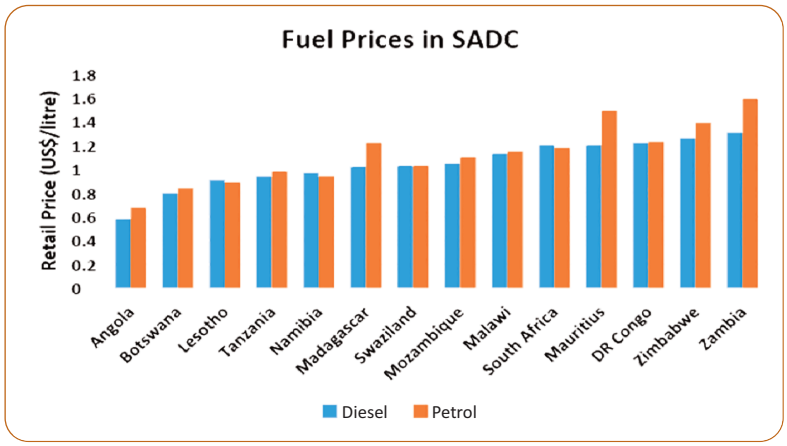
The SADC Ministers responsible for Energy, meeting in Eswatini in July 2017, approved to migrate to low sulphur content diesel of 50 parts per million by 2022 and to ultra-low sulphur diesel of 10 parts per million by 2030.

4.3 Fuel Pricing in SADC

A comparative analysis of fuel prices in SADC shows that countries in the region have a wide spectrum of fuel prices because the SADC countries impose different taxes and subsidies for diesel and gasoline, resulting in different retail prices of diesel and petrol across the region.

Generally, countries that produce and export oil have significantly lower prices. For instance, fuel prices in Angola are the lowest in the region and among the lowest in the world.

Figure 4.3 Fuel Prices in the SADC Region at 21 May 2018



**World Average diesel price was US$1.07/litre, while that of petrol was US$1.18/litre on that date.*
Source GlobalPetrolPrices.com

4.4 Legal, Regulatory and Institutional Framework

Development of the petroleum and gas sector for electricity generation in the SADC region is generally regulated by the Regional Electricity Regulators Association (RERA), which has national institutions in the Member States.

In recognition of the growth in the sector and its potential to contribute significantly to the regional energy mix, and contributing to the reduction in greenhouse gas emissions, SADC has initiated the establishment of an Interstate Petroleum and Gas Sub-Committee to ensure the inclusion of natural gas in the regional energy mix. This is also intended facilitate an increase in universal access to energy and accelerate industrial development in the region. The Terms of Reference of the Regional Gas Committee were drawn up at a meeting convened by the SADC Secretariat in Johannesburg in May 2018 (SADC, 2018).

In Tanzania, the Petroleum Upstream Regulatory Authority (PURA) and Energy and Water Utilities Regulatory Authority (EWURA) are the authorities that regulate the extraction of oil and gas. The two authorities fall under the Ministry of Energy and Minerals, the parent ministry, which is responsible for oil and gas, among other matters. The Petroleum Act 2015 is the principal legislation governing oil and gas exploration and production. It governs the import, export, transformation, storage and wholesale and retail distribution of petroleum and petroleum products in a liberalised market. Once an application relating to a specific area is received from a private developer which meets the requirements, the Government of Tanzania, through the Minister for Energy and Minerals grants a licence to the Tanzania Petroleum Development Corporation (TPDC). The TPDC holds the licence and enters into a Production Sharing Agreement (PSA) with private developers to undertake exploration, development and production activities (Nyange, 2015).

In Namibia, the National Petroleum Corporation of Namibia (NAMCOR) is a wholly owned Government institution, under the Ministry of Mines and Energy, charged with the mandate to carry out two main functions either on its own or in partnership with other organisations in the industry; upstream and downstream operations. The upstream compo-

nent, also known as the Exploration and Production sector, involves the search for potential underground or underwater oil and gas fields, the drilling of exploratory wells, and the subsequent operation of the wells which recover and extract this crude oil and/or raw natural gas to the surface.

The downstream component involves the refining and processing of the product derived from crude oil and the trading and distribution of the product and its derivatives, such as liquid petroleum gas, petrol, jet fuel, diesel oil, other fuel oils, asphalt and petroleum coke, as well as reconnaissance, exploration and production operations of oil and gas. Its role is to actively promote the hydrocarbon potential of Namibia and to advise the Ministry of Mines and Energy on policy issues regarding the upstream petroleum industry and monitoring the petroleum activities of oil companies operating within Namibia (Namcor, 2017).

In Angola, the national oil company Sonangol has shareholding in almost all oil and natural gas exploration and production projects. International oil companies from the United States and Europe lead oil and natural gas exploration and production while Chinese companies have been increasing their participation in the Angolan oil and natural gas industry. Sonangol's key subsidiaries include: Sonangol Pesquisa e Produção (P&P), which undertakes exploration and production activities for Sonangol in Angola; Sonaref, which runs refining operations in Angola; and Sonangás, which runs Angola's natural gas sector and is tasked with the exploration, evaluation, production, storage, and transport of Angola's natural gas and natural gas derivatives. Sonangás is working with Sonangol P&P to establish a regulatory environment, including taxation, to help to expand research and development in Angola's natural gas sector.

International oil companies involved in Angola operate under joint-venture arrangements and Production Sharing Agreements (PSAs) with Sonangol. Major operators and shareholders include Total, Chevron, ExxonMobil, BP, Statoil, and Eni, among others. China's national oil companies, Sinopec and the China National Offshore Oil Corporation (CNOOC), and the Hong Kong-based New Bright International Development, are also involved in Angola and provide development assistance as well as oil-backed loans and trade (SARDC 2016; IEA, 2018).

Empresa Nacional de Hidrocarbonetos (ENH), the state-owned hydrocarbon company, represents the Mozambican Government in petroleum operations. It is stipulated by law that ENH participates as a stakeholder in petroleum operations and production as well as exploration projects.

Exploration and production of oil and natural gas in South Africa is governed by the Mineral and Petroleum Resources Development Act 28 of 2002, while the exploration, extraction and production of petroleum is regulated by the Petroleum Agency of South Africa (PASA) (ICLG, 2018). South Africa also established PetroSA as a national oil company.

Similar institutions are in place in the other Member States, but there is a proposal for regional bodies along the lines of SAPP, to coordinate regional efforts in the sector. The following shows the development in terms of establishing the national oil and gas companies in the region.

4.5 Oil and Gas Reserves and Production

There is an estimated 600 trillion cubic feet (tcf) of natural gas reserves in southern Africa (Killian, 2018). Angola is the second-largest oil producer in sub-Saharan Africa, behind Nigeria. Angola holds an estimated 10.9tcf of proved natural gas reserves.

Angola produced nearly 1.8 million barrels per day (b/d) of crude oil in 2015 (IEA, 2018). Limited infrastructure inhibits trade among countries in the region. For example, of the 1.8 million barrels per day of crude oil exported by Angola in 2015, only 4 percent was destined for countries in Africa. More than half went to Asia (60 percent) with Europe at 22 percent and the Americas at 14 percent being also major destinations for Angolan oil. Angola's flat production is the result of persistent technical problems related to water injection systems, gas cooling and floating, production, storage, and offloading units associated with some projects. The technical problems resulted in lengthy maintenance work and disruptions to production from some fields (IEA, 2018). Nearly all of Angola's oil production is exported because its domestic refining capacity is limited, forcing the country to import about 80 percent of the petroleum it consumes.

Table 4.1 National Oil Companies/Agencies in SADC Member States

Member State	National Oil Company or Agency
Angola	Sonangol
Botswana	Botswana Oil Limited (BOL)
Comoros Islands	-
DRC	Cohydro SARL
Eswatini	-
Madagascar	Madagascar Oil
Lesotho	-
Malawi	National Oil Company of Malawi -NOCMA
Mauritius	-
Mozambique	Empresa Nacional de Hidrocarbonetos - ENH
Namibia	National Petroleum Corporation of Namibia -NAMCOR
Seychelles	PetroSeychelles
South Africa	PetroSA, iGas, PASA, Transnet
Tanzania	Tanzania Petroleum Development Corporation -TPDC
Zambia	Zambia National Oil Company- ZNOC
Zimbabwe	National Oil Infrastructure Company of Zimbabwe - NOIC

Source Government websites

Angola produces small quantities of marketed natural gas, but the bulk of its production is flared as a by-product of oil operations or reinjected into oil fields to increase oil recovery. Angola lacks the infrastructure needed to commercialize more of its natural gas resources which are currently vented and flared. The country's new Liquid Natural Gas (LNG) plant at Soyo was developed to commercialize more of its natural gas. However, the plant experienced chronic problems and was temporarily shut down one year after it exported its first cargo to Brazil in June 2013. The plant was expected to return to operation in 2016.

Tanzania has 57tcf of proven natural gas reserves of which 47tcf is offshore and 10 tcf is onshore, but they are mostly undeveloped. Furthermore, for the gas that is readily available, there is very little infrastructure to deliver it to potential consumers. Gas production is mainly done from two blocks, Songo Songo and Mnazi Bay. The Songo Songo gas fields produce 105 million standard cubic feet of gas per day (mmscfd), which is transported to Dar es Salaam for power generation and for industrial and household use. The production of Songo Songo gas field started in 2004 through a Songo Songo Gas to Power project funded by World Bank. The Mnazi Bay gas field commenced gas production in 2006 to enable power production for Mtwara and Lindi regions.

Following the country's demand for more power, in 2013, the Government initiated a new natural gas infrastructure project that included a 542km natural gas pipeline from Mtwara and Songo Songo Island to Dar es Salaam and two processing plants with capacity to process 350mmscfd. The project was commissioned in October 2015 (*Diplomat, 2016*). To cater for natural gas demand for industries and household, TPDC has embarked on a project known as Dar es Salaam Ring Main, which is aimed at laying natural gas pipelines along main roads of Dar es Salaam and to supply gas to industries, households and vehicle-refuelling stations.

In support of industrialisation, TPDC has signed a joint venture agreement with international companies (Ferrostaal GMbH, Haldor Topsoe, Fauji Fertliser and Minjingu Fertiliser) for implementation of a fertiliser manufacturing project. The plant will be located in Kilwa district and it will produce Urea and Ammonia. The project is at its initial stage and the objective is to produce about 3,850 metric tonnes of Urea and 2,220 metric tonnes of Ammonia.

Tanzania is making significant progress towards the construction of a US$344 million, 240MW natural gas power plant (Kinyerezi II) outside of the nation's commercial centre, Dar es Salaam. Japanese company Sumitomo Corp is constructing Tanzania's new natural gas plant, and a Japanese bank loan covered 85 percent of the total capital required. As of April 2018, the power station had capacity of 167.82MW, with ongoing expansion to the full 240 megawatts expected to be completed by December 2018.

Following completion of Kinyerezi I (150MW) power plant in late 2015, Kinyerezi I - Extension 185MW is under construction for a total of US$188 million from the Government. As part of the country's push for sustainable energy independence, Tanzania has moved away from importing fossil fuels such as heavy furnace oil and diesel, to focus on using their own domestic natural gas reserves, allowing them to save US$4 billion between 2015 and 2017, and therefore stimulating economic activities. Domestic demand for natural gas has already more than doubled from 145 million standard cubic feet (scf) a day in 2016 to 300 million scf in 2017, according to figures from the Tanzania Petroleum Development Corporation (TPDC).

Namcor and the Government of Namibia have identified the offshore Kudu Gas Project as one of its key and ultimate responses to the energy needs of the country. The gas produced from the Kudu Gas Field will be transported through a 170km pipeline to a power station that will be built and situated at Uubvlei, approximately 25km north of Oranjemund in the southern part of Namibia (Namcor, 2017).

Namcor and its partners (collectively known as the Upstream Parties) will be responsible for drilling of production wells, installation of subsea equipment, installation of the floating production system, gas production, conditioning and transportation of the gas to the power plant. The Company and its partners (collectively known as the Downstream Parties) will be responsible for the purchase of the gas, the design and construction of a 475MW combined cycle gas turbine that will be utilised for the generation of electricity. NamPower will be the sole purchaser of the electricity produced by the power plant. Since the expected Namibian domestic electricity demand from the power plant is approximately 400MW, the remainder of the electricity will have to be exported by means of power purchase agreements with Zambia (Copperbelt Energy Corporation) and South Africa (Eskom) According to the *Oil & Gas Journal*, Mozambique held 100 trillion cubic feet (tcf) of proven natural gas reserves by 2014, placing the country as the third largest known natural-gas reserve holder in Africa, after Nigeria and Algeria. Mozambique's natural gas production was mainly operated by international company Sasol headquartered in South Africa. The natural gas was produced and processed at a central facility in Temane and then transported via an 865km Sasol Petroleum International Gas Pipeline to South Africa, with a link to southern Mozambique for domestic use. In May 2016, Sasol initiated drilling of the first well for its Production Sharing Agreement (PSA) license. The PSA development was an integrated oil, liquefied petroleum gas project adjacent to Sasol's existing petroleum facility. The first phase of the project included 13 wells and an LPG production facility for an estimated cost of US$1.4 billion.

Following the discovery of over 180 tcf of natural gas reserves in the Rovuma basin off the northern coast of Mozambique near the border with Tanzania by Texas-based Anadarko and ENI of Italy, Mozambique was expected to become a major exporter by 2023. Anadarko planned to build an LNG plant to process the gas. ENI has commissioned a Floating LNG (FLNG) facility for its Coral South Project, due for completing in 2022. The Engineering Procurement and Construction (EPC) contract was officially awarded to a consortium composed of Technip, JGC and Samsung Heavy Industries.

ExxonMobil agreed to acquire from ENI a 25 percent indirect interest in the Area 4 block. ENI led the Coral South FLNG project and all upstream operations, and ExxonMobil would lead the construction and operation of liquefaction facilities onshore. ENH was engaged with other national flagship projects such as the port expansion of the oil and gas terminal in the port of Pemba, and the General Urbanization Plan for the district of Palma, where the natural gas business activities would be concentrated. In partnership with the Korean gas company Kogas, ENH was also operating a gas distribution network to provide households and industry with piped gas in the south of Mozambique.

The government of Mozambique determined that a portion of the gas should be used locally to address the domestic market and the Ministry of Mineral Resources and Energy launched a tender to identify companies interested in developing industrial projects to use the gas. Norway's Yara International was granted an allocation of gas to produce fertilizers. In addition, Royal Dutch Shell's Gas to Liquid project would produce liquid fuels such as diesel, naphtha, and kerosene.

Due to the high costs to develop an LNG facility, the Mozambican government was considering a proposal to construct a pipeline from Rovuma, in the far north of the country, to Gauteng in South Africa to deliver gas to Mozambican towns along the pipeline route before delivering the natural gas to South Africa. SacOil, a company backed by South African Investors, was spearheading the proposal and has partnered with China Petroleum Pipeline Bureau. The pipeline was estimated to cost US$6 billion, but that amount may be underestimated, as cost overruns are common with pipelines built in the area.

With the recent discovery of large natural gas deposits off the coast of Mozambique, Madagascar, just across the Mozambique Channel, has received much interest in the last few years as a potential source of natural gas and petroleum in the Bemolanga field which is estimated to contain 16.6 billion barrels of oil in place and recoverable, probable and possible reserves of 9.9 billion barrels. This tar sands reservoir has been extensively drilled for many years, but due to economic and technical difficulties, commercial production is not expected until 2019. The Tsimiroro field, estimated to hold 1.7 billion barrels of oil, has seen production of heavy oil through a steam flood pilot project in 2015 and should see a significant increase in production over the coming years.

The companies involved in these two projects, Madagascar Oil, the biggest operator in the country and 100 percent owner of Tsimiroro, and Total, which partners with Madagascar Oil at the Bemolanga field, indicate the production potential could be as high as 180,000 barrels per day for Bemolanga and 100,000 barrels per day for Tsimiroro. Madagascar Oil, an AIM listed company, has been producing heavy oil since 2013 from its field in northwest Madagascar and in April 2014 became the first oil company in the country to receive a 25-year exploitation license (Exportgov, 2017). The country's limited infrastructure and remote geographical location make access to equipment and logistics complicated, and political stability has been lacking at times (N.J. AYUK Africa Energy Frontiers -Madagascar).

The government of South Africa was planning to fast-pace the exploration of shale gas in the southern Main Karoo basin, to maximise production and to reshape the country's energy economy. PetroSA has estimated that the Main Karoo Basin may have about 205tcf of recoverable shale gas (*Oil Review*, 2018)

4.6 Investment on Infrastructure in the Oil and Gas Sector

The NEPAD Business Forum has called for SADC to develop a natural gas master plan to assist in attracting investment and developing natural gas resources. This would enhance economies of scale, help to transform the regional economy and leverage regional value chains. Opportunities for the industrialization of the domestic market have been limited owing to insufficient local demand, with the exception of South Africa. Therefore it is imperative to look beyond national borders and identify potential demand and uses for natural gas throughout the region and continent.

The Angolan national oil company Sonangal has been constructing of a new Sonaref refinery in Lobito since December 2012 with an estimated cost of US$5.6 billion. However, Sonangol suspended building work at the Lobito Refinery and the Ocean Terminal to reassess the project in 2016, to allow for a thorough review of its development, phasing and financing, the state company said in a statement. (Macauhub, 2016). The refinery was designed to process 200,000 barrels of Angola's crude oil per day and produce fuels such as gasoline, diesel, jet fuel and other derivatives sold to domestic and international markets.

Namibia's Kudu Gas field, is estimated to contain 4.393 trillion standard cubic feet (tscf). The project involves the development of the offshore Kudu Gas Field to deliver gas through a 170km-long pipeline to a planned 885MW combined cycle, gas turbine power station onshore Namibia. The upstream capital requirement to develop the gas field has been estimated at US$1 billion. In February 2017 the group announced that it had agreed to accept an investment offer from BW Kudu Limited (a wholly owned subsidiary of BW Offshore Singapore (Pty) Ltd) for a 56 percent working interest in the Kudu License and assume the role of field operator. Namcor would hold the remaining 44 percent interest in the license. Drilling of production wells, the construction of subsea and gas transmission pipelines and the installation of a Floating Production System (FPS) would proceed. Project Status gas field development planning, Feasibility and Front-End Engineering Design (FEED) work has been completed. Tendering processes for substantive engineering work, including the subsea pipeline and floating production system have also been completed.

Namcor intends to further reduce its equity participation in the Kudu license to around 10 - 15 percent. Discussions with interested parties from the international Oil and Gas industry and the global investment banking sector are at an advanced stage.

In Tanzania, Shell, in collaboration with Statoil and Tanzanian Petroleum Development Corporation (TPDC) 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. On the other hand, 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).

Zambian authorities have been looking for an investor to take up 49 percent ownership in the Indeni Oil Refinery located in copper-producing region of Ndola, to support future

enhancement of the plant. Much of the output from Indeni was supplied to mining operators in the Copperbelt area. It was fed with crude oil by the 1,700km Tazama pipeline which connects Ndola to Dar es Salaam in Tanzania.

4.7 Conclusion and Policy Considerations

The SADC Petroleum and Gas sub-sector activities have been resuscitated following a call by South Africa as a chair of SADC at the time, for the region to establish an Interstate Gas Committee that would be charged with ensuring the inclusion and promotion of natural gas in the regional energy mix and with facilitating an increase in universal access to energy as well as industrial development in SADC. The terms of reference of the sub-committee were drawn up in May 2018.

Development of petroleum and gas sector in the region has been hampered by inadequate infrastructure to distribute the gas, as well as lack of market economies of scale and investment. According to the SADC Energy Monitor (2016), the contribution of natural gas to the regional energy mix was still very low, accounting for a mere 1.3 percent of the total power generation mix, which rose to 2.21 percent in 2017 (SARDC, 2016 and SAPP, 2017).

Southern African 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. The approval was made by the Southern African Development Community (SADC) Council of Ministers that met ahead of the 38th SADC Heads of State and Government Summit to be held in Windhoek, Namibia.

There have been calls, particularly from various stakeholders in the region Southern Africa Business Forum (SABF) for a regional gas masterplan that would help to consolidate the regional market and create economies of scale, and galvanize investors in the sector.

The oil and gas extraction industry has been challenged in recent years by a decline in oil and natural gas prices, and revenue contracted over the past five years due to steep price decreases in 2015 and 2016. However, oil prices have been on an upward trend since 2017 and industry operators positioned themselves to perform strongly as prices rise over the five years to 2022. Moving forward, the industry is also expected to increasingly hinge on improvements in drilling technology and techniques.

Chapter 5

ENERGY EFFICIENCY AND SADC INDUSTRIALIZATION

5.0 Introduction

Energy efficiency (EE) has become an important consideration and innovative way of reducing energy consumption and use. This is particularly critical for the Southern African Development Community (SADC), which is facing crippling challenges in meeting its energy requirements due to a combination of factors that has resulted in rising energy costs and low access to clean and affordable energy across the region. Ultimately, inadequate access and supply of energy has affected the pace of regional integration and industrial development. For example, the SADC Industrialization Strategy and Road Map (2015-2063), aims to increase Competitiveness (at the firm/industry, country and regional level) with a quantitative goal to lift the regional growth rate of real Gross Domestic Product (GDP) from 4 percent annually (since the year 2000) to a minimum of 7 percent a year.

However, to attain this goal, there is need for SADC to adopt energy efficient technologies to reduce the cost of production and minimise greenhouse gas emissions that contribute to climate change. The region through the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), is developing a regional SADC Industrial Energy Efficiency Programme (SIEEP) in support of the SADC Industrialization Agenda as part of its overall energy efficiency program.

This chapter presents the current status of industrial energy efficiency in the SADC region including barriers and opportunities. The chapter also presents some key interventions proposed by the SIEEP to assist the SADC region's industrial sector to utilise energy efficiently in a cost-effective manner for its economic development and sustainable development agenda.

5.1 Background on SACREEE and SIEEP

SACREEE was established by the SADC Ministers responsible for Energy in 2015 as a Centre of Excellence of the SADC Secretariat with a mandate to contribute to:

- Increased access to modern energy services, and
- Improved energy security across the SADC region.

The centre is also expected to contribute substantially to the development of thriving regional renewable energy and energy efficiency markets through knowledge sharing and technical advice in the areas of policy and regulation, technology cooperation, capacity development, as well as investment promotion. Based in Windhoek, Namibia, the centre is supported by the Austrian Development Agency (ADA) and the United Nations Industrial Development Organization (UNIDO).

The SIEEP is intended to support the implementation of the SADC Industrialization Strategy and Roadmap, 2015-2063. SIEEP will contribute to the competitiveness of the industrial sectors of SADC Member States by building their capacity to adopt, invest and utilise energy efficient technologies and practices. The target group are medium and large scale industries. The objectives of the Program (SIEEP) contributes to the region's goals of:

- Energising SADC towards adequate, reliable, least cost and environmentally sustainable energy service; and
- Long-term transformation of the SADC economy and creating the knowledge economy of the future.

5.2 Regional Status on Energy Efficiency

A Scoping and Assessment Study of SIEEP conducted in 2017 revealed that the performance of industries in the region is low, based on capacity utilization and other measures. This is attributed to the poor global economic environment, ageing infrastructure, labour issues, shortage of energy and quality of supply, and high energy costs. In all countries, food and beverages, agro-based industries and those based on natural resources such as forestry are operating at relatively high capacity levels and are least affected by changes in national and global economies.

The general state of play in the region is that little effort has been made in the industrial sector regarding industrial energy efficiency, save for a couple of countries such as Mauritius and South Africa that have achieved a significant level of success in the promotion of energy efficiency through a combination of governmental incentives (policies, regulation and tax incentives) and of private sector led initiatives.

The industrial sector has been the least active in developing and implementing energy efficiency measures compared to other sectors in the SADC region. The lack of activities towards industrial energy efficiency can be attributed to the general lack of guiding policy frameworks for energy efficiency. The Scoping and Assessment study identified that the majority of countries in the region do not have dedicated policies and strategies to address energy efficiency as illustrated in Table 5.1.

Table 5.1 SADC Member States Energy Statistics, Policy Framework and Economic Contribution of Manufacturing Sector to GDP

Country	Electricity Access Rate %[1]	Energy Policy in Place (year)	EE Policy / Strategy/ Action Plan /Master Plans in Place (year)	EE Target- National & Industry % Savings	RE Policy Strategy/ Action Plan/Master Plan/ Act in Place (year)-	RE Target Total/Grid Share (%)	REFIT (year)	Net Metering Exists	Subsidized Industrial Tariff in USD cents[2] ***	Financial Incentives for EE Measures in industries	Share of Industry in Energy Consumption %	Share of Manufacturing Sector in GDP (2016)[3]
Angola	32	2011							6.37		8	5.4 (2015)
Botswana	56	D	2016 S	10N	2016S		D		5.7		18	6[4] (2015)
DRC	14	2013							5.6		16	18
Eswatini	65	2017D	2017(P) D			32 by 2030			7.1		52	36 (2014)
Lesotho	28	2003							2.0		36	10 (est)
Madagascar	17	2015		60I***					7-8	P	19	15
Malawi	12	2003							2.7		26	10
Mauritius	100		2011A/ 2016 MP/IN	10N					16.5	CL	26	14.1
Mozambique	21	2009S							1.8		20	10
Namibia	50	2017	IN		2017	70 by 2030 (NDC)	E	T	9.2-16.2[5]		12	
Seychelles	100	2012 S 2012A							25-30[6]		28	15.3 (2014)
South Africa	86		2016S IN	15I	2011P		CB	T 2017D	8-10	CL/TR	39	13
Tanzania	16	2010S	(A)D	20I(electricity)			D		7.0		15	6 (18)
Zambia	28	2008							1.5-3.3		32	11
Zimbabwe	40	2012	IN		2017D IN			+D	7.0		8	10

[1] Source of electricity access data is SE4ALL Global Tracking Framework database 2017 and validated by the MS during the SIEEP design.
[2] Estimated from various sources and converted to USD cents using exchange converter.
[3] Majority of figures from https://data.worldbank.org/indicator/NV.IND.MANF.ZS
[4] 31% including mining
[5] Mining is 9USD cents/kwh then commercial/industrial is 16.2 USD cents/kwh
[6] Spanning range of maximum demand level
[7] Figure from consultation is 18% from literature review is 6%

D- draft; P- Policy, IN- dedicated RE/EE institution, S- Strategy, A- action plan; CL Credit Line; TR- tax rebate, I Industry share; T- Trail net metering in municipality (South Africa) and Regional Electricity Distributor region (Namibia); N- national, I-industry, CB- competitive bidding; E-exists; p-pending; The tariffs are for energy charge only and does not include max demand and fixed charges; *** industry penetration not energy improvements; NDC – Nationally Determined Contributions.

Between 2015 and 2018, two significant programs covering industrial energy efficiency were implemented at regional level. The two programs are the SADC Industrial Energy Management Programme (SIEMP) and the Efficiency Energy Management Programme in Southern Africa (EEMP), both implemented to promote energy efficiency awareness and capacity building in industry. The objective of SIEMP, which was funded by the Canadian International Development Agency was to promote energy management in industry through delivery of training of trainers and production of training manuals and material on energy management. Some of the achievements realized by the SIEMP that ran from 1994 to 1998 included the training of technicians and engineers in the selected industries and the conduction of numerous basic energy audits and introduction of some level of energy management.

The objective of the EEMP funded by the European Union from 2007 to 2014 was to create and enhance awareness on the value of energy management among Small to Medium Enterprises in selected sectors to improve their energy consumption and improve their competitiveness thus ensuring long term sustainability of energy usage. Monitoring of energy consumption was key in the program to identify the need for replacing existing inefficient equipment and installation of integrated renewable energy systems. In as much as the regional programs were useful in creating awareness and building some technical capacity of a few consultants, their sustainability was not ensured. The design and development of SIEEP, which will set an agenda for the region's industrial efficiency program, will be informed by the past activities.

5.3 Opportunities and Challenges

Opportunities exist in the industrial sector to reduce energy intensity and improve energy efficiency in their operation. SIEEP has identified the following possible actions to increase energy in the industrial sector across the SADC region:

- Implementation of energy audits to identify opportunities for energy reduction;
- Benchmarking energy use in different sectors of activity and setting targets;
- Ensuring that energy efficiency policies, strategies, action plans are put in place;
- Involvement of the private sector and creation of industries in the region producing energy efficient technologies;
- Creating awareness to the industry community about the benefits of energy efficiency through demonstration programs;
- Setting up energy services companies to deal with energy audits, monitoring and verification; and;
- Embedded power generation from renewable energy facilities to offset electricity uptake from the grid.

In most Member States a number of barriers still exist for mainstreaming energy efficiency in industries. Most countries are affected by inadequate power supply and lack of investment in new energy efficiency equipment and technologies. There is still lack of dedicated or comprehensive energy efficiency policies, strategies and action plans in the countries to promote energy efficiency. In some countries, energy efficiency appears in the National Energy policies but without any action plans or targets which makes it difficult to guarantee their implementation and measure effectiveness. The level of cooperation between government and the private sector is lacking in most of the Member States. The other issue is the lack of coordination and limited dialogue among the different market players.

The low tariffs which are not cost-reflective as well as subsidies do not incentivise energy efficiency investments. Furthermore, some of the main challenges are:

- Lack of energy efficiency standards such as Minimum Energy Performance Standards (MEPS) to guide the selection of technologies, and low capacity in guiding industry to adopt energy management standards such as ISO 50001;
- Lack of understanding by key decision-makers on the use of energy by the industrial sector and where opportunities exist for energy efficiency;
- Limited expertise in energy management including conducting energy audits;
- Low involvement of the private sector in energy efficiency activities such as Energy Service Companies (ESCOS) due to the small market, among other factors;
- Limited financing facilities for energy efficiency especially from local commercial banks and direct foreign investors due to lack of awareness as well as technical expertise in assessing energy efficiency projects;
- Complexity of integrating energy efficiency applications and technologies including solar thermal applications;
- Lack of regulatory frameworks allowing for self-generation of renewable energy;
- Limited use of Measurement and Verification in energy efficiency projects.

5.4 Legal and Institutional Landscape

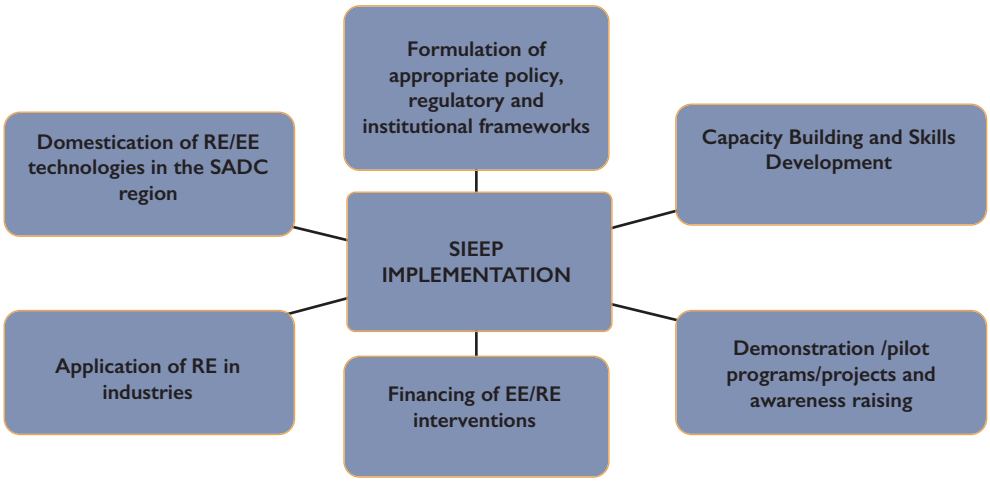
Despite the challenges and opportunities, there are a number of legal documents, policies and institutional frameworks, aimed at facilitating availability of energy and energy security for the SADC region. The main existing frameworks are:

- SADC Treaty (1992);
- SADC Protocol on Energy (1996);
- SADC Energy Cooperation Policy and Strategy (1996);
- SADC Energy Action Plan (1997) and (2000);
- SADC Regional Energy Access Strategy and Action Plan (2010);
- SADC Regional Infrastructure Development Master Plan (RIDMP) and Energy Sector Plan (ESP) (2012-2027);
- SADC Regional Indicative Strategic Development Plan (RISDP) 2010 to 2020;
- Revised Regional Indicative Strategic Development Plan (2015 – 2020;
- SADC Industrialization Strategy and Roadmap (2015 – 2063); and,
- 2015 Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP).

These frameworks have created an enabling environment for investment in the energy sector and economic cooperation among the Member States. The Directorate for Infrastructure at SADC Secretariat is tasked to coordinate developments in the energy sector through the Energy Division.

5.5 Structuring and Implementation of SIEEP

Based on extensive consultations with Member States, industry and other key stakeholders, the need to develop a regional industrial energy efficiency program was highlighted to be long overdue. The design and implementation of SIEEP will be focussed 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:



The SIEEP will also contribute to previous efforts to establish the role of renewable energy and energy efficiency to improve access to energy.

5.6 Policy Options/Way Forward

To ensure a sustainable regional industrial energy efficiency program for the region, Member States are encouraged to develop clear energy efficiency policies and strategies for their implementation. The policies should have targets for the industrial sector. SIEEP will inform the formulation of such policy environment as it pertains to industry. In creating policies, SIEEP will assist Member States to articulate standards, regulations, incentives, tariff structures and mechanisms such as, net-metering for self-generation. SIEEP can assist Member States to develop legislations that will ensure energy efficiency is adopted to ensure security of energy supply in the region.

Legally binding directives setting targets to be met by the SADC region and Member States should be considered by SIEEP. SIEEP will ensure that there is support to financial institutions to develop financial packages and mechanisms for business opportunities in energy efficiency in industry. Voluntary or mandatory approaches can be adopted working in partnership with the regional standards bodies, such as SADC Cooperation in Standardization (SADCSTAN) and the involvement of the private sector.

5.7 Conclusion

The foundation has been laid for regional collaboration in developing a sustainable energy sector through the SADC Energy Protocol of 1996, the 2013 SADC Regional Indicative Strategic Development Plan, among other regional policy instruments. However, very limited programs have been initiated to promote energy efficiency in the region. The region has an enormous task of transforming its energy supply towards a low carbon economy as well as its industrial sector to make its companies and products cost competitive.

It is very clear that energy plays a significant role in the overall manufacturing costs, hence energy efficiency can contribute to improved industrial competitiveness. Targeting the industrial sector for SIEEP is the right choice especially with the importance the SADC region has placed on its industrialization efforts. There are recommended pillars, objectives and actions for SIEEP to elaborate with the engagement of key stakeholders to ensure ownership of the program. SIEEP will support the Member States to achieve their targets for the Sustainable Energy for All (SE4ALL) by doubling the rate of improvement in energy efficiency.

Chapter 6

TRENDS AND SCENARIOS

6.0 Introduction

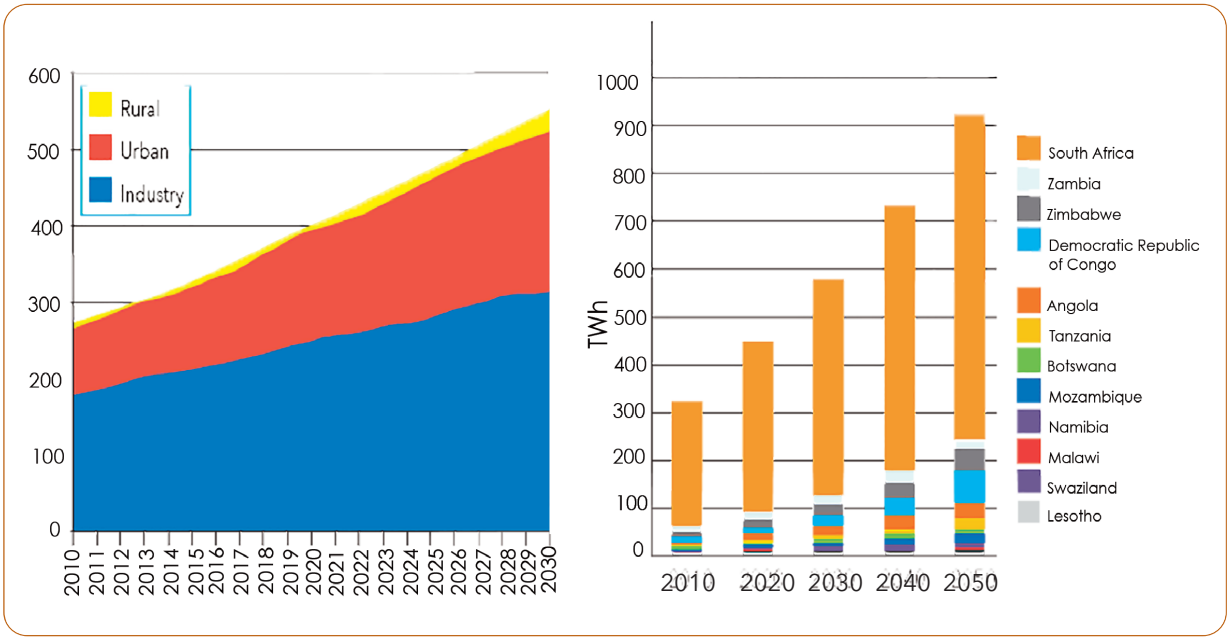
This chapter highlights key trends in various sub-sectors and possible scenarios that may come as a result of regional action towards addressing issues raised or if current situations prevail. This is crucial in flagging key issues the region should focus in making energy a "key enabler" of industrial development. Trends and scenarios are presented from the electricity sub-sector, renewable energy, energy efficiency, tariffs and financing of power projects. The installed capacity in the region is still dominated by coal-fired plants mainly from South Africa. However, from 2013 to 2017 the overall share of coal decreased from 74 percent to 60 percent, while hydropower remained constant at 21 percent.

6.1 Energy Demand and Electricity Supply

Access to modern forms of energy such as electricity remains a major challenge, with the average access to electricity in rural areas at about 34 percent within the SADC region. SADC growing population and urbanization as well as the drive towards industrialization and beneficiation are expected to increase demand on electricity. Figure 6.1 shows energy demand projections from 2010 to 2030 by category (rural, urban and industry) and by country for 12 member states of SADC.

By 2030, the demand for electricity in southern Africa is expected to reach 580TWh and continue rising to 920TWh by 2050. There are a number of factors behind the rise in demand

Figure 6.1 Energy Demand Projections by Country and Category



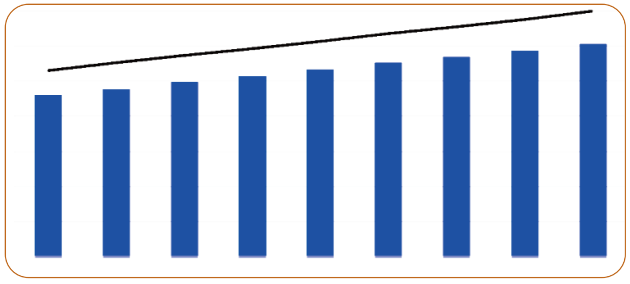
Source Mutanga and Simelane, 2016

which include population growth, urbanization and industrial development. The Action Plan for SADC Industrialization Strategy and Roadmap envisage a significant transformation of the industrial sector and allied services – through doubling of the share of Manufacturing Value Added (MVA) in GDP to 30 percent by 2030 and to 40 percent by 2050. During the same time, the share of medium and high technology is expected to rise from its current level of less than 15 percent to 30 percent by 2030 and 50 percent by 2050. These developments in the industrial sector will increase the demand for electricity in SADC.

As indicated in Figure 6.1, industrial development in SADC will result in more demand for energy coming from industries. Urban settlements will have a steady increase in energy demand. However, under the current policy frameworks in SADC Member States, little change will be witnessed in rural electrification. This means that rural electrification rates will remain low in southern Africa. To speed up rural electrification process, SADC Member States should consider alternative sources of electricity such as wind and solar. Independent and decentralised power grids will also offer a solution for rural electrification.

Indications are that SADC is constantly planning and anticipating an increase in energy demand in the next decade. According to the Southern African Power Pool, the region should be able to generate enough electricity to meet its peak demand until 2025. Figure 6.2 illustrates the rise in demand against the rise in generation capacity.

Figure 6.2 SAPP Capacity Balance 2017-2025



Source SAPP presentation to the SADC Energy Thematic Group, Gaborone, 2018

SAPP is expected to commission an average of 5,200MW from the year 2018 to 2022, as shown on Table 6.1.

With regard to energy balance, indications are that southern Africa will have surplus electricity from 2019 to 2025 (Figure 6.3). This is made possible by coordination in the electricity sector and demand-side management practices. As planned projects are completed, the region is expected to meet its power demands that will sustain socio-economic devel-

Table 6.1 Committed Generation Projects 2018-2022

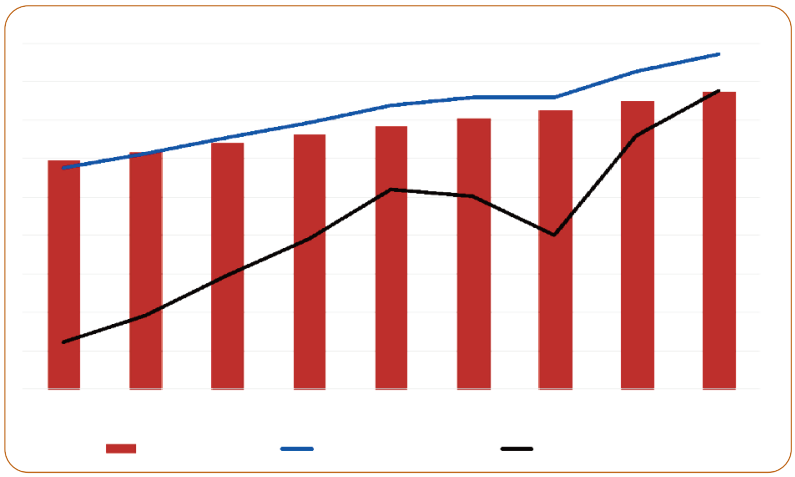
No	Country	Committed Generation Capacity, MW						
		2018	2019	2020	2021	2022	Total	% Share
1	Angola	1 269	0	0	0	2 100	**3 369**	12.90
2	Botswana	-	110	300	-	-	**410**	1.57
3	DRC	-	-	360	300	-	**660**	2.53
4	Lesotho	-	20	-	-	-	**20**	0.08
5	Malawi	112	-	300	18	-	**430**	1.65
6	Mozambique	130	30	-	-	650	**810**	3.10
7	Namibia	20	81	175	175	-	**1 076**	4.12
8	RSA	2 662	3 234	1 219	1 219	1 525	**10 982**	42.06
9	Eswatini	-	12	-	-	5	**17**	0.07
10	Tanzania	397	-	627	2,510	837	**4 371**	16.47
11	Zambia	102	450	891	930	-	**2 373**	9.09
12	Zimbabwe	150	240	600	600	-	**1 590**	6.09
	TOTAL	**4 842**	**4 177**	**4 472**	**7 500**	**5 117**	**26 108**	**100**

Source SAPP presentation to the SADC Energy Thematic Group, Gaborone, 2018

opment. It is therefore imperative that planned projects are implemented as a matter of urgency to complement efforts to strengthen the generation capacity. Simply put, failure to decongest the existing generation and transmission infrastructure would negate efforts to boost generation capacity in the region.

To maintain a surplus electricity scenario, SAPP Member States will need to strengthen cooperation and coordination in power generation, transmission and trading. Interconnection transmissions will also provide opportunities that will allow the region to constantly meet electricity demand. This means that planned interconnection projects must be implemented if this is to come to fruition.

Figure 6.3 SAPP Energy Balance 2017-2025



Source SAPP presentation to the SADC Energy Thematic Group, Gaborone, 2018

For example, the Central Transmission Corridor (CTC) that passes through Zimbabwe and Zambia is particularly important for the region, given that Zimbabwe's electricity network is interconnected to all its neighbours and, therefore, acts as a conduit for the rest of the region. Most SAPP utilities have power supply contracts that use or need to use the Zimbabwe transmission network for power wheeling purposes.

The ZIZABONA interconnector project is equally important as it will allow the four countries involved (Zimbabwe, Zambia, Botswana and Namibia) to export or import more power and to trade energy with each other and with the wider SAPP area (South Africa in particular), in addition to easing congestion on North-South transmission corridor through Zimbabwe to South Africa.

The same urgency is needed for implementation of transmission projects that have been identified to bring on board non-operating SAPP Member States such as Angola, Malawi and Tanzania. Unless these are brought on board, interconnected SAPP Member States will continue not benefitting from power generated in the three countries, and vice versa.

Another important area of focus in the planning horizon should be implementation of interconnector projects to bring in new generation capacity to the SAPP grid. These include the Mozambique Backbone Project initially set for completion in 2017 and now expected to be commissioned in 2021. There is also the second interconnector between Mozambique and Zimbabwe, the 2nd interconnector linking the South African and Zimbabwean electricity systems, and a second transmission line between the DRC and Zambia.

6.2 Renewable Energy

An increase in the uptake of renewables will allow the region to achieve a renewable energy mix of at least 32 percent by 2020, which should rise to 35 percent by 2030.

In terms of actual energy projects, based on the SAPP Energy Plan and national plans, SADC is planning to increase the renewable energy capacity by,

- 13,719MW in 2017
- 10,345MW in 2022, and
- 8,243MW in 2027.

Most of the additional capacity will be from hydropower and these projects are already captured in the electricity sector (RIDMP, 2012).

Apart from hydropower, the major capacity addition will be from wind energy, followed by solar PV, Concentrated Solar Power (CSP) and biomass. Geothermal energy is not expected to make any significant contribution to the RE capacity up to 2027.
The largest growth is expected from tapping the existing hydropower projects, particularly along the Zambezi and Congo River Basins.

Development of a harmonized regional policy framework for new and renewable energy has been identified as an important step towards realization of SADC's goal of achieving the balance between meeting the region's energy needs and ensuring sustainability of the environment.

6.3 Energy Efficiency

SADC Member States have been implementing programs to ensure that the region uses less energy to provide the same service.

These initiatives include the use of remote electric geyser switches, water sensor dispatching equipment, and time-controlled shower units for institutions, as well as banning the use of incandescent light bulbs, electric geysers, boilers and other inefficient water heating and lighting equipment.

Switching from traditional light bulbs to compact florescent lamps and commercial lighting, as well as the uptake of solar water heaters have been effective in most SADC countries as they have significantly reduced energy use. The use of compact florescent lamps can save up to 80 percent of the electricity consumption compared to incandescent bulbs.

While Member States have reached milestones to promote energy efficiency, the legal or regulatory frameworks are too weak to ensure the continuity and sustainability of efforts. Adequate regulatory and legal frameworks for the sustainable use of energy efficient products, as well as mandatory energy audits are required.

Governments lack comprehensive energy management schemes and targets for savings from energy efficiency initiatives. There are also no clear incentives to consumers to adopt energy efficiency and energy conservation, apart from cost savings. This calls for systematic schemes that can enable countries to undertake energy efficiency programs and meet targets.

6.4 Cost Reflective Tariffs

With the increase in the number of independent power producers and independent power transmission companies, the issue of tariff has become a major determinant of successful implementation of power projects over the years.

As the region opens up to further investment in the power sector, investors are concerned with tariffs that can justify their investment and yield returns. The major issue has been striking a balance between a return-yielding tariff and the one that the residents of southern Africa can afford. Governments want user tariffs that are affordable and can ensure access for as many users as possible. The challenge, therefore, is how to strike a balance.

SADC Council of Ministers, meeting in Zambia in February 2008, resolved that Member States should endeavour to reach cost-reflective tariffs within a period of five years, i.e. by 2013. This target was extended to 2019/2020. The Meeting of Ministers responsible

for Energy in 2015, 2016 and 2017 reaffirmed the need to accelerate the migration towards cost-reflective tariffs by 2019 and devise innovative pro-poor electrification support strategies, including the tariff structures that allow for a minimum level of service while ensuring that the viability of the power supply industry is not compromised. Indications are that the slow pace of migration towards cost-reflective tariffs will remain an impediment to development of new power projects.

Although recent studies by SAPP and RERA show that power tariffs throughout the region are below the combined real cost of generation, transmission and distribution, raising the tariff is likely to result in reduced consumption of generated power. This would impact on the development of new power projects in the long run.

On the other hand, current tariffs in most SAPP Member States cannot sustain the power supply industry, provide the right signals for investment, and encourage efficiency. Combined with the absence of a defined feed-in-tariff mechanism to promote renewable energy technologies, low tariffs are expected to remain a stumbling block for the entry of independent power producers into the sector as well as regular maintenance of existing power infrastructure. This calls for political will to ensure that the region attains cost-reflective tariffs and ultimately energy self-sufficiency while ensuring pro-poor tariffs to enable minimum services to the low-income citizens.

6.5 Financing of Power Projects

Power project financing remains one of the crucial areas in the development of the energy sector in southern Africa. Lack of investment is often cited as one of the reasons why the SADC region lacks the capacity to carry out proper planning and project preparation. This lack means energy projects have been failing to attract more investments from across the globe. Lack of administrative and technical staff in project preparation units of SADC Member States has also contributed to poorly structured and packaged regional energy projects.

To be accountable for the preparation and implementation of selected and agreed priority regional electricity projects in the power pool, SAPP has set up a Projects Advisory Unit (PAU) to conduct regional analytical work, and screen, select, prepare and monitor the implementation of regional priority projects.

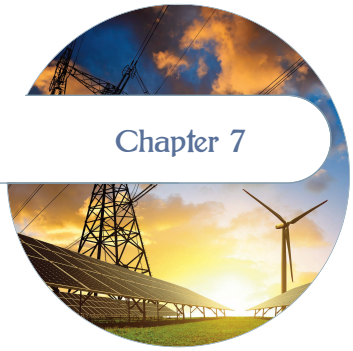
A number of long-planned projects have failed to take off as the private sector has been reluctant to engage in partnerships with governments mainly due to inappropriate financing formulas. Most SADC Member States have been slow in putting in place mechanisms that promote private sector participation in the energy sector and therefore improve the attractiveness of the industry for investors.

Except for a few countries such as Zambia and South Africa, the majority of SADC Member States are yet to fully embrace the concept of Public Private Partnerships (PPPs) despite being party to the SAPP Inter-Utility Memorandum of Understanding that formally allowed private players into the region's energy sector. Zambia has a public institution that facilitates and promotes the implementation of PPPs. The Zambian government has classified power as a strategic resource and has put in place mechanisms to implement various power projects.

Therefore, there is need for the Member States to build individual and collective capacity to package energy projects and develop incentives that can attract investors to the sector. Generally, there is need for a review of the operating environment in the power

sector to encourage investment, including PPPs. This would involve a review of the legal and regulatory framework governing the sector. Proposed incentives include introduction of tax exemptions for investors involved in the construction and rehabilitation of power stations. For example, Member States could allow tax exemptions for defined periods for those companies and investors who import power equipment and machinery.

In addition, other incentives should include the introduction of rebates for power producers in the form of subsidies as well as government grants for power utilities. While subsidies to lower tariffs have an important role to play in extending access, subsidy programs need to be carefully designed and targeted at the power producers to encourage more investment. The rationale is that subsidies to consumer energy prices simply reduce the cost of energy for those who already have access to electricity. For this reason, government or donor resources available for subsidies would contribute more to equity and efficiency objectives if they are spent on once-off capital subsidies rather than on subsidies to recurrent costs.



Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.0 Introduction

Efficient and affordable energy infrastructure is an important driver for regional integration in southern Africa. The importance of energy security has never been more profound than at present, given that the Southern African Development Community (SADC) has adopted a path towards rapid industrial development. Energy security is inextricably linked to industrialisation. Availability of affordable and reliable energy infrastructure reduces transaction costs for industry and trade, as well as for enhancing the economic and social wellbeing of society at large.

For the first time in more than a decade, the region experienced a surplus in power generation in 2017 and it exceeded 2,600MW in June 2018. Starting in January 2017, the region has had excess generation capacity, partly due to a slowdown in the South African economy but also as a result of the impact of a coordinated approach in implementation of the SADC energy program.

The analysis in this report has looked at both "hard" and "soft" energy issues. The "hard" aspects relate to the physical infrastructure that will be required, while "soft" gaps relate to the necessary policies/strategies, institutional capacity and financial issues that need to be addressed to ensure the development of physical infrastructure. This chapter discusses some of the policy recommendations for SADC energy sector players.

7.1 Policy Recommendations for SADC Energy Sector

7.1.1 Energy and SADC Industrialization

As noted in Chapter 1, current plans for hydropower network connectivity and proposed new generation and transmission projects should be fast-tracked, including regional joint-ventures. In this regard, Member States are encouraged to accelerate the design and implementation of an appropriate institutional framework for the early development of regional power projects, in particular the Inga Hydropower Project which has enormous potential for the supply of low-cost electricity to the SADC region.

There should be alignment of the Regional Infrastructure Development Master Plan (RIDMP) with the SADC Industrialization Strategy and Roadmap. It is, therefore, pleasing to note that there is an ongoing exercise to review implementation of the Short Term Action Plan of RIDMP. Such an exercise is crucial in order to ensure that the master plan is aligned with the needs of the SADC Industrialization Strategy and Roadmap as well as to ensure that the use of existing infrastructure capacity is optimized. Adequate measures should be put in place to ensure that implementation of the RIDMP does not lag behind. Such measures could include a coordinated mechanism to track implementation of priority energy projects.

In addition, the region should consider introducing an infrastructure support program designed for industrialization. Such a program would ensure that there is a constant pipeline of financial resources to support the development of energy infrastructure and industrialisation.

It has been noted that the poor quality and inefficiency of existing energy (and other) infrastructure in the SADC region is largely due to the neglect of standards in asset procurement and operation, and inadequate maintenance and management. It will, therefore, be critical for the region to ensure there is regular maintenance of existing energy infrastructure.

New funding should include adequate provision for repair, maintenance, rehabilitation, reconstruction and asset replacement costs. The national budgets of Member States should include increased allocations for operational and maintenance expenditure.

Member States are encouraged to increase public investment in energy provision, both for domestic use and export to regional partners through the Southern African Power Pool. Similarly, governments should step up efforts to encourage the involvement of independent power producers to ease the burden on the fiscus.

Focus should also go towards the development of the oil and gas sector, given the huge reserves that have been identified in the region recently. This would call for the fast-tracking and adequate resourcing of the proposed Inter-State Gas Committee. Similar attention should be paid to harnessing the benefits derived from the massive oil reserves that reside in the region.

SADC should exploit the enormous potential offered by its ocean resources under the Blue Economy Initiative in order to catalyze industrialization and economic transformation. The opportunities under the Blue Economy Initiative include, among others, renewable energy, fishing, shipping, oil and mineral exploration. In this regards, the Blue Economy Initiative should be mainstreamed in developing infrastructure required to accelerate industrialization.

To close financing gaps, action will be needed across the policy spectrum. Governments will need substantial funding for infrastructure development of energy and soft infrastructure as well as funding for human capital development and access to technology. Almost certainly this will require greater private sector participation than in the past, with potentially far-reaching implications in respect of public-private projects and the commercialization or privatization of infrastructure industries.

A well-resourced Regional Development Fund is a pre-requisite for accelerated regional industrialization. The planned SADC Development Fund should be urgently operationalized as a regional development bank with the capacity to attract international funding.

Finally, there is need to strengthen efforts to tap into domestic sources of funding. Possible sources include taxes, the domestic banking sector, private equity funds, public-private partnerships, sovereign wealth funds, remittances, and pension funds. Mechanisms could be put in place to access funding for energy infrastructure development from these domestic sources.

7.1.2 Electricity

The improved electricity generation in southern Africa is a welcome development for the region. The availability of reliable power supply is expected to aid the drive towards industrialization by easing the cost of doing business and reducing concerns by investors about the reliability of electricity supply. As mentioned in Chapter 2, SADC Member States are encouraged to strengthen efforts to ensure conditions are conducive for increased investment in power generation. In this regard, there is need for a faster pace towards migration to cost-reflective tariffs in order to attract private sector investment in the electricity sub-sector.

It is essential that the region continues strategizing on regional power development to ensure that the demand for electricity is met. Such strategizing should include efforts to harness the vast array of renewable energy resources available in the region. This calls for greater use of incentives to attract investment in renewables. These include introduction of feed-in tariffs and net metering.

There is need for concerted effort by SADC Member States, the Southern African Power Pool and International Cooperating Partners to ensure that the planned transmission projects are finalised. These projects are crucial in enabling Member States to benefit from new generation capacity installed in other countries in the region.

With regard to the legal, regulatory and institutional framework, it is critical to review some of the outdated documents to align them with new and emerging realties in the global community such as climate change. These include the SADC Protocol on Energy in order to align it to the industrialization strategy.

Equally important is the political will to move on agreed projects. Thus the current situation where projects wait for several decades for implementation is not attractive to private investors. In the case of electricity, the "hard" infrastructure gaps relate to additional generation capacity required to ensure energy self-sufficiency. Considering the planned and available capacity required under the various growth projections, the planned capacity will only be adequate for a maximum demand (inclusive of the 10 percent reserve margin).

A key sub-sector is that of nuclear energy, which is currently dominated by South Africa but could expand in coming years should the vast uranium deposits across the region be exploited. The "hard" infrastructure gap for nuclear energy relates to a lack of many planned projects for electricity generation and the uncertain future of the technology.

There is need for awareness building to ensure that proponents and opponents of nuclear development agree on the safety of the new technology. This should be accompanied by a presentation of safe nuclear waste disposal mechanisms and the assurance that a nuclear disaster management plan is in place. None of these measures exist at present.

Another reality of the regional electricity sub-sector is that SADC institutions are hampered by the limited authority and capacity to implement electricity projects. For example, RERA does not have powers that would enable it to spearhead the pace of regulation in the region. The same applies to the SAPP, which would need authority to raise funds and implement projects together with the involved Member States. There is need to give these SADC energy subsidiary organisations more authority to advance development in the energy sector.

7.1.3 Petroleum and Gas

A major development during the past few years was the decision by SADC to establish a petroleum and gas sub-sector. This followed a call by South Africa during the 38th SADC Summit in Pretoria in August 2017 that the region establishes an Inter-State Petroleum and Gas Committee that would be charged with ensuring the inclusion and promotion of natural gas in the regional energy mix. The terms of reference of the sub-committee were drawn up in May 2018. There is need to hasten the process of operationalizing the committee and a developing a regional strategy for exploitation of the vast gas reserves available in the region.

The petroleum and gas sector in the region has been hampered by inadequate infrastructure to distribute the gas, as well as lack of market economies of scale and investment. There is need for a regional gas master plan that would help to consolidate the regional market and create economies of scale, and galvanize investors in the sector. According to the *SADC Energy Monitor 2016*, the contribution of natural gas to the regional energy mix was still very low, accounting for a mere 1.3 percent of the total power generation mix. This rose to 2.21 percent in 2017.

The oil and gas extraction industry has been challenged in recent years by a decline in oil and natural gas prices, and revenue contracted over the past five years due to steep price drops in 2015 and 2016. However, oil prices have been on an upward trend since 2017 and industry operators positioned themselves to perform strongly as prices rise over the five years to 2022. Moving forward, the industry is also expected to increasingly hinge on improvements in drilling technology and techniques.

In some cases, the "buy local" campaigns in most of the SADC Member States have taken a more national approach at the expense of regional plans and integration. It is recommended

that the region's strategies and policies need to be aligned so that such campaigns promote regional integration.

7.1.4 Renewable Energy

Renewable Energy sources are increasingly assuming a greater role in the SADC energy mix. Projections by the International Energy Agency (IEA) predict that the next two decades could witness a surge in the uptake of renewables in SADC and other African regions. IEA estimates that 55 percent of all new power between 2017 and 2030 would have to come from decentralized energy sources, with 90 percent of it being renewable, if universal energy access goals are to be met. There is, therefore, need to scale up investment in renewables and put in place mechanisms in the SADC region to ensure the increased penetration of renewable energy technologies and the critical role of Independent Power Producers.

To ensure increased deployment of renewables, there is, however, need for standardised regional rules, regulations and guidelines concerning RE as well as the development of standard specifications for biofuel products, and setting timeframes for the achievement of similar specifications by all Member States.

Another crucial consideration for the region should be the need to adopt feed-in tariffs to encourage use of RE technologies. South Africa and Namibia have already embarked on the development of feed-in tariffs for renewable energy through the Renewable Energy Feed-in Tariff (REFIT). Feed-in tariffs are often used to encourage the use of new energy technologies such as wind power, biomass, hydropower, geothermal power and solar photovoltaics. This type of tariff is also used if there is a shortage of energy to get renewable energy sources on board within short periods of time. South Africa has recently approved REFIT tariffs and Namibia has also initiated a study on the possible use of tariffs for renewable energy sources.

The operationalization of the Southern African Centre for Renewable Energy and Energy Efficiency (SACREEE) was a step in the right direction for the promotion of the deployment of renewable energy resources in the region. Member States and ICPs are encouraged to render full support to the centre.

As noted in Chapter 3, the high frequency of droughts and erratic rainfall patterns in the SADC region due to climate change make hydropower generation unreliable. This calls for SADC to aggressively look at other renewable energy resources, particularly solar and wind energy as complementary alternatives.

7.1.5 Energy Efficiency and SADC Industrialisation

As mentioned in Chapter 6, SACREEE is developing a regional SADC Industrial Energy Efficiency Programme (SIEEP) in support of the SADC Industrialization Agenda. SIEEP will contribute to the competitiveness of the industrial sectors of SADC Member States by building their capacity to adopt, invest and utilise energy efficient technologies and practices. It is important, therefore, that Member States and ICPs render full support to this initiative.

To ensure a sustainable regional industrial energy efficiency program for the region, Member States are encouraged to develop clear energy efficiency policies and strategies for their implementation. The policies should have targets for the industrial sector. SIEEP will inform the formulation of policies. SIEEP will assist Member States to articulate standards, regulations, incentives, tariff structures and mechanisms such as, net-metering for self-generation. SIEEP can assist Member States to develop legislations that will ensure energy efficiency is adopted to ensure security of energy supply in the region.

There is need for legally binding targets to be established by SACREEE, working with Member States and the SADC Secretariat.

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