

Exploiting renewable energy opportunities through integrated regional power systems: Analysis of institutional perspectives on barriers in Southern Africa

by

Elijah Chizamusoka Sichone



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Supervisor: Prof. Alan Colin Brent

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Integrated Abstract – of two journal articles

Renewable energy resources are abundant, but the opportunities presented by such sources of energy for power generation have not been fully exploited, particularly using an integrated regional approach, due to a myriad of barriers. Although so much research points out and categorises the barriers to renewable energy development in general, it remains too generalised and fails to consider the institutional environments and contextual factors. Using institutional theory and informed by the theory of international trade cooperation in electricity, this study develops a conceptual framework for analysing and understanding the institutional perspectives that traverse the barriers to exploiting renewable energy opportunities in a regionally coordinated and integrated system. The findings of the study should provide stakeholders with insights on and direct more attention at institutional barriers contributing to the large gap between the current levels of the exploitation of renewable energy opportunities in the SADC region and the potentials that are technically feasible using the available renewable energy technologies. An extensive traditional literature analysis found that the institutional elements of legitimation, functions, administrative structures, processes and mechanisms, and culture and attitudes in the SADC region were generally inadequate for up-scaling and sustained development of renewable energy. The findings further indicate that institutional perspectives or conditions have a significant pervasive bearing on renewable energy barriers in general and exploiting such energy resources using integrated power systems and approaches in particular. This study provides strong support for addressing the institutional barriers and that all stakeholders should rethink the approach to scale-up harnessing of renewable energy by taking into account and paying greater attention to the institutional and contextual perspectives.

Keywords: Renewable energy, integrated power systems, cross-border electricity trading, institutional barriers and Southern Africa (SADC region)

Geïntegreerde Opsomming – van twee joernaalartikels

Hernubare energiebronne is volop, maar geleenthede om hierdie energiebronne vir kragopwekking te ontgin, is nog nie ten volle ondersoek nie, veral deur die gebruik van 'n geïntegreerde plaaslike benadering, as gevolg van 'n magdom hindernisse. Ten spyte daarvan dat baie navorsing die hindernisse uitlig en in die algemeen kategoriseer, bly die navorsing steeds te veralgemenend en neem nie institusionele omgewings en kontekstuele faktore in ag nie. Deur die gebruik van institusionele teorie, asook 'n internasionale handelsamewerkingsteorie in elektrisiteit, word 'n konseptuele raamwerk in hierdie studie ontwikkel om institusionele perspektiewe, wat die hindernisse oorkom, binne 'n plaaslike gekoördineerde en geïntegreerde sisteem te analiseer en te begryp. Bevindinge van hierdie studie behoort aandeelhouers toe te rus met 'n beter insig sodat meer aandag toegespits kan word op institusionele hindernisse, wat bydra tot die groot gaping tussen huidige vlakke waarop hernubare energiebronne in die SADC-streek ontgin word en die potensiaal wat tegnies haalbaar is met beskikbare hernubare energietegnologieë. 'n Uitgebreide tradisionele literatuuranalise het bevind dat institusionele elemente rakende legitimasie, funksies, administratiewe strukture, -prosesse en -meganismes, asook kultuur en houdings in die SADC-streek oor die algemeen onvoldoende is vir die opgradering en volhoubare ontwikkeling van hernubare energie. Verder dui die bevindinge daarop dat institusionele perspektiewe, of toestande oor die algemeen, 'n beduidende en deurdringende verband toon met hindernisse ten opsigte van hernubare energiebronne en meer spesifiek met die ontginning van sulke energiebronne deur die gebruik van kragstelsels en benaderings. Hierdie studie verskaf sterk ondersteuning aan die idee dat institusionele hindernisse aangespreek moet word en dat alle aandeelhouers die benadering tot opgradering, met betrekking tot die benutting van hernubare energie, moet heroorweeg en meer aandag moet skenk aan institusionele en kontekstuele perspektiewe.

Sleutelwoorde: *Hernubare energie, geïntegreerde kragstelsels, oorgrens handel in elektrisiteit, institusionele hindernisse en Suider-Afrika (SADC-streek)*

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List of Acronyms and Abbreviations

ACEC	Africa Clean Energy Corridor
BC	Bilateral Contracts
BIS	Department for Business, Innovation and Skills of the United Kingdom
BM	Balancing Market
CC	SAPP Coordination Centre
COP21	The 21 st Session of the Conference of the Parties (COP21) held Paris, France from 30 November to 12 December 2015
CSP	Concentrated Solar Power
DAM	Day Ahead Market
DFIs	Development Financial Institutions
DPs	Development Partners
DRC	Democratic Republic of Congo
DRES	Distributed renewable energy systems
ECA	Economic Consulting Associates
EJ	Exajoule
EPI	Environmental Policy Integration
ESI	Electricity Supply Industry
ESMAP	Energy Sector Management Assistance Programme of the World Bank Group
EU	European Union
EAS	European Administrative Space
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
FM	Financial Markets
FPM-M	Forward Physical Markets (month ahead)

FPM-W	Forward Physical Markets (week ahead)
GDP	Gross Domestic Product
GENI	Global Energy Network Institute
GRN	Government of the Republic of Namibia
GW	Gigawatt
IA	Impact Assessment
ICPs	International Cooperating Partners
IDM	Intra-Day Market
IGMOA	Inter-Governmental Memorandum of Agreement
IGMOU	Inter-Governmental Memorandum of Understanding
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent power producers
IRENA	International Renewable Energy Agency
IRPs	Integrated Resource Plans
ITC	Independent Transmission Company
IUMOU	Inter-Utility Memorandum of Understanding
LBD	Literature Based Discovery
LHC	Lunsemfya Hydropower Company
MANCO	SAPP Management Committee
MCP	Market Clearing Price
MMS	Markets Monitoring & Surveillance
MMST	Markets Monitoring & Surveillance Team
MO	Market Operator
MS	Member State
MSC	Markets Sub Committee
MTP	Market Trading Platform
MW	Megawatt

NP	Non-Operating Members
NREL	National Renewable Energy Laboratory of USA
NRSE	New and Renewable Sources of Energy
OB	Observers
OP	Operating Member
PDAM	Post Day Ahead Market
PPAs	Power purchase agreements
PV	Photovoltaic
RE	Renewable Energy
REASAP	Regional Energy Access Strategy and Action Plan
REC	Regional Economic Community
REEE	Renewable energy and energy efficiency
REEESAP	Renewable Energy and Energy Efficiency Strategy and Action Plan
REEEx	Renewable Energy External Expert
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
REN21	Renewable Energy Policy Network for the 21 st Century
RERA	Regional Electricity Regulators Association of Southern Africa
RETs	Renewable Energy Technologies
RIDMP	Regional Infrastructure Development Master Plan
RISDP	Regional Indicative Strategic Development Plan
RRAs	Renewable Readiness Assessments
SACREEE	SADC Centre for Renewable Energy and Energy Efficiency
SADC	Southern African Development Community
SADCC	Southern African Development Coordination Conference
SAIREC	South African International Renewable Energy Conference
SANEDI	South African National Energy Development Institute

SAPP	Southern African Power Pool
SDG 7	Sustainable Development Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all
SEA	Strategic Environmental Assessment
SOU	State-Owned Utilities
SPLAT	System Planning and Test
STEM	Short Term Energy Market
TOR	Terms of Reference
TSO	Transmission System Operator
TWh	Terawatt hour
UAE	United Arab Emirates
UNEP FI	United Nations Environment Programme Finance Initiative
UNIDO	United National Industrial Development Organisation
WEC	World Energy Council

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Chapter 1 – Introduction

1.1 Introduction

Renewable energy resources are abundant, but the opportunities presented by such sources of energy for power generation have not been fully exploited, particularly using an integrated regional approach, due to a myriad of barriers (ECA, 2010; Yamba *et al.*, 2012; Oseni & Pollitt, 2016). According to Moriarty and Wang (2015), the assessment of the global annual technical potential of all renewable energies is varied depending on the assumptions used, but they are estimated in the order of 7,500 EJ, which would be more than enough to cater for the projected energy needs for 2050. Supporting the claim about the adequacy of renewable energy to meet projected energy needs is the demonstration by Moriarty and Honnery (2012) that the global demand of energy in 2050 could be in the range of 800 to 1,000 EJ, just about 14% of the annual technical potential. Lior (2012) offers further support with estimates that renewable energy could meet the global energy demand by more than two-folds and other estimates by WEC (2013) and REN21 (2013) are generally in concurrence about the abundance of renewable energy resources. According to Moriarty and Honnery (2012), it is no longer the issue of energy adequacy, but the sustainable supply mix from various sources of energy to meet the future demand.

In 2014, the estimated renewable energy share of the global final energy consumption mix was 19.2%, while its share in terms of the global electricity production was estimated at 27.3% in 2015 (REN21, 2016). According to REN21 (2016), fossil fuels and non-renewable electricity remain dominant with shares of 78.3% and 76.3%, respectively. With the assessed global annual technical potential of all renewables and the current share of such resources in the global energy consumption and electricity production mix, there is sufficient reason to hypothesise that the current energy paradigm has not taken full advantages of the opportunities to harness renewable energy. So many ambitious plans tend to be developed at various levels (local, national, regional and international) for harnessing renewable energy but the implementation of the plans in a coordinated, integrated, efficient and cost-effective manner remain a challenge (ECA, 2010; BIS, 2011; REN21, 2013). As a consequence, the contribution of the vast potential of renewables to the global energy supply and demand is insignificant due to the barriers that are prevalent (WEC, 2013, REN21, 2013; UNEP FI, 2012).

The barriers to renewable energy development have been studied by many researchers and are classified differently (Painuly, 2001). Generally, the broad classification of barriers includes: legal/regulatory, market, institutional, political, technical, financial, pricing/costs and

perceptual. While perceptions about the impacts of the barriers on renewable energy development are varied, Costello and Finnell (1998) argue the commercial development of renewable energy is more susceptible to non-technical than technical barriers, and that institutional factors and associated constraints need to be addressed for investments to materialise. The extant literature shows that not much research has been done on institutional barriers despite the important role of institutions in the systems of innovation (Gillingham & Sweeney, 2012; Peck *et al.*, 2015).

The research study delved into a general proposition that institutional perspectives would most likely provide a better understanding of the barriers to exploiting renewable energy opportunities through an integrated regional power system than the conventional lens that does not necessarily take into account the contextual aspects (Yiu & Makino, 2002). The research endeavoured to provide the practitioners in the field of energy in general, and renewable energy in particular, with a conceptual framework for analysis of institutional perspectives on barriers and increase awareness about the significance of contextual factors.

The thesis has four chapters. The first chapter provides an overview of the theme of the research study, the context and manner in which it was conducted, and its academic and practical importance. The second and third parts are a reflection of the thesis research option elected for this study, namely two academic journal articles. The first academic paper (chapter two) provides a conceptual background and framework, while the second academic paper (chapter three) analyses case studies focusing on the Southern Africa region using the conceptual framework developed in the first academic paper. The fourth chapter is the general conclusion synthesising the overall findings, critique of the study, and its contributions and recommendations for further research.

1.2 Background

Deichmann *et al.* (2010) state that the potential of renewable energy (RE) resources of most sub-Saharan countries, if harnessed using the proven renewable energy technologies (RETs), is theoretically several times their current levels of energy demand. In the Southern African context, estimates from the Southern African Development Community (SADC) and the International Renewable Energy Agency (IRENA) of the renewable energy potential for power generation indicate that less than 10% of hydro is currently utilised, with virtually negligible rates in the case of wind, solar, geothermal, and bioenergy (Yamba *et al.*, 2012; Miketa & Merven, 2013). Under certain assumptions, the 2030 projections from the same reports from SADC and IRENA indicate that up to 62% and 39%, respectively, of the power

generation capacity in the region could be feasible from renewable sources, such as hydropower, solar and wind.

The current regional electricity generation mix with a large share of fossil fuels is a cause for concern as regards the veracities of climate change and long-term unsustainability (Chikova & Beta, 2017). SADC (1996) strives to enhance energy cooperation, pooling and integration for the benefit of a total population of about 294 million people, a much larger market than any single country, for purposes of harnessing and creating a sizeable market for deploying renewable energy technologies. Notwithstanding the numerous well-meaning initiatives, the region's track record in finalising and implementing the plans in general, and increasing the uptake of renewable energy in particular, are rather dismal (Zhou, 2012).

In Southern Africa, it is not so much about the question of resource availability, prospects and/or appropriateness of the RETs, but more about addressing the impediments that are hindering the up scaling of such important sources of energy, and finding options to harness renewable energy on a regional basis using the integrated power system (Lior, 2012). This research study then delved deeper into the analysis of the institutional perspectives on barriers accounting for their marginal penetration rate(s) in the region.

1.3 Rationale for the study

If the Southern African region is to be on a path of sustainable energy development and increasing energy access, the pivotal role of renewable energy, among a menu of alternative energy options, cannot be over-emphasised (Bazilian, 2012; Panwar, Kaushik & Kothari, 2011; Brew-Hammond, 2010; Lior, 2008). From the available literature and the author's twenty-six years of working experience in the energy sector, and substantial involvement with regional energy initiatives, it is evident that there are some impediments to renewable energy development and utilization that need to be addressed in order to enable the region to start making significant strides on the sustainable energy development pathway (Bazilian, 2012).

The research study focused on institutional barriers with a view to understand them from a Southern African regional perspective, because of insufficient empirical research (Gillingham & Sweeney, 2012). It was also motivated by the desire to contribute meaningfully in dealing with practical problems impeding renewable energy development in Southern Africa.

1.4 Problem statement

Renewable energy and alternative energy sources are receiving greater attention from a variety of stakeholders in view of the rising environment pollution and degradation from energy consumption, global warming, faster depletion and price volatility of fossil fuels, as well as technological advancements and learning rates (Bozkurt & Destek, 2015). However, many stakeholders still believe that the barriers to taking advantage of the opportunities presented by renewable energy are onerous (Rai & Beck, 2015; Gabriel, 2016). Rai and Beck (2015) argue that some of the barriers are simply misperceptions due to a lack of awareness, as illustrated by customers who thought that the cost of solar was high despite the availability of incentives and rebates, declining prices, and lease options that are quickly increasing the affordability of, for example, solar photovoltaic (PV) in Texas, United States of America.

Many stakeholders, including some research scholars, have failed to fully grasp the barriers to renewable energy development and utilisation, and Yiu and Makino (2002) contend that they do not pay greater attention to the contextual variations in the institutional environments comprising three pillars: regulative, normative, and cognitive. By rethinking the approach to take into account the institutional perspectives when analysing barriers to exploiting renewable energy opportunities, contextual and responsive solutions could be found to scale-up the harnessing of renewable energy.

With this qualitative research study, the supposition was that institutional barriers have a significant pervasive bearing on renewable energy barriers in general, and taking them into account when analysing barriers would provide a better understanding of how renewable energy opportunities could be exploited through an integrated regional power system from the context of the Southern African region.

1.5 Research questions

The core research question that guided this study can be stated as follows:

- *What are the institutional perspectives that traverse the barriers to exploit renewable energy opportunities in a coordinated and integrated system in the Southern African region?*

More specifically, this study attempted to answer the following two specific research questions (one exploratory and the other explanatory):

1. *What are the institutional conditions creating barriers to the exploitation of renewable energy opportunities using a coordinated and integrated regional approach?*
2. *How are the institutional barriers limiting the development of renewable energy using an integrated regional approach in Southern Africa?*

1.6 Overarching research design and strategy

According to Mouton (2012), a research design is a plan or blueprint of how the research would be conducted and it has different types, a particular choice of which is mainly dependent on the research questions to be addressed. In terms of broad classification, the two main research design types are 'empirical studies' and 'non-empirical studies', and with these classifications, the dimensions can be varied. Typically, empirical studies generate and use primary data from surveys, experiments, among other means or analyse existing data that could be textual or numerical data. In the case of non-empirical studies, they are mainly associated with philosophical analysis, conceptual analysis, theory building and literature reviews.

The research design adopted was that of a 'non-empirical study' premised on literature reviews and analyses using existing or secondary data (Mouton, 2012). In other words, a literature based research methodology was used to sample textual data to address the research questions. Aside from the challenges of generating representative primary data from the various SADC MS in a timely manner, this research design was considered pragmatic and justified on the basis that there was sufficient extant literature from numerous regional initiatives on renewable energy and cross border power trading to provide a good understanding of the issues concerning the areas of the study.

As Mouton (2012) states, every research project starts with the review of the extant literature to find out what has been done in the field of study and avoid unnecessary regurgitations. Extensive literature was gathered from a variety of scholarly databases using the "Building Block Search Technique" (reference) to search for scholarly written peer-reviewed journals of 5 years or less. The internet was also used, not as locale for research, but as a search tool for grey literature, such as: renewable energy news, media statements, press releases, and documents produced by governments, as well as documents from regional and international organisations, such as: policies, strategic initiatives, annual reports, presentations, event proceedings (meetings, courses and workshops), and technical reviews, among others (Harriman & Patel, 2014).

Given the many regional and international events attended by the researcher, the study also benefited from personal observations, reflections, and informal discussions. Grey literature (articles not formally published by commercial academic publishers) from Google and other sources was also be used given the limited research on some of the issues, especially on Southern Africa (Haddaway *et al.*, 2015). The data triangulation methodology was used for the case study given a variety of data sources (Hussein, 2015).

1.7 Delimitations of the overall study

According to Simon and Goes (2013), the delimitations of a study are essentially the “defining boundaries” that provide its scope by deliberately excluding and including some aspects. This study was restricted to Southern Africa only, because it is the most electricity grid interconnected regional economic community (REC) on the African Continent, and with the only functional power pool (Southern African Power Pool, or SAPP) with an operational regional electricity market-trading platform (Oseni & Pollitt, 2016). It is also the region under which the author has worked for the past 26 years and is therefore, fully conversant with its regional energy/electricity supply industry (ESI). Implicitly, the regional population of the study was the 15 SADC Member States (MS) with an aggregate population of about 300 million people (Chikova, 2017).

There are a variety of renewable energy resources, namely: solar, hydro, wind, biomass, wave, tidal, ocean, and geothermal (Twidell & Weir, 2015). However, the study focused on modern renewable energy resources with large potential and commercially available technologies, and with scope for relatively large-scale electricity generation (solar, hydro, wind and biomass) that could allow for cross border trading (Panwar *et al.*, 2011). Furthermore, trading in renewable energy technologies and services, such as thermal energy, did not form part of this study, because they are not tradable over interconnected regional electricity markets using the transmission grid.

Chapter 2 – First Journal Article: Conceptual framework for analysis of institutional perspectives on barriers to regional renewable energy development using an integrated approach (Literature Review)

2.1 Introduction

Little research has been carried out to understand the institutional perspectives on barriers to exploiting renewable energy opportunities using the integrated power systems, particularly in Southern Africa. Globally, the opportunities presented by renewable energy resources are immense given the resource abundance, but it is paradoxical that they remain largely untapped with an annual share of contribution in the range of 10% to 19% of the final energy consumption (WEC, 2013, REN21, 2013; UNEP, 2012; REN21, 2016). This is despite the significant attention to, and recognisable advantages and benefits of, renewable energy and its technologies from the perspective of the triple bottom-line of sustainable development – economic, social and environmental dimensions (Masini & Menichetti, 2013).

Resource-wise, Moriarty and Wang (2015) assess the global annual technical potential of all renewable energies is at least seven and half (7.5) more times capable of meeting projected global energy demand, as stated by Moriarty and Honnery (2012), of up 1,000 EJ in 2050. Lior (2012) also estimates that renewable energy can meet at least twice the world demand for energy, and other estimates or projections (WEC, 2013; REN21, 2013) are generally in concurrence about the abundance of renewable energy resources. Furthermore, some of the scenarios from the International Panel on Climate Change (IPCC, 2011) project high shares of renewable energy in the global primary energy supply of up 43% in 2030 and about 77% in 2050.

Highlighting the importance of exploiting renewable energy opportunities, Panwar *et al.* (2011) assert that *renewable technologies are considered as clean sources of energy and optimal use of these resources minimise environmental impacts, produce minimum secondary wastes and are sustainable based on current and future economic and social societal needs*. Volker (2005) also emphasises that renewable energies are pertinent to any development endeavours, because of the capability to meet global energy needs in an environmentally friendly and sustainable manner. By definition, renewable energy sources replenish naturally in the local environment and are infinite on a human timescale (Volker, 2005; Twidell & Weir, 2015).

Undoubtedly, the global concern is not so much about energy resource adequacy, but rather the supply-mix with which to meet the future demand sustainably (Moriarty & Honnery, 2012). It remains a very definite cause for concern having the fossil fuels and non-renewable electricity with dominant shares of 78.3% and 76.3%, respectively (REN21, 2016). Opportunities for international cooperation and trade that would otherwise create much larger markets for the viable and cost-effective deployment of renewable energy technologies, also remain largely untapped, because most of the ambitious programmes and projects have not been implemented or taking too long to be implemented at colossal cost overruns (REN21, 2013; BIS, 2011; ECA, 2010). Some sceptics, including researchers and industry experts, also doubt the technical and economic viability of renewable energy technologies (Masini & Menichetti, 2013).

It is quite apparent that there are barriers hindering the exploitation of renewable energy opportunities despite the recognition of the pivotal role that renewable energy could play in addressing the veracities of climate changes, and meeting the targets under the Sustainable Development Goal (SDG) 7 and commitments under COP21 (WEC, 2013; Lior, 2012; Moriarty & Honnery, 2011; Lenzen, 2010; Foxon & Pearson, 2007; Lidula *et al.*, 2006; Foxon, 2002; Painuly, 2001). In discussing the nature of barriers to climate change adaption, Biesbroek (2013) argue that understanding the impediments is critical in exploring ways and means of dealing with them. The same argument could be advanced insofar as barriers to renewable energy are concerned.

Although so much research has been done to pinpoint and categorise the barriers¹ to the development and utilisation of renewable energy in general, the literature is rather high level, too generalised, and usually not context specific (Dunstan *et al.*, 2011; Verbruggen *et al.*, 2010). As a case in point, Painuly (2001) broadly classifies the renewable energy barriers into economic/financial, technical, market, institutional, social, and environmental, while Gillingham and Sweeney (2012) make a narrower classification of three barriers, namely: institutional, market, and behavioural barriers. The generality of the extant literature neither adequately encapsulates the pervasive nature of some of the barriers, nor provides the analytical lenses through which to view them on a case-by-case basis (Dunstan *et al.*, 2011).

In discussing the barriers to implementation of low carbon technologies including renewable energy technologies (RETs), Gillingham and Sweeney (2012) acknowledge that many of the

¹ Defined as obstacles, constraints, hindrances or impediments to reaching a goal

barriers are intertwined to each other and make an interesting observation to the effect that: *'institutional barriers are not often discussed by economists, but may have particular relevance to the implementation of energy efficient technologies. Most of these issues do not yet have adequate empirical support because there has been relatively little research into these barriers'*. Glasson & Gosling (2001) and Yiu and Makino (2002) appear to agree with this observation by pointing out that most previous studies have not recognised the importance of the institutional environment and its contextual factors. This contradicts literature reviews from other research studies on climate change adaptation that show that institutional and social barriers are quite prominent and often reported on (Biesbroek, 2013). Chai and Yeo (2012) also observe that most studies treat the barriers in isolation of each other and do not consider the intertwined relationship acknowledged by Gillingham and Sweeney (2012).

This article introduces the institutional perspectives and its purpose was to develop a conceptual framework for understanding and assessing institutional environment and context by asking the following exploratory question:

"What are the institutional conditions creating barriers to the exploitation of renewable energy opportunities using a coordinated and integrated regional approach?"

Examined in this article is a general proposition that institutional theory, and the theory of international trade cooperation in electricity, would most likely provide a better understanding of the barriers to exploiting renewable energy opportunities through an integrated regional power system. The emphasis on an integrated regional power system is more from a point of view of cross border electricity trading.

An extensive literature analysis was done in developing the theoretical and conceptual framework. However, it was opted to use the 'traditional or narrative literature review' as a defining boundary that does not necessarily assess the validity of studies, synthesize areas of conceptual knowledge, or assess the theory/hypothesis, but present overviews of the wider literature and concepts (Petticrew & Roberts, 2006). The object and unit of analysis was the institutional environment, and in particular the institutional arrangements or factors that are dynamic and contextual (Rodriguez-Pose, 2013).

2.2 Methodology and methods

Saunders, Lewis and Thornhill (2009) argue the terms ‘research methodology’ and ‘research methods’ are often used interchangeably in a wide range of literature and yet they have different connotations. This argument is also supported by Rajasekar, Philominaathan and Chinnathambi (2013). These researchers define ‘research methodology’ as the theory or science of how the research would be carried out and refer to ‘research method’ as the various procedures, schemes, techniques and algorithms used in research used to obtain and analyse data.

The methodology adopted for this article was non-empirical research (literature based methodology) using a traditional literature review (narrative or comprehensive) as the research method (Mouton, 2012). This methodology was the most feasible given the resource constraints, complexities and bureaucratic challenges of gathering primary data from the various stakeholders in the 15 Member States of the Southern Africa Development Community (SADC). Traditional literature reviews provide excellent overviews of wider literature (Hart, 1998; Leopold, 2016; Sharifi & Yamagata, 2016). Unlike systematic literature reviews that normally require two or more authors and quantitative synthesis, the adopted method sufficed for purposes of qualitative synthesis of evidence from the literature (Rother, 2007).

Both the methodology (literature based) and method (traditional literature review) have been widely used in energy sector studies, and peer reviewed literature has been published in journals such as the ‘Renewable and Sustainable Energy Reviews’ (Engelken *et al.*, 2016; Barrios-O’Neill & Schuitema, 2016; Strantzali & Aravossis, 2016; Yaqoot, Diwan & Kandpal, 2016; Leopold, 2016). It was also contemplated to use another sophisticated method called Literature Based Discovery (LBD) adopted in 1986 by Swanson to create new knowledge in the biomedical science studies, which is being progressively applied in other sectors such as energy (Dixit *et al.*, 2010; Liu & Fu, 2012; Wang, Nathwani & Wu, 2016). However, this method could not be used, but merely informed the analysis.

The ‘Building Block Search Technique’ (illustrated in Figure 2.1) was used to gather extensive (peer reviewed) literature from a variety of scholarly databases including JSTOR, EBSCO, ScienceDirect, SUNSearch, Scopus, SAMedia, Google Scholar, Sabinet Reference and Web of Science. The key words used were: renewable energy, power systems, regional integration, institutional barriers and Southern Africa. With these key words, some search strings were created and included: (Renewable Energy OR Solar Energy OR Wind Energy)

AND (Power System OR Electricity); Renewable Energy AND Power Systems; Renewable Energy AND Electricity; Renewable Energy AND (Institutional) Barriers; Renewable Energy AND Regional Integration; Regional Integration AND (Institutional) Barriers; Renewable Energy AND Southern Africa; and Regional Integration AND Southern Africa.

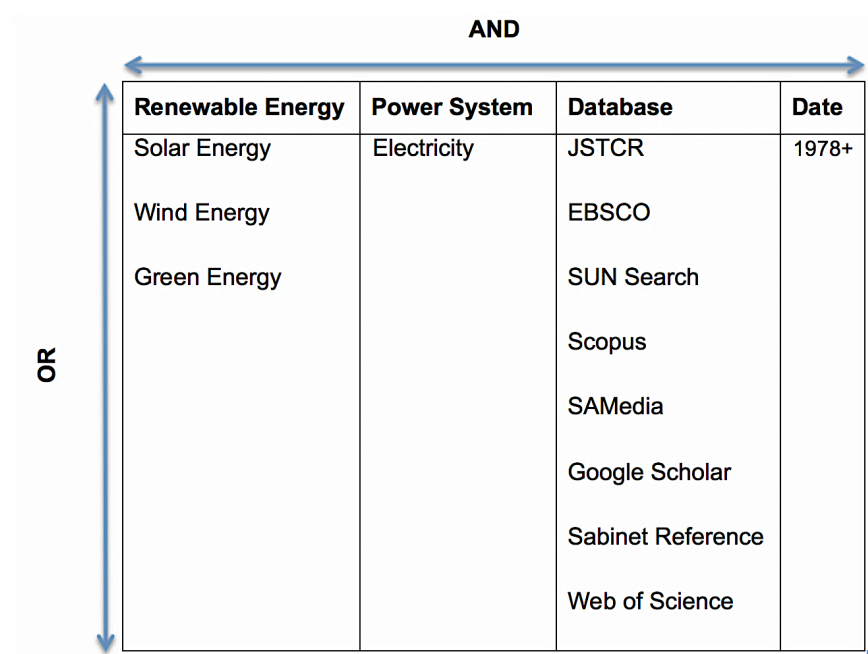


Figure 2.1. Building block search technique

The internet was also used as a search tool for renewable energy news, media statements, press releases, and documents produced by governments, as well as documents from regional and international organisations, such as: policies, strategic initiatives, annual reports, presentations, event proceedings (meetings, courses and workshops), and technical reviews, among others. Grey literature (articles not formally published by commercial academic publishers) from Google Scholar and other sources was also be used given the limited research on some of the issues, especially on Southern Africa (Haddaway *et al.*, 2015).

As a literature based article, the existing literature was considered as the population, and the sampling of the 'textual' data from the different databases was done using the alluded to 'Building Block Search Technique'. Textual data was gathered from slightly more than 200 publications that were searched. With the searching, collecting and reviewing of textual data from so many sources, triangulation, a combination of two or more methodological

approaches, theoretical perspectives, data sources, and analysis methods, was applied (Hussein, 2015).

2.3 Institutional perspectives and barriers

2.3.1 Key elements of institutional theory

Many theories could be applied to gain deeper insights into the environment, evolution and behaviour of organisations, and, in doing so, identifying, understanding and analysing some of the institutional barriers (Lobo, 2009; Madani, 2010; Hatch & Zilber, 2012; Turner, 2012). Game theory is about strategic decision-making, choices and the behaviours of the parties to meet their own objectives, as opposed to those of the systems to which they belong, especially in conflict situations (Madani, 2010). According to this theory, when the rules are not being broken and are enforceable, it is a good manifestation of stable institutions (Binmore, 2010). Organisations can also be quite complex in their operations. The word 'complex' is so commonly and widely used on daily basis. More often than not, complexity is mistakenly synonymous with 'confusion'. Turner (2012) uses the 'butterfly effect' as a good metaphor of complexity theory, and points out that its useful in modelling institutional behaviour, especially that simple and short-range rule-governed behaviour can produce emergent system level behaviour that looks to be coordinated.

This article focuses on the institutional theory that has evolved over time, and is premised on the notion that organisations tend to legitimise their existence by adopting structures and practices that conform to other organisations, due to isomorphic pressures dictated by the environment (both internal and external) and routine aspects (DiMaggio & Powell, 1983; Slack & Hinings, 1994; Yiu & Makino, 2002; Scott, 2004; Ashworth, Boyne & Delbridge, 2009). Isomorphism, in this case, infers a compelling process of change that makes an entity to conform to other entities when subjected to similar environmental circumstances (Slack & Hinings, 1994).

Researchers have identified different types of isomorphic pressures and several factors that cause them. DiMaggio & Powell (1983) suggest mimetic, coercive and normative forces as the pressures of institutional isomorphism. As described by DiMaggio & Powell (1983), mimetic isomorphism pertains to forces that compel organisations to be responsive to environmental uncertainty, by emulating others even without necessarily having empirical evidence justifying prospects of performance improvements. Coercive isomorphism is an embodiment of external forces that incline organisations toward legitimacy through legal,

regulatory, and other requirements. Normative isomorphism forces describe the influence of, and conformity to, professionalization or professionalism.

With regards to the elements causing isomorphism pressures, the three pillars alluded to by Yiu and Makino (2002) are: regulative (laws and rules), normative (social values, cultures and norms), and cognitive (cognitive structures). Reflecting on the exposure and extent of organisations to isomorphism pressures, Phillips and Zuckerman (2001) argue that organisations with a cutting edge or higher status are less susceptible to isomorphism forces than those at the other lower end of the spectrum.

In the context of this article, the understanding of 'institutions' is pertinent, but rather difficult. Cortner *et al.* (1996) argue that defining and researching institutions is not an easy undertaking given the challenges in categorising the institutional arrangements, the intertwining nature of the different institutions, and the environments within which they operate. Rodriguez-Pose (2013) also acknowledges the challenges in defining institutions and concedes that there is no universally accepted definition. Be that as it may, the commonly used definition of institutions is that of North (1990), which refers to them as '*the rules of the game in a society and/or the humanly devised constraints that shape human interaction*'. Nykvist and Nilsson (2009) use the definition of 'institutions' by North (1991) as the formal rules (constitutions, laws, property rights) and informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and also point out that the organisations, as actors, are subject to the institutional rules and constraints. Foxon (2002) agrees with this definition and refers to 'institutions' as '*any form of constraint, formal or informal, that human beings devise to shape human interaction*'.

According to Rodriguez-Pose (2013), formal institutions are also referred to as '*hard*' or '*society*' institutions, while informal institutions are described as '*soft*' or '*community*' institutions. Formal institutions include: constitutions, laws, charters, bylaws, regulations, rule of laws, property rights, contracts, and competition monitoring systems, among others. Encompassing informal institutions are: norms, traditions and social conventions, interpersonal contacts, relationships, and informal networks. Other integrative ways of looking at institutions governing behavioural patterns have been identified at hierarchically three levels, namely: embedded institutions, institutional environments, and institutions that govern transactions (Andrews-Speed, 2016). At the highest level are embedded institutions that include: traditions, norms, customs, beliefs, and prevailing culture. The next level is the institutional environment that embraces political, economic and legal systems, government structures, property rights, contracts, dispute resolutions, and policy aspirations. A third tie is

a makeup of institutions that govern transactions, being: firms, bureaus, markets, hybrids, networks, policies, laws, and policy instruments.

It is apparent that definitions and elements of institutions are essentially the same, since they are paraphrased from the early works of North (1991) on institutions and institutional evolution. However, there are instances when partial or ambiguous definitions of 'institutional' are used, and a paper written by Amin (1999) discussing the Indian power sector is a case in point, referring to 'institutional' as bureaucratic and political frameworks. It is not unusual for institutional theory and organization culture theory being mistakenly interpreted as the same and interchangeably used, and yet the two are different from each other (Lobo, 2009; Hatch & Zilber, 2012). The distinction between institutions and organisations is the focus on the 'rules of the game' and 'players or groups (of individuals)', respectively (North, 1995). Lobo (2009), however, observes that there is strong relationship between institutions and organisations, a relationship with significant impacts on the well-being of society. Furthermore, at the core of the organisations is the advancement of the interests of the members in a given institutional framework and environment.

Zucker (1987) argues that institutional theory is intrinsically not easy to explain, because it deals with societal issues that are perceived to be obvious or ordinary in many respects. It is also criticised by Suddaby (2010) as having evolved to an extent of losing its original founding elements and being applied outside its defining boundaries. In words of Dacin, Goodstein and Scott (2002), institutional theory is being criticised for not being applied to its potential, on account of much emphasis being placed on the assumption that trends endure and remain relatively the same over time in dynamic environments.

Whereas Suddaby (2010) and Dacin *et al.* (2002) criticise institutional theory, they also acknowledge that it is attaining dominance, prominence and practical importance in explaining actions of individuals and organisations. From the energy sector perspective, Andrews-Speed (2016) acknowledges that institutions are an integral and important part of the sector and could provide further insights in promulgating policies for its transformation and transition. Notwithstanding the criticisms, it is apparent that many researchers reaffirm the theory as being useful in analysing institutions and the associated barriers. By applying the institutional theory, organisations, development trends, and processes, among other things, could be analysed in terms of whether there are any established rules (formal or informal), and, if so, the extent to which those rules are complied with (Pattit, Raj & Wilemon, 2012).

2.3.2 Institutional environment and barriers to renewable energy development

Barriers hinder the development and deployment of renewable energy, and the accrual of the potential associated benefits (Peidong *et al.*, 2009; IPCC, 2011; Chu & Majumdar, 2012). A barrier prevents or hinders action, and impedes progress or achievement in realizing potentials. Verbruggen *et al.* (2010) refers to the IPCC definition of a barrier as ‘*any obstacle to reaching a goal, adaptation or mitigation potential that can be overcome or attenuated by a policy, programme, or measure*’. From an energy point of view, it is the gap due to human related issues (by desire or otherwise) that stands between what has been harnessed and the potential that is technical available for development.

The renewable energy barriers have been subjected to extensive research (Painuly, 2001; Gillingham & Sweeney, 2012). Painuly (2001) cites some of the renewable energy technology barriers from literature as technical, market, pricing structures, institutional, political, and regulatory, and argues that they may be specific to a technology, country or region. Martinot and McDoom (2000) suggest the following broad, but fairly comprehensive, list of barriers to renewable energy:

1. Lack of utility acceptance of technologies;
2. Difficulty of firm dispatch in utility grid operations;
3. Technical limits to utility integration of intermittent sources;
4. Competition for access to resources;
5. Restrictions on urban siting and construction;
6. Lack of utility grid access to remote sites;
7. Risks of permit process;
8. Difficulty of future- fuel-price risk assessment;
9. Institutional mismatch of capital costs and fuel-price risks;
10. Difficulty of quantifying environmental costs;
11. Lack of detailed geographic resource data;
12. Prejudice against a technology because of poor past performance;
13. Lack of government support;
14. Opposition of existing interest groups; and
15. High costs of developing new infrastructure and market institutions.

Gillingham and Sweeney (2012) observe that there is little research on institutional barriers, and yet Andrews-Speed (2016) reaffirms the importance of institutions in the energy sector transitions and transformations. Peck *et al.* (2015) acknowledge that even with so many

biofuels sector studies having been done in Sweden, not much focus has been placed on *the role of institutions, behavioural patterns, and established practices within the innovation systems*. Further supporting this argument is McCormick and Kaberger (2007) by agreeing that the hindrance in the bioenergy development in the European Union (EU) is inclined more on the side of non-technical than technical challenges, and this is more pronounced at the implementation stages when critical investment and contractual decisions are made.

Costello and Finnell (1998) advance some compelling arguments in support of the need to address and overcome institutional challenges pertaining to the commercial development of renewable energy challenges. They argue that the commercial development of renewable energy is prone to impediments that are of non-technical nature. In particular, it is pertinent to resolve institutional constraints to enable the growth of the market for the deployment of renewable energy technologies. However, it is also acknowledged that having an enabling institutional environment to pave way for the commercialisation of renewable energy technologies could be a challenge, given the dynamic and complex institutional factors. It is further argued that unless the early stages of planning process in the commercialisation and deployment of renewable energy technologies takes into consideration the institutional factors and associated constraints, success in such endeavours could be a large challenge. Yaqoot, Diwan and Kandpal (2016) agree that institutional barriers could be significant in hindering the dissemination of distributed renewable energy systems (DRES), and so does Eleftheriadis and Anagnostopoulou (2015) by acknowledging the undesirable impact on renewable energy sources in the absence of a stable and enabling institutional framework.

Dunstan *et al.* (2011) describe institutional barriers, from the distributed energy perspective, as *'barriers that exist in how humans relate to the distributed (renewable) energy resources through laws and regulations, and through values and culture'*. As pointed out by Painuly (2001) and McCormick and Kaberger (2007), the literature on (institutional) barriers takes different analytical perspectives. Table 2.1 shows the difference in the classification and categorisation of institutional barriers by different researchers.

Table 2.1. Institutional barriers to renewable energy development

Source	Institutional Barrier Description
Costello & Finnell (1998)	<ul style="list-style-type: none"> <li data-bbox="528 322 1394 488">• Regulatory: <i>Lagging development of legal precedents behind technology development, causing artificial delays between the time a technology is ready to be applied and the actual time of application under normally stable regimes</i> <li data-bbox="528 501 1394 613">• Financial: <i>Financial constraints pertain to the availability and cost of project and to the overall financial attractiveness of renewable energy technologies</i> <li data-bbox="528 627 1394 792">• Infrastructural: <i>Educating bankers and the financial community about the ability of the overall power project to generate economic rates of return when there can be no long-term contracted fuel supply is a challenge</i> <li data-bbox="528 806 1394 965">• Perceptual: <i>Lack of familiarity with renewable energy (biomass) power technologies and options by the public, corporate decision-makers, regulatory and legislative decision-makers</i>
Painuly (2001)	<ul style="list-style-type: none"> <li data-bbox="528 994 1394 1016">• Lack of institutions/mechanisms to disseminate information <li data-bbox="528 1039 1394 1061">• Lack of a legal/regulatory framework <li data-bbox="528 1084 1394 1106">• Problems in realising financial incentives <li data-bbox="528 1128 1394 1151">• Unstable macro-economic environment <li data-bbox="528 1173 1394 1196">• Lack of involvement of stakeholders in decision making <li data-bbox="528 1218 1394 1240">• Clash of interests <li data-bbox="528 1263 1394 1285">• Lack of research and development (R&D) culture <li data-bbox="528 1308 1394 1330">• Lack of private sector participation <li data-bbox="528 1352 1394 1375">• Lack of professional institutions
Dunstan <i>et al.</i> (2011)	<ul style="list-style-type: none"> <li data-bbox="528 1420 1394 1509">• Imperfect information: <i>Lack of access to relevant information</i> <li data-bbox="528 1523 1394 1599">• Split incentives: <i>Challenge of capturing benefits spread across numerous stakeholders</i> <li data-bbox="528 1612 1394 1778">• Payback gap: <i>Difference in the acceptable periods for recovering investment between energy consumers (and Distributed Energy proponents) and large centralized energy supply utilities</i> <li data-bbox="528 1792 1394 1921">• Inefficient pricing: <i>Failure to reflect costs (including environmental costs) properly in energy prices</i>

Source	Institutional Barrier Description
Negro <i>et al.</i> (2012)	<ul style="list-style-type: none"> • Regulatory barriers: <i>Biasing of regulation against distributed energy resources</i> • Cultural barriers: <i>Resistance to, and scepticism about, the use of Distributed Energy on the part of individuals and organisations (including utilities, regulators and policy makers)</i> <hr/> <p><u>Hard Institutions</u></p> <ul style="list-style-type: none"> • Stop and go policy: <i>Lack of continuity and long-term regulations; inconsistent policy and existing laws and regulations</i> • Attention shift: <i>Policy makers only support technologies if they contribute to the solving of a current problem</i> • Misalignment between policies on sector level such as agriculture, waste, and energy, and on governmental levels, i.e. EU, national, regional level, etc. • Valley of Death: <i>Lack of subsidies, feed-in tariffs, tax exemption, laws, emission regulations, venture capital to move technology from experimental phase towards commercialisation phase</i> <p><u>Soft Institutions</u></p> <ul style="list-style-type: none"> • Lack of legitimacy <i>Different actors opposing change</i>
Zyadin <i>et al.</i> (2014)	<ul style="list-style-type: none"> • Subsidies distortion, incentives mechanism, regulatory hurdles • Lack of supportive policies • Lack of public support
Yaqoot, Diwan & Kandpal (2016)	<ul style="list-style-type: none"> • Policy and regulatory: <i>Lack of consistent policies and regulations</i> • Infrastructure: <i>Ineffective institutional infrastructure to dissemination of distributed renewable energy sources (DRES)</i> • Administrative: <i>Lack of coordination between various stakeholders</i>

Dunstan *et al.* (2011) demonstrate in Figure 2.2 the relationship between technical and institutional barriers insofar as distributed (renewable) energy technology is concerned, and how those barriers could be balanced out in terms of the triple bottom-line of sustainability, that is: economic, social and environmental outcomes. This is a good example of showing how addressing institutional barriers could contribute to sustainable development endeavours. The relationship between technical and institutional barriers is also supported by Lund (2010) who argues that the identification of institutional barriers is critical to the implementation of radical technological change. Worth noting is the fact that the manifestation and analysis of institutional barriers could be at different levels, such as: micro, meso, and macro levels (Nykqvist & Nilsson, 2009), and/or local, national, regional or international levels (Suzuki, 2015). Given the potential benefits that could arise from integrated approaches at regional and international levels, it is imperative to also have due regard for institutional barriers at such levels.

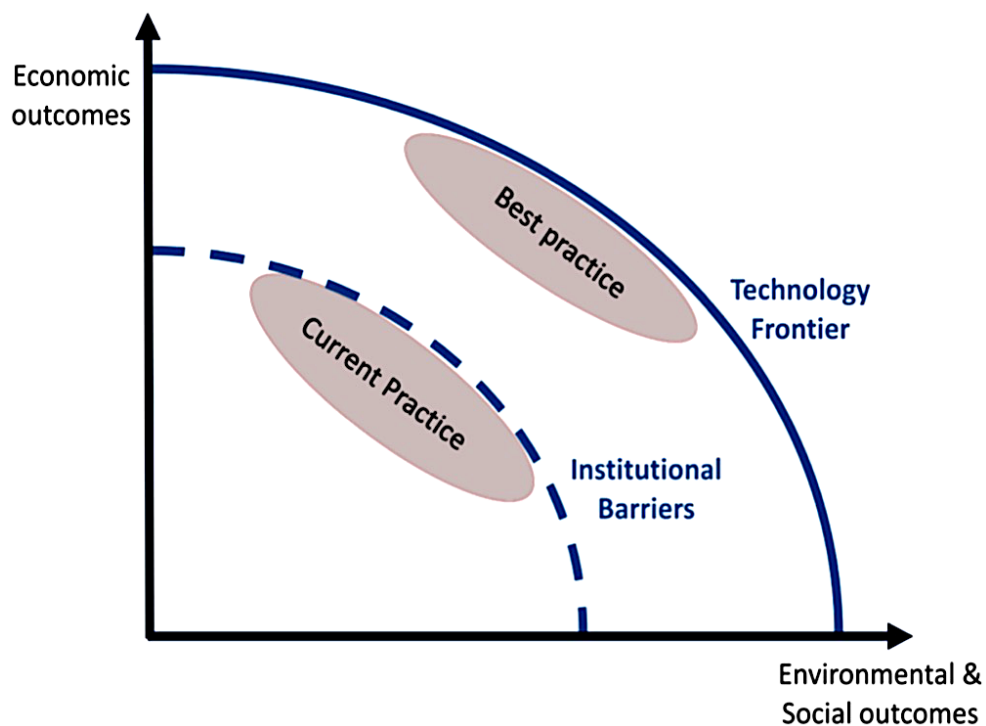


Figure 2.2. Relationship between technical and institutional barriers

(Source: Dunstan *et al.*, 2011)

2.3.3 Institutional environment and barriers to integration of power systems

The planet is confronted by a myriad of interweaved global sustainability challenges such as energy security, air pollution, climate change and biodiversity, and there is recognition that system integration could play an important role in addressing the complex interconnections (Liu *et al.*, 2015). Significant benefits from economies of scale and shared resources could accrue from linking smaller systems to make it possible to have flows of energy and information. This is particularly important considering that the endowment of (energy) resources is different from one country to another, and from one region to another, and this favours the increasing integration of infrastructure systems to facilitate cross border trading.

As a result of increasing integration of infrastructure systems, the market structures are also being integrated and harmonised. These developments are presenting many opportunities to exploit the abundant regional renewable energy resources to support sustainable economic growth, enhance security of supply, diversify the primary sources of energy, share spinning reserves, create green jobs, and reduce greenhouse emissions (SADC, 2013b; ECA, 2010; Peidong *et al.*, 2009). It is in the context of the potential benefits associated with developing renewables on an integrated approach that IRENA (2013b) is championing an accelerated introduction of clean and cost-effective renewable power options through an Africa Clean Energy Corridor (ACEC) initiative.

A cooperative and integrated approach also presents further opportunities that can accrue from the development of renewable energy in terms of optimization of the use of such resources and investments, and addressing the issues of intermittency of some of the renewable sources of energy, such as wind and solar (ECA, 2010; Connolly *et al.*; 2010). In addition to increasing the diversification of the portfolio of power plants, European experience appears to indicate that cross border electricity trading could increase the effective capacity factors of the intermittent renewable generating power plants (Bahar & Sauvage, 2013). From the trade theory perspective, the positive technology effect could reduce pollution by 1.25 to 1.5% (Oseni & Pollitt, 2016).

It is without a doubt that many benefits could be realised from pursuing initiatives aimed championing regional energy cooperation and integration, and power pooling and trading. With power interconnections and regional trade, harnessing renewable energy resources could also be scaled up using collaborative regional approaches. However, taking advantage of the various renewable energy opportunities is about strategic choices and investments dictated by public policy objectives and other imperatives, and are not necessarily without

challenges (Wüstenhagen & Menichetti, 2012). Some of the renewable energy generating power plants have specific challenges that need to be addressed. For instance, solar and wind power plants, as intermittent sources of power, could be variable in terms of output depending on the time of the day and season of year, and result in instability risks of the power system, as the share of renewable generated power increases (Bahar & Sauvage, 2013).

According to Bahar and Sauvage (2013), the transmission capacity constraints of the interconnected power systems, lack of harmonised regulatory environment, and different operational and administrative practices and rules/regulations, could also limit cross border power trading. With respect to other challenges pertaining to cross border power trading, Oseni and Pollitt (2016) argue that some countries are inward looking, less interested in cross border power trading and hesitant in investing in cross border power transmission lines. To put this argument in context, Oseni and Pollitt (2016) observe that electricity had a paltry 3% share in only in the global exports, as opposed to commodity oil and natural gas that had a share of 52%. Some of the fears associated with cross border electricity trading, cited by Oseni and Pollitt (2016), include the following:

i) Pricing risks

Risks of this nature could arise when price or tariff differentials and price shocks are more pronounced, and the countries with lower prices/tariffs could lose their competitive advantages.

ii) Energy security

Aside from the hold-up issues arising from import dependence and failure by exporters to supply under emergency or unforeseen circumstances, cheaper imports could negatively impact on the domestic power plant facilities. In case of exporting countries, dependence on export revenue could be a financial risk.

iii) Environmental impact

The quest for cheaper prices in regional electricity trading could lead to burning cheaper fossil fuels, like coal, and concomitant challenges of environmental pollution. The scale effect in terms of pollution is between 0.25 and 0.5% for every increase of a percentage point in the Gross Domestic Product (GDP).

iv) Market behaviour

In the absence of regulatory oversight from competitions or other regulatory authorities, players in the electricity trading market with dominant market share could be manipulative and do price damping or predatory pricing.

In order to develop efficient and success regional cross border power trading arrangements, and fully integrated power markets, it is vitally important to establish rules, and operational and administrative practices that are harmonised (Bahar & Sauvage, 2013). Oseni and Pollitt (2016) argue that pre-conditions for international electricity trade, good institutional arrangements, and how to ensure timely development, are cardinal in facilitating electricity cooperation and integration. Table 2.2 provides additional details under each of the requirements.

Table 2.2. Requirements for cross border power trade

Requirements	Description
Pre-conditions	<ul style="list-style-type: none"> • There should be a commitment to free trade for electricity to be successful either through bilateral trade and competitive market • Adequate transmission capacity is essential for power trading to occur and agreements for expanding transmission capacity should be an integral part of the development of an international power pool
Institutional arrangements	<ul style="list-style-type: none"> • Strive to create strong, efficient and independent institutions in ensuring an effective functioning integrated power market • Getting the appropriate combination of regulation and market design for power pools is important • The use of day-ahead markets and/or real-time markets facilitates more trade and greater market efficiency
Timetabling	<ul style="list-style-type: none"> • There should be a scheduling of reforms and developments with set milestones • The role cooperating and development organisation should be recognised to facilitate the creation of power pools • A cost benefit analysis should be carried out to determine the viability and motivate for establishment of a power pool • Power pools can (and should) start with a small number of countries and grow over time

(Source: Oseni and Pollitt, 2016)

Rodriguez-Pose (2013) argues that while institutions are cardinal to regional economic development endeavours, and should be considered in the enunciation of any developments policy, there is no common universal policy framework that would be suitable for all instances given the different contextual conditions. Additionally, it is important to make a distinction between institutional environment and institutional arrangements, with the focus being more on the institutional factors influencing regional economic development, rather than on the institutional environment that gives a specific character to the regional territory. It is evident from the literature that the concept of institutional arrangements is vaguely used in certain instances, and implies organisations in other instances. Institutions are also difficult to measure, given their dynamic and variability nature, different institutional environments, and striking the right balance between 'hard' and 'soft' institutions tends to be challenging (Rodriguez-Pose, 2013). Therefore, it is important to have clear definitions and a conceptual framework for analysing institutional environments and barriers.

2.3.4 Conceptual framework for analysis of institutional barriers

According to Painuly (2001), barriers could be analysed from broad to detailed levels, and from general to specific levels. Furthermore, the classification or categorisation of barriers is not necessarily the same, and it is not uncommon to have barriers being allocated to more than one particular category. Even within the broad classifications, there could be different levels and/or frameworks of barrier analyses. Dunstan *et al.* (2011) advocate for classification of institutional barriers in a manner that is simplified and context specific (distributed energy). Painuly (2001) outlines four levels of barrier analysis levels: barrier categories, barriers, barriers elements, and barrier element's dimensions. Whatever the classification or level of analysis, barriers tend to be contextual, evolve with time, and are difficult to identify with absolute certainty (Verbruggen *et al.*, 2010).

The general nature of the extant literature remains a challenge in that the contextual and analytical lenses for specific energy barriers are either limited and/or different due to varying assumptions and restrictions (Dunstan *et al.*, 2011). The situation is also exacerbated by differences in the understanding, use of different definitions, and underlying analytical assumptions (Verbruggen *et al.*, 2010). Chai and Yeo (2012) argue that attempts to classify and categorise barriers differently could be helpful in analysing them, but would not necessarily make much of a difference to the very nature of the barriers being analysed. In addition, understanding and tackling the barriers in isolation, without considering the interrelations and interdependence between the different types, may be equally not very helpful. It is for this reason that researchers in other fields of the energy sector have

advocated for the 'systems thinking' approach as a conceptual framework for analysing and overcoming barriers (Chai & Yeo, 2012).

Conceptual frameworks to analyse renewable energy institutional barriers are very limited, and those available are not elaborate enough to address the apparent and prevailing confusion pertaining to analysis of such barriers. This paper seeks to develop a conceptual framework that could be used as an analytical instrument to connect conceptual ideas to analyse renewable energy institutional barriers. As Powell and Colyvas (2008) state, it is about delving into micro-level component of institutional analysis, so that useful analytical building blocks can be conceptualised and applied. In developing a conceptual framework to analyse renewable energy institutional barriers, it was inevitable to review the broader academic literature on conceptual frameworks for understanding and assessing institutional context and barriers.

The initial review was a framework for analysis of barriers to renewable energy penetration by Painuly (2001). Under this framework, four levels of barrier analyses are elaborated from lower to more detailed and specific levels, as barrier categories, barriers, barrier elements, and barrier element's dimensions. It also includes barrier categories such as market failure or imperfection, market distortions, economic and financial, institutional, technical, social, and cultural and behavioural, among others. The framework is quite comprehensive and the narrations insofar the remarks on barriers and detailing on barrier elements are quite elaborate and very informative. It could also be applied in the analysis of barriers at any level – national or regional. However, it is too general and appears to treat the barriers in isolation of each other; there were no semblances of systems thinking or approach advocated by Biesbroek (2013). Furthermore, it has a specific category of institutional barriers, but is disaggregated from a point of view of the classical definition of institutions introduced in this paper (rules of the game - formal or informal), since social, cultural, and behavioural appear under a separate category.

A second review was also from the energy sector and addressed the conceptual issues concerning renewable energy costs, potential, and barriers, by Verbruggen *et al.* (2010). The paper offers useful conceptual perspectives on the renewable energy related definitions (and where applicable the metrics) of potentials, barriers, costs, and prices. Verbruggen *et al.* (2010) also allude to some barriers to mitigation potentials, such as: limited availability of and knowledge about new technologies; social norms; individual habits; attitudes; values; vested interests; lack of competition; trade barriers; undefined property rights; and inadequate information. Though not explicitly cited in the paper as institutional barriers, but '*man-made*

and changeable', they are evidently encapsulated in the definitions of institutions and institutional barriers. However, other than clarifying the definitions and focusing on the interrelationships among the drivers, the paper has very little to do with the development of a conceptual framework and/or application of the same.

The third review was about an analytical framework used to explore institutional constraints and opportunities in the environmental sector and unrelated to energy field. Specifically, this was about a three-level (micro, meso and macro) of barrier analytical framework used by Nykvist and Nilsson (2009) in analysing institutional perspectives on barriers and opportunities in Sweden, regarding the promotion of sustainable development using impact assessment (IA) procedures. At micro-level, it was about the assessment of the available human resources capacity and capabilities to the impact assessment process. The meso-level focused on the assessment of organisational norms and culture, and the dimensions of decision-making, coordination and leadership. The last and upper macro-level assesses the linkages between the systems (policies, law, regulations) and external context (stakeholders) in relation to knowledge management. Although this three-level analytical framework is policy-specific in context, and useful in assessing the institutional constraints in the impact assessment practices and processes, its application to analyse institutional barriers to renewable energy is limited, and better suited for the national rather than the regional level.

The last and fourth review was a framework for institutional analysis, also in the environmental sector, and in particular a paper by Glasson and Gosling (2001) on the 'Strategic Environmental Assessment (SEA) and Regional Planning – Overcoming the Institutional Constraints: Some Lessons from the EU'. Informing this framework was the suggestion by Glasson (1995) that, in the context of regional planning, there are two major impediments to reach the necessary steps needed to achieve synergetic effects of the imperatives of the triple bottom-line of sustainable development, and especially between socio-economic development and the environment - '*institutional unwillingness*' and '*institutional technical in-ability*'. Elaborated further were barriers that included: lack of political will; lack of clear objectives; narrow perception of issues; lack of accountability; organisational structures operating in 'silos'; lack of incentives; and political expediency and bureaucracy. These barriers were perceived as limiting the application and integration of SEA in the regional planning processes. Shown in Figure 2.3 is a framework that was developed for analysing the application of SEA in regional planning with the following five institutional factors or elements:

1. Legitimation;
2. Functions;
3. Administrative structures;
4. Processes and mechanisms; and
5. Culture and attitudes.

In addition to the analytical framework developed by Glasson and Gosling (2001) being holistic in integrating environmental concerns in the regional planning processes, it is also informed by the systems approach and thinking. Four other notable observations are worthy pointing out about this framework. Firstly, it embraces the elements of the common definition of institutions adopted in this paper – rules of the game (formal and informal). Secondly, it is applicable at regional level and regional planning in this instance, but could also be applied at any other level. Thirdly, the framework is context-specific and in a given set of defining boundary conditions. Fourthly, it was applied in (energy) project cases studies – hydro, pipeline, and transmission line planning.

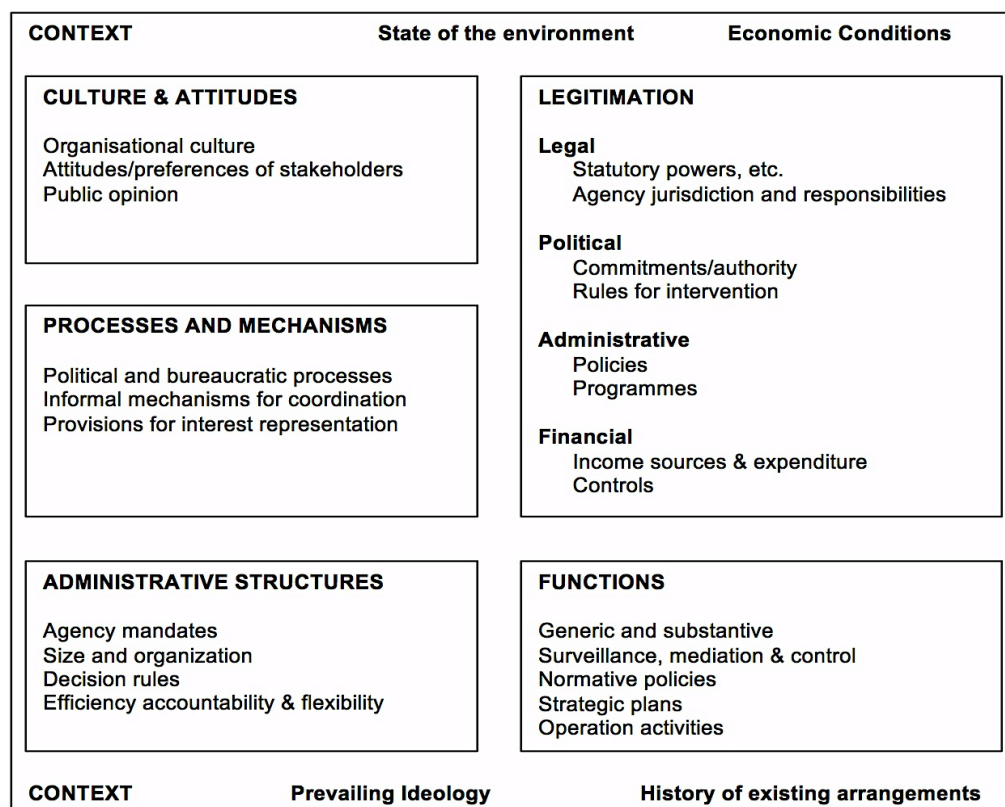


Figure 2.3. A framework for institutional analysis

(Source: Glasson and Gosling, 2001)

The conceptual framework for analysing institutional perspectives on barriers to regional energy development adapts the framework for institutional analysis by Glasson and Gosling (2001) as applied to the integration of SEA in the planning process, which also drew on the earlier works of Mitchell and Pigram (1989) and Smith (2014) (refer to Figure 2.4). The works of Martinot and McDoom (2000), Painuly (2001), Eleftheriadis and Anagnostopoulou (2015), and Yaqoot, Diwan and Kandpal (2016) also informed the framework insofar as the understanding and analysis of institutional barriers are concerned.

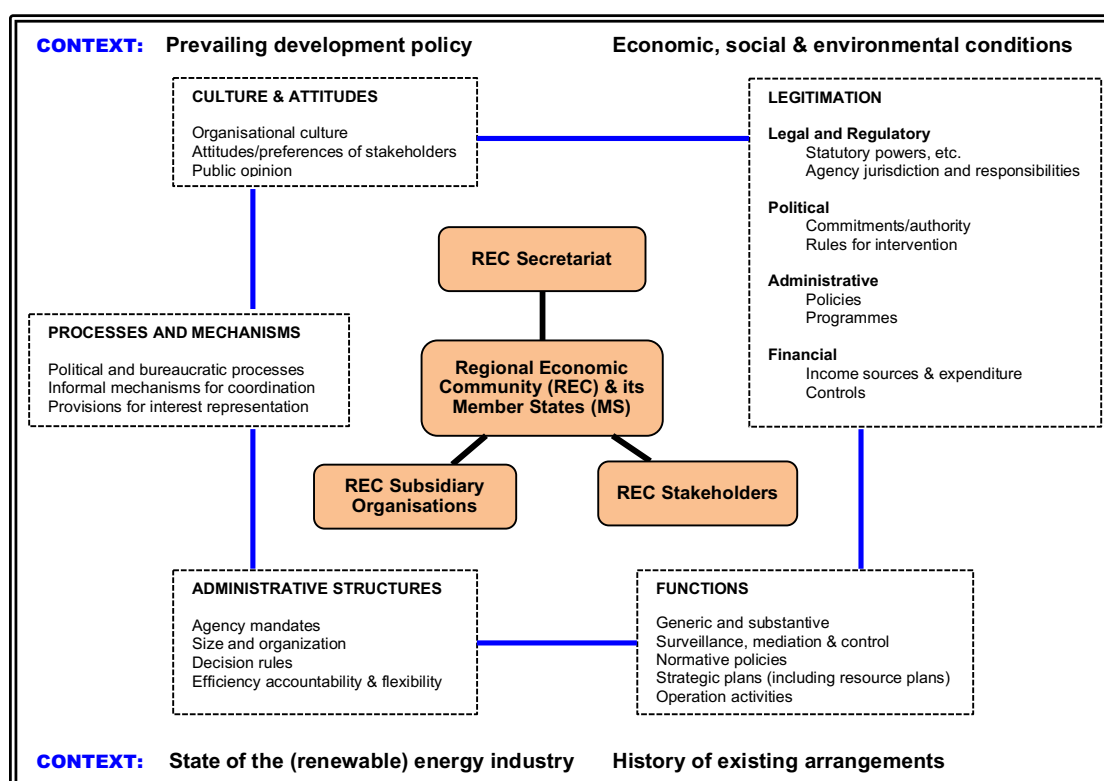


Figure 2.4. Conceptual framework for institutional analysis

(Adapted from: Glasson and Gosling, 2001)

In respect of the variations, the context is slightly different in that it is within the confines of the prevailing development policy, prevailing economic, social and environmental conditions, state of the (renewable) energy industry and the history of existing arrangements. The principal institutional elements or factors espoused by Glasson and Gosling (2001) remain essentially the same, but the applicability would be holistically to all organisations in the regional setups typical of the five regional economic communities (RECs) on the African continent. The secretariats, subsidiary organisations, and other relevant stakeholders,

support the implementation of regional development agendas of the RECs and their Member States (MS). Another slight variation would be in narratives including pertinent issues to be considered under of the principal institutional elements, given the stated contextual differences.

With this framework, the understanding and essence of the principal institutional elements is important. Legitimation refers to purpose, responsibilities, and statutory powers, including the requisite rules for possible interventions in renewable energy development and cross border power trading. In the case of functions, they imply operational means with which to guide, execute, and oversee the implementation of the intended initiatives and activities. The administrative structures are about the agencies, their mandates, means for decision-making, and operational effectiveness. Issues to do with the operation procedures, advocacy, and public or stakeholder participation, fall under processes and mechanisms. The culture and attitudes encompass the receptiveness of the organisations and the participants to renewable energy development, and cross border trading of the electricity generated from such energy sources.

When analysing the institutional perspectives on the barriers in relation to the specified institutional elements, a number of issues could be considered under each of the elements for all the concerned administrative structures (agencies). Table 2.3 shows some of the possible issues that could be considered during the analysis.

Table 2.3. Institutional perspectives on barriers

Elements	Pertinent Issues	Line of Inquisition
Legitimation	Legal basis and enforcement mechanism for promoting RE	Is there any legal basis or enforceable mechanism to promote the development of RE?
	Legal basis for participation of RE IPPs	Does the legal and regulatory framework allow for private sector participation in RE development (independent power producers, IPPs)?
	Specificity of the Market structure design	Is there a legislated or specified market structure that levels the playing field between State-Owned Utilities (SOU) and the IPPs, and allows the IPPs to trade domestically and internationally on the regional market?
	Political commitment to and rules for the development of RE	Is there strong and demonstrable political will and commitment towards RE development? Are there any rules for intervention in the regional RE development?
	Policies and programmes for development of RE	Are there any policies and programmes specific to the development of RE?
	Financial resources and controls	Are there any dedicated and sufficient financial resources, and expenditure controls pertaining to RE development?
Functions	RE resource assessments	Are there any RE resource assessments?
	Integrated resource plans (IRPs) with RE targets	Do integrated energy plans and strategies exist that include or specific a share of RE that is both economically and technically feasible?
	Regional electricity market platforms	Is there competition in or for the energy market and there any tailor designed trading platforms receptive to renewable energy generated electricity?
	Market oversight and dispute resolution	Are there any frameworks for independent market oversight, surveillance, monitoring and dispute resolution?
Administrative and operational structures	Established agency or section for RE development	Is there be a dedicated agency for promoting renewable energy development or that mandate could be embedded in an existing organisation?
	Capacity of RE agency or section	Does the agency mandated to promote renewable energy development have the capacity to executive its mandate?
	Operational and decision-making rules	Are decision rules in place?
	Efficiency, predictability and accountability of agency or section	How efficient, predictable and accountable are the administrative structures?

Elements	Pertinent Issues	Line of Inquisition
Processes and mechanisms	Stakeholder consultations and engagements	Are there processes for public and stakeholder consultations, engagements, negotiations and mediation and bargaining?
Culture and attitudes	Perception or attitude towards RE	What is the perception or attitude of the public towards renewable energy?
	Receptiveness to regional RE development and cross border electricity trading	Is there any organisation culture amenable to renewable energy development and cross border electricity trading?

2.4 Conclusions from theory and literature analysis

In summary, various studies have identified the barriers that seek to explain the large gap between the current global levels of the exploitation of renewable energy opportunities, and the potentials that are technically feasible using the available renewable energy technologies (Painuly, 2001; Foxon, 2002; Lidula *et al.*, 2006; Foxon & Pearson, 2007; Lenzen, 2010; Moriarty & Honnery, 2011; Lior, 2012; WEC, 2013). Painuly (2001) broadly classifies the renewable energy barriers into economic/financial, technical, market, institutional, social, and environmental, and in the case of Gillingham and Sweeney (2012), it is a much narrower classification into three categories, namely: institutional, market, and behavioural barriers.

A number of issues arose from the extensive traditional literature review, as follows:

1. although so much research has been done to pinpoint and categorise the barriers, the extant literature on renewable energy barriers tends to be too general, not contextualised in most instances, and are treated in isolation of each other irrespective of their interrelationships, interdependences, dynamism and complexities (Dunstan *et al.*, 2011; Chai & Yeo, 2012; Gillingham & Sweeney, 2012);
2. Costello and Finnell (1998) and McCormick and Kaberger (2007) argue that commercial development of renewable energy is prone to impediments that are inclined more towards non-technical than technical challenges during the stages of making critical investment and contractual decisions; and
3. there is little research on institutional barriers, and yet it is of absolute necessity to resolve them to enable the growth of the market for the deployment of renewable energy technologies, especially in the early stages of planning and commercialisation processes

(Gillingham & Sweeney, 2012; Eleftheriadis & Anagnostopoulou, 2015; Peck *et al.*, 2015; Andrews-Speed, 2016; Yaqoot, Diwan & Kandpal, 2016).

This paper focuses on one of the least studied classification of barriers called 'institutional barriers'. Although there is no universally accepted definition of institutions, a commonly used definition of institutions by North (1990) was adopted that refers to them as '*the rules of the game (formal and informal) in a society and/or the humanly devised constraints that shape human interaction*'. According to Nykvist and Nilsson (2009), the formal rules include constitutions, laws, and property rights, while the informal rules include sanctions, taboos, customs, traditions, and codes of conduct. Dunstan *et al.* (2011) describe institutional barriers as '*barriers that exist in how humans relate to the energy resources through laws and regulations, and through values and culture*'.

A general proposition was that the institutional theory and the theory of international trade cooperation in electricity would most likely provide a better understanding of the barriers to exploiting renewable energy opportunities, through an integrated regional power system from the perspective of cross border electricity trading. Rodriguez-Pose (2013) argues that institutional factors have a bearing on regional economic development.

A number of conceptual frameworks have been used to analyse institutional barriers (Painuly, 2001; Glasson & Gosling, 2001; Nykvist & Nilsson, 2009; Verbruggen *et al.*, 2010; Biesbroek, 2013). However, frameworks specific to the analysis of the renewable energy institutional barriers are very limited, and those available are not as elaborate as required. The situation is also exacerbated by differences in the understanding, use of different definitions, and underlying analytical assumptions, and the attempts to classify and categorise barriers differently have not made much difference to the very nature of the barriers being analysed (Verbruggen *et al.*, 2010; Chai & Yeo, 2012).

A conceptual framework has then been adapted from Glasson and Gosling (2001) applicable as an analytical instrument to connect conceptual ideas to analyse renewable energy institutional barriers (refer to Figure 2.4). The limitations of the context of this framework are the state of the (renewable) energy industry, prevailing economic, social and environmental conditions, history of existing arrangements, and prevailing development policy. The five institutional elements considered include: legitimation, functions, administrative structures, processes and mechanisms, and culture and attitudes; all being dynamic, interrelated, and interdependent. The conceptual framework provides the means to undertake a case study, in

SADC, to analyse the institutional perspectives on barriers to exploit renewable energy opportunities through an integrated regional power system in Southern Africa.

Chapter 3 – Second Journal Article – Analysis of institutional perspectives on barriers to renewable energy development using an integrated approach in Southern Africa (Case Study Analysis)

3.1 Introduction

Renewable energy, excluding large hydro, contributes a paltry 8% to the total electricity generation mix in Southern Africa, which is about 400 TWh from a total installed generation capacity of about 67.2 GW (Chikova & Beta, 2017). With the inclusion of large hydro, the total renewable generated electricity share increases to about 29%. Figure 3.1 shows the contribution of the various sources of electricity to the generation mix in 2017 in the SADC region and it is quite evident that the development of renewable energy gained some appreciable traction over the last few years. The much-acclaimed auctions under the REIPPPP in South Africa made significant contributions of almost 3,900 MW during the first three windows up to November 2013, particularly from intermittent renewables (solar and wind) (Rycroft, 2013). Other countries in the region such as Namibia and Zambia have auctioned some limited solar capacity in the recent past with very competitive winning prices/tariffs in the order of 6.02 US\$/kWh (Kruger, 2017).

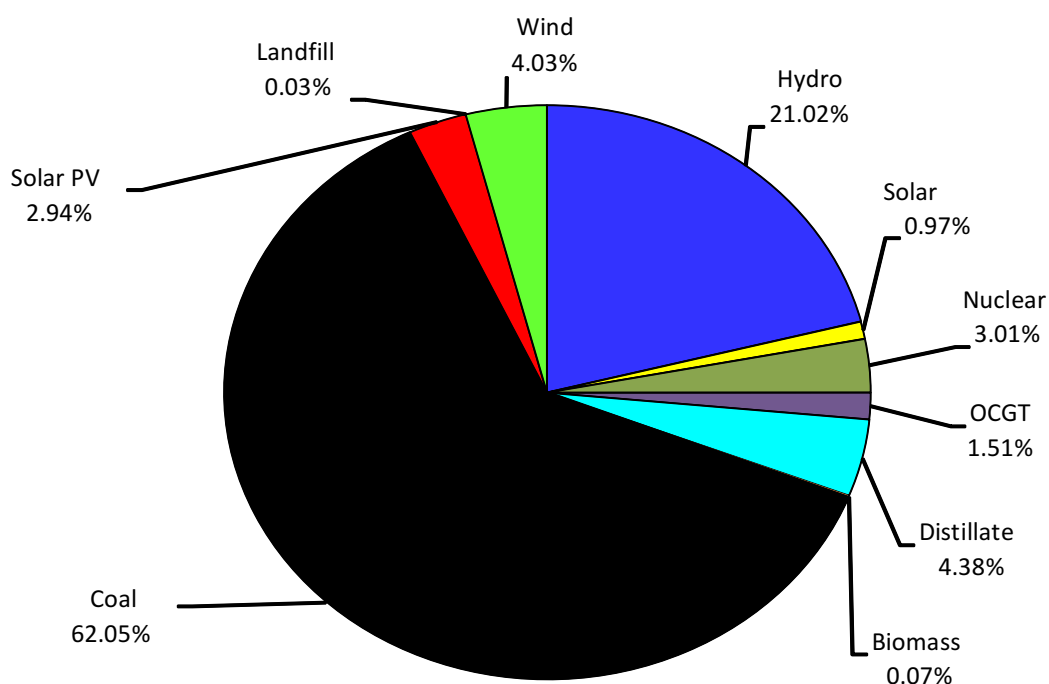


Figure 3.1. SAPP electricity generation mix

(Source: Chikova and Beta, 2017)

Coal remains a dominant source of electricity generation with a share of about 62% of the generation mix. Interestingly and unexpectedly, the region has also moved from an aggregate supply deficit of 6,514 MW in 2016 to an excess capacity of about of 2,616 MW. Countries with excess capacity are South Africa (7,089 MW), Angola (362 MW), Zambia (224 MW) and Mozambique (163 MW) (Beta, 2016; Chikova & Beta, 2017). Although the SAPP Member Utilities have been improving the availability of their power plants and developing additional (new) generation capacity, it can be argued, without empirical evidence, that the general economic downturns being experienced and the increasing interest in distributed energy resources (DER²) could be significantly impacting and contributing to the current excess capacity (Fine and Mihlmester, 2017; Chikova & Beta, 2017). The rest of the eight (8) countries are not able to meet their peak demands and reserve margin requirements. This is against a backdrop of an estimated potential of 38,657 MW of large hydropower (without including the Grand Inga), 3,420 MW of small hydropower, 2,195 TWh of solar PV, 1,093 TWh of solar thermal, 8,470 MW of biomass and 153,180 MW of wind energy (Stiles & Murove, 2015).

Theoretically, it is abundantly clear that the potential for electricity generation from renewable energy is several times more than the current demand and installed capacity. The IRENA Director-General, Adnan Z. Amin, also recognises renewable energy resource potential on the African continent and was quoted stating *“Africa holds some of the best renewable energy resources in the world in the form of biomass, geothermal, hydropower, solar and wind. This, combined with the precipitous drop of renewable energy technology costs, creates a massive opportunity for African countries to both transform and expand their energy systems while providing a pathway for low-carbon economic growth”* (McBride, 2015).

With the front loading on the regional development agenda of the SADC Industrialisation Strategy and Roadmap 2015-2063 by the SADC Heads of State and Government in April 2015 and the need to bridge the current electricity supply deficit, renewable energy and alternative energy sources are receiving greater attention from a variety of stakeholders (SADC, 2015). Without sufficient and quality energy services at just and reasonable prices and tariffs, it is inconceivable to imagine how SADC MS would advance their socio-economic

² According to Fine and Mihlmester (2017), DERs include: Distributed Solar, Energy Storage, Energy Efficiency, Demand Response, Combined Heat and Power (CHP) and Electric Vehicles.

development agendas and implement the newly acclaimed Industrialisation Strategy and Roadmap 2015-2063 (Sen & Ganguly, 2016).

In recognition of the potential benefits that could be accrued from regional energy pooling and the need to address the concomitant challenges of the region's diminishing surplus electricity generation capacity since 2007, a number of regional initiatives have been developed, some of which signify some political commitment and will to harness the abundant renewable energy resources. Figure 3.2 shows the milestones for energy cooperation and integration in the SADC (Southern African) Region. Admittedly, most of the regional plans have not seen the light of day in terms of their implementation. Consequently, and regrettably, Southern Africa, like other regions of Africa, has underdeveloped energy resources and continues to lag in the installed generation capacity, transmission capacity adequacy and electricity access (Rosnes & Shkaratan, 2011).

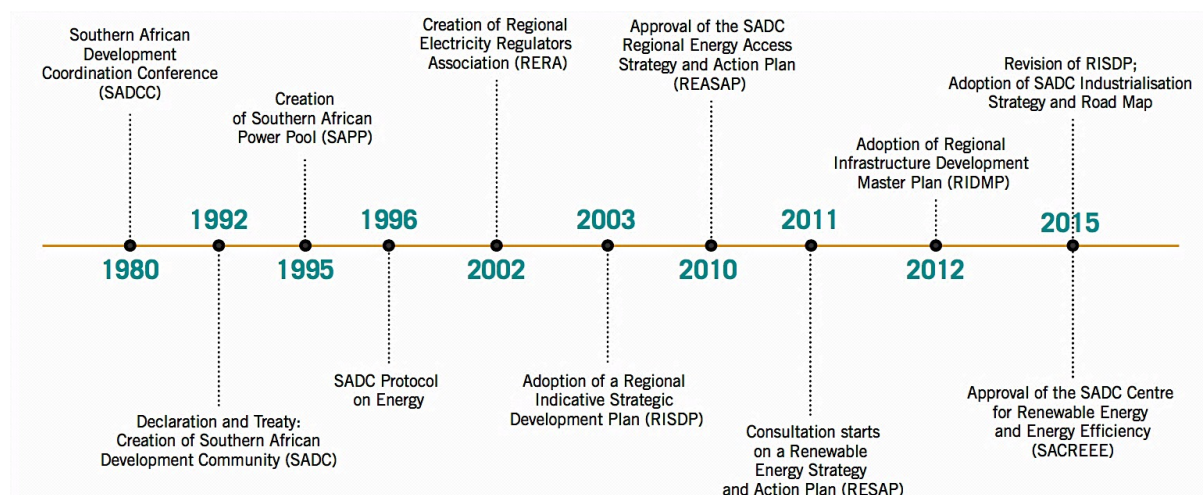


Figure 3.2. Milestones for regional cooperation and integration in the SADC region

(Source: Stiles and Murove, 2015)

With the challenges in the regional energy and water sectors reaching crisis proportions, SADC (2016) held a joint ministerial workshop in Gaborone, Botswana in June 2016 that identified the following challenges specific to the energy sector in general:

1. Countries tend to be inward looking and advocating for self-sufficiency;
2. Sectors and organisations in SADC operate in 'silos' (in isolation);
3. Lack of consumer education and awareness on efficient usage of energy;

4. Lack of energy diversification to enhance security of supply;
5. Slow pace of the implementation of priority energy under the Regional Infrastructure Development Master Plan (RIDMP);
6. Lack of regional interconnectivity by some countries for power trading;
7. Limited investment in and utilisation of new and renewable sources of energy (NRSE);
8. Inability to conclude power purchase agreements with off-takers;
9. Limited capacity to do research and innovate that leads to unsustainable programmes and projects energy services; and
10. Unpreparedness against extreme weather and climatic events.

The ministerial workshop reaffirmed the belief held by many stakeholders that there are barriers hindering the scaling up in the development of the NRSE (Rai & Beck, 2015; Gabriel, 2016). However, understanding and ultimately addressing the barriers to renewable energy development and utilisation are not without challenges. In addition, it has been argued that not so much attention is given to the context and the prevailing institutional environments (Yiu & Makino, 2002). Hence, there is need to revisit the approaches to analysing barriers to the development of renewable energy and to develop new conceptual frameworks that do not only provide a better understanding of impediments at hand but also take the context into account to find appropriate and responsive interventions.

This second paper seeks to analyse the institutional perspectives on barriers to renewable energy development using an integrated approach in Southern Africa. At the core of this paper was the following explanatory question:

“How are the institutional barriers limiting the development of renewable energy using an integrated regional approach in Southern Africa?”

As De Massis and Kotlar (2014) observe, it is quite common to have an explanatory nature of this case study being combined with its exploratory goal. Regardless, this paper explores through a case of study on Southern Africa with a proposition that institutional perspectives could provide a better understanding of the barriers to the exploiting renewable energy opportunities through an integrated regional power system. It applies a conceptual framework developed in the first paper as an analytical lens, frame or instrument to connect conceptual ideas to analyse renewable energy institutional barriers in the Southern African context. The analytical lens delved into five institutional elements, namely: legitimation,

functions, administrative structures, processes and mechanisms, and culture and attitudes. The unit of analysis in this case study was the Southern African region.

3.2 The case study

Case study, as a research method, has been widely used in so many disciplines and research fields including social sciences but the universal consensus on its definition is yet to emerge (Levy, 2008; Thomas, 2011). Furthermore, arguments have been advanced to the effect that the definitions and understandings of the case study are varied, contested and perceived differently depending on the field of research or the inclination of individual researchers (Zucker, 2009; Hammersley, 2010; Thomas, 2011; Cronin, 2014). According to Neale, Thapa and Boyce (2006), a case study is storyline that gives an account of whatever happened in a phenomenon that led to a particular eventuality, whether successful, failure or difficulty state. It is also defined as a *“systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest”* (Zucker, 2009). Levy (2008) describes a case study *‘as an attempt to understand and interpret a spatially and temporally bounded set of events’*. The unit of analysis in a case study could be individuals, organizations, processes, programs, neighbourhoods, institutions and events, geographical units, among others.

A question often asked is when should a case study approach be considered? The critical features initially proposed by Yin (2003) to warrant a case study comprised four main constituents. Firstly, the case study had to have emphasis placed on responding to the ‘how’ and ‘why’ type of questions. Secondly, the behaviour of those involved in the case study could not be manipulated. Thirdly, the contextual environment and its conditions relevant to the case study mattered. Fourthly, the case study had to have no clear distinctive boundaries between phenomenon and the context. In recent years, Yin (2013) revisited the features of a case study and described it as an empirical inquiry that examines an occurrence in depth and in a given real world context with no clear distinctive boundaries between phenomenon and the context.

The typologies of case studies are also as diverse in their categorisations as the definitions. Categories of the typologies based on a combination or variation of research objectives and selection techniques include atheoretical, interpretive, hypothesis-generating, theory-confirming, configurative-idiographic, disciplined-configurative, heuristic, plausibility probe and crucial case studies (Levy, 2008). In the quest to make the expansive typologies much simpler and narrower, Levy (2008) suggests four basic typologies consisting of idiographic

(inductive or theory-guided), hypothesis generating, hypothesis testing and plausibility probes, and acknowledges that it is not unusual to have practical case studies involving a combination of two or more of the typologies.

This case study on the ‘analysis of institutional perspectives on barriers to renewable energy development using an integrated approach in Southern Africa’ has the critical features of such studies. Firstly, it responds to the ‘how’ type of question as highlighted in Section 1.5. Secondly, the case study constituents shown in Figure 3.3 cannot be manipulated. Thirdly, it has the relevant contextual environment and conditions that are well defined. Fourthly, there was no clear distinction between institutional elements or perspectives and the defined context given the dynamic (interrelationships and interdependences) and complex nature of both the institutional elements and the context. In terms of its typological categorisation, it is an ‘Idiographic Case Study’ falling under the subtype of ‘Theory-Guided Case Studies’ (Levy, 2008). Rather than intending to make generalisations beyond its data, the case study seeks to explain institutional perspectives on barriers to renewable energy development using an integrated approach in Southern Africa using a conceptual framework developed in Section 2.3.4. The categorisation of this case study is also along the same of lines of the observation by Brent (2012) that many studies on renewable energy technologies in Africa are ‘Theoretical/Configurative Idiographic Case Studies’.

In this case study, the following were considered as representative SADC organisations and stakeholders:

- Regional Economic Community (REC) - SADC and its MS
- REC Secretariat - SADC Secretariat
- REC Subsidiary Organisations - RERA, SACREEE and SAPP
- REC Stakeholders - Publics, Private Sector, DPs, etc.

Figure 3.3 shows the analytical frame with representative SADC organisations and stakeholders. Similar organisational setups could be at MS level with the central governments and their ministries/departments, parastatals organisations (regulatory authorities, power utilities and rural electrification agencies) and stakeholders, as highlighted. However, this case study considered SADC, subsidiary organisations and stakeholders in their own right as regional organisations and did not delve much into their constituent or member organisations.

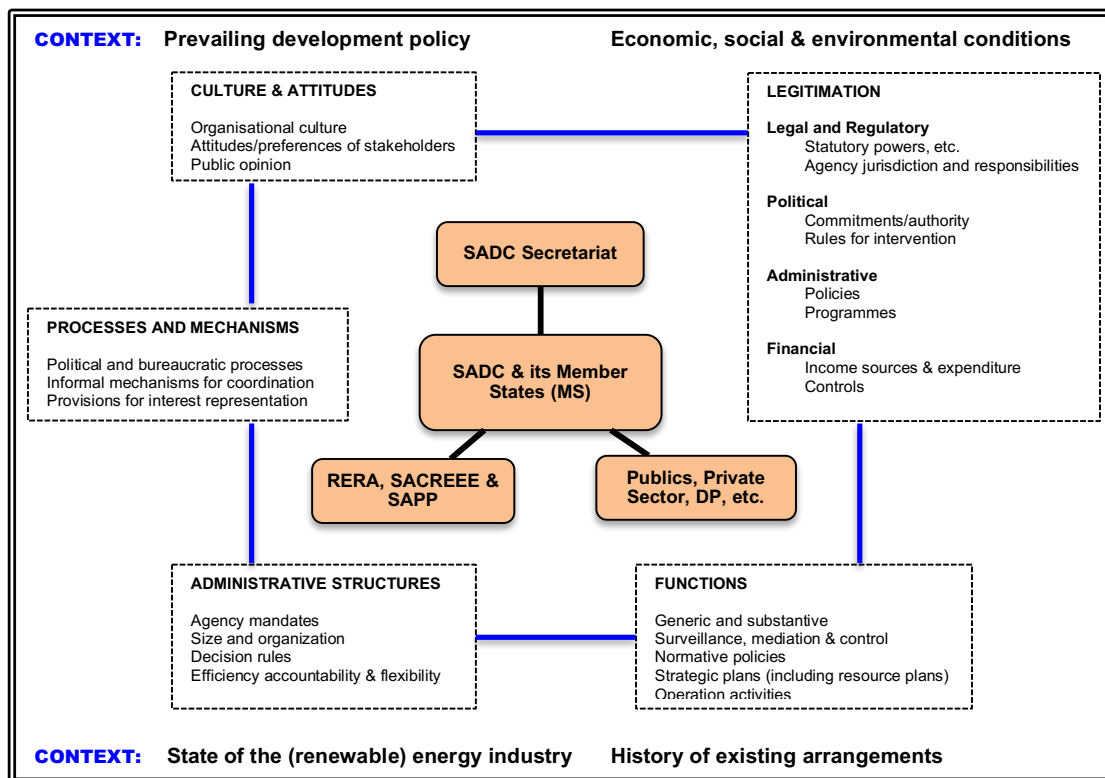


Figure 3.3. SADC conceptual framework for the institutional analysis

(Adapted from: Glasson and Gosling, 2001)

Some key facts pertaining to the SADC or Southern African Region are as shown in Figure 3.4.

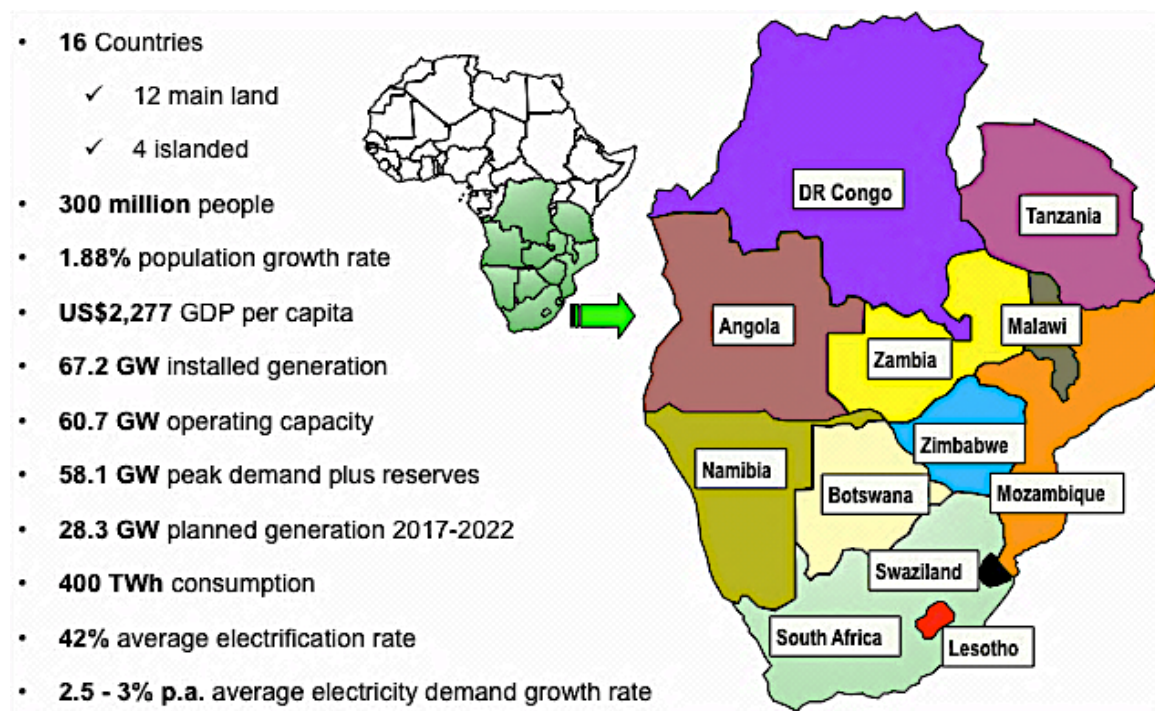


Figure 3.4. Some key facts about the SADC region

(Source: Stiles and Murove, 2015; Chikova, 2017)

As stated in Section 1.7, the paper focuses on modern renewable energy resources with a large potential and commercially available technologies, and with scope for relatively large-scale electricity generation (solar, hydro, wind and biomass) that could allow for cross border trading (Panwar *et al.*, 2011). Furthermore, it was restricted to Southern Africa, a region that is most interconnected countries, with a functioning power pool (SAPP) and very well known to the researcher over the past 26 years of working in various capacities in the region (Oseni & Pollitt, 2016).

3.3 Methodology and methods

The essence of this case study was to provide better explanations and understandings of the institutional perspectives on barriers to renewable energy development using an integrated approach in Southern Africa through an explicit and structured use of a conceptual framework developed using the institutional theory. In addition, it was not the intention of this study to make generalisations beyond data but to describe, interpret and explain the

research phenomenon guided by theoretical underpinnings. Hence, the selection of a case study typology categorised by Levy (2008) as an 'Idiographic Case Study' but of the specific subtype described as 'Theory-Guided Case Study'. Besides, the overall goal of the research study, as elaborated in Section 1.1, had a strong bearing on the selection of the case study since it implicitly discounted other choices including categories such as inductive (an alternative subtype under the idiographic case studies), hypothesis-generating, hypothesis testing and plausibility probes (Levy, 2008). Many renewable energy technology studies in Africa are also typical of this choice of case studies (Brent, 2012).

One of the characters of case study research is the use of variety data sources that only not enhances data credibility but also contributes to the in-depth understanding of the phenomenon (Patton, 1990; De Massis & Kotlar, 2014). Tellis (1997) and Ritchie *et al.* (2013) identified the following potential data sources for case studies in no particular order of importance or preference:

1. Observation (direct or participant observations);
2. Documents;
3. Interviews (open-ended, focused, structured or survey);
4. Archival records; and
5. Physical artifacts.

The choice of which data collection method to utilise could be influenced by the context, structure and timing of the case study research (Ritchie *et al.*, 2013). Besides, it could also be a choice between naturally occurring and generated data (Ritchie *et al.*, 2013). Naturally occurring data could be obtained through observation and documentary analysis while generated data is through in-depth interviews and group discussions. This case study chose the method of collecting naturally occurring data over generated data for practical considerations. Specifically, the naturally occurring data was sourced from referenced documents including peer reviewed journal articles, reports, presentations, records and newspaper articles. Ritchie *et al.* (2013) argue that naturally occurring data as a data collection method is particularly useful in instances when the research is seemingly a complex process and with the targeted sample showing signs of unresponsiveness or subjectivity or both. However, downside of this data collection method is that it relies heavily on the interpretation of what the researcher reads and observes. In addition, the documents could have a one-sided view and fail to fully take into account the context of the research phenomenon.

There was also an element of using some semblance of participant-observation though not in the strictest sense of its applicability by way of the researcher being an active participant in event being studied (Tellis, 1997). For instance, the researcher participated in and did not influence the following events in 2015 and 2016 that discussed renewable energy and its technologies, among other things:

1. IRENA high-level technical workshop during World Future Energy Summit in Abu Dhabi, United Arab Emirates (UAE) in January 2016 that facilitated a global exchange of experiences and views from investors and government/implementing agencies on barriers to investment into renewables;
2. IRENA Africa Renewable Energy Training Weeks that discussed renewable energy target setting, support schemes for target achievement, system integration and regional cross-border initiatives - 2 events (in Abu Dhabi, UAE in January 2015 and in Arusha, Tanzania in October 2015);
3. South African International Renewable Energy Conference (SAIREC) in Cape Town, South Africa in October 2015;
4. First (1st) RERA/IRENA Stakeholder Consultation in support of Regulatory Approaches for Long-Term Electricity Resource Planning (that integrates renewable energy) in Swakopmund, Namibia in April 2016;
5. SADC Ministerial Workshop on Water and Energy Crisis in the SADC Region in Gaborone, Botswana in June 2016; (SADC, 2016);
6. SADC Energy Ministers Meetings – 3 meetings (in Johannesburg, South Africa in July 2015; Gaborone, Botswana in June 2016 and Ezulwini, Swaziland in July 2017);
7. Validation Workshop on SADC Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) in Johannesburg, South Africa in October 2016; and
8. SADC Energy Investment Conference in Ezulwini, Swaziland in July 2017.

This method of data collection was useful in appreciating the recent renewable energy developments and associated challenges, and also collecting documents that informed this case study.

The practical considerations that influenced the choice of naturally occurring data as a data collection methods were as follows:

- Complexities of getting timely primary or generated data from a representative sample from the SADC Region with 16 MS, three subsidiary organisations (SACREEE, SAPP & RERA) and a total population of about 300 million people;
- Ethical challenges around getting timely consent from SADC organisations and the likely unwillingness of the people to be frank, especially those bound by confidentiality in contractual engagements in government ministries/departments, regulatory authorities, power utilities, development financial institutions (DFIs), private sector; and
- Most of the documents referenced were from data generated using empirical research methods such as interviews (open-ended, focused, structured or survey) and observations (direct or participant observations) using extensive consultancy services.

As a case study using the naturally occurring data, the population sampled was the extant and expansive literature (peer reviewed or grey literature) from databases using search engines including the Internet and in particular Google Scholar (Harriman & Patel, 2014; Haddaway *et al.*, 2015). The 'Building Block Search Technique' and the Internet, as a search tool, were used to sample the textual data from the different databases. In the quest to avoid sampling textual data that did not shed light on or was out of touch with the context of the research phenomenon, the inclination was towards extant literature of 5 years or less.

The case study literature based article and therefore, the existing literature was considered as the population. Textual data from numerous publications was sampled from the different databases using the 'Building Block Search Technique'. Triangulation, as shown in Figure 3.5, was applied; being the case when a combination of two or more methodological approaches, theoretical perspectives, data sources, and analysis methods are used (Hussein, 2015).

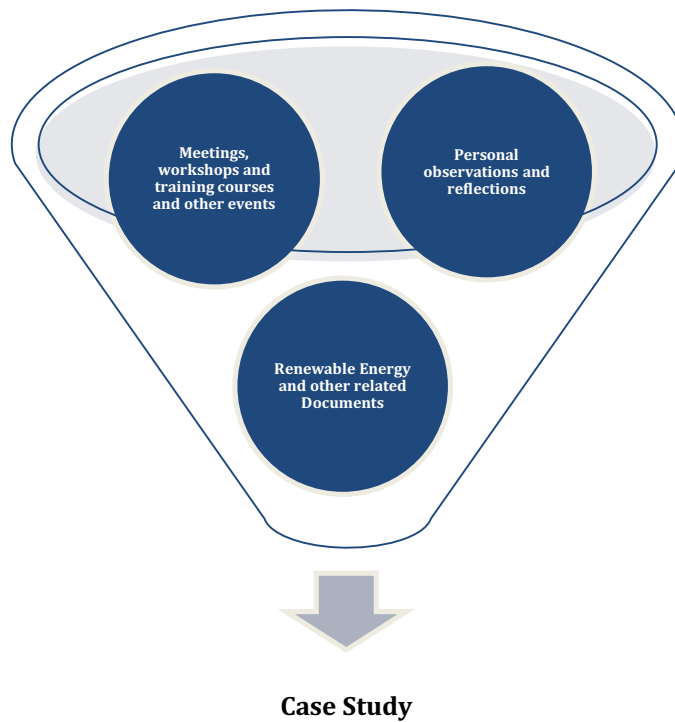


Figure 3.5. Data triangulation

3.4 Findings

Using the analytical frame outlined in Figure 3.3, a summary of the contrasts of the SADC organisations and stakeholders by assessing the perspectives on legitimation, functions, administrative structures, processes and mechanisms, and culture and attitudes are presented in Table 3.1 The highlights of the findings under each of the five elements are provided below.

Table 3.1. Contrasts of SADC structures by institutional perspectives

Elements	Pertinent Issues	Status				
		SADC	RERA	SACREEE	SAPP	Others
<i>Legitimation</i>	Legal basis and enforcement mechanism for promoting RE	Protocol on Energy in place advocates that the region develops and utilises NRSE	None regionally at the moment but SADC MS have different enabling legal frameworks	None at the moment but a Draft Inter-Government Memorandum of Agreement (IGMOA) instead of IGMOU is being finalised	IGMOU (revised in 2006)	Not applicable
	Legal basis for participation of RE IPPs	Protocol on Energy alludes to the creation of a conducive environment for private sector participation	None regionally at the moment	Not applicable	IGMOU and Inter-Utility MOU (IUMOU) allows for the participation of IPPs in general	Not applicable
	Specified Market structure design	Approved Market and Investment Framework for SADC Power Projects (M&I Framework) in June 2016	RERA facilitated the development of M&I Framework	Not applicable	A competitive regional electricity trading market allows for the participation of SOUs and IPPs in general	Not applicable
	Political commitment to and rules for the RE development	Political will and commitment to implement RE related aspects in the Protocol on Energy and the approved frameworks, action plans and strategies are inadequate Enforceable rules for intervention in RE development at regional level are not in place	Political commitment to transform RERA into Regional Regulatory Authority is evident but political will to support 'independent or autonomous' regulators in SADC MS is inadequate	Approval of the establishment of SACREEE and the REEESAP is a demonstration of political commitment towards RE development but the political will to expedite the operationalisation of SACREEE through the signing and ratification of the IGMOA by two-thirds of the SADC MS is lacking	SAPP IGMOU is a good sign of political commitment but the political will to implement all the aspects of the IGMOU is lacking	There is political commitment to involve other stakeholders in RE development but mechanisms to do so are not elaborate, consistent and definitive
	Policies and programmes for RE development	Specific regional RE policies are not in place but the REEESAP with various regional RE initiatives has been approved	RERA has its own regional RE regulatory initiatives supported by ICPs and while some of them arise from the approved REEESAP	SACREEE is the champion for the implementation of the approved REEESAP with various regional REEE programmes and projects	SAPP regional RE initiative arise mainly from its own Pool Plan and the approved REEESAP	The DPs, as lenders and the private sector, as IPPs, have diverse interests in RE programme and projects

Elements	Pertinent Issues	Status				
		SADC	RERA	SACREEE	SAPP	Others
	Financial resources and controls	Lack of dedicated regional budgetary provision of financial resources for RE development leading to high dependence on international cooperating partners (ICPs)	Insufficient own financial resources from membership subscription fees and highly dependent on the ICPs for the regional RE regulatory initiatives	Highly dependent on the ICPs and the Host SADC MS (Namibia) since the IGMOA is yet to be signed and ratified by two-thirds of the SADC MS	Highly dependent on ICPs for the implementation of its regional RE related initiatives	Other than for the general public and consumer organisations, financial resources are not a deterrent to the private sector and DPs provided there are bankable projects
<i>Functions</i>	RE resource assessments	IRENA RE resource assessment and zoning, Global Atlas and REmap are at the disposal of SADC	Not applicable	Not yet operational but part of the planned regional initiatives	SAPP Pool Plan is being revised	Not applicable
	Integrated resource plans (IRPs) with RE targets	RIDMP and REEESAP with a target of 33% and 39% share of electricity from RE by 2020 and 2030, respectively	Not applicable but assisting SADC to develop IRP Guidelines with technical assistance from IRENA	As stated in the RIDMP and REEESAP, being an implementing agent of SADC	SAPP Pool Plan was in the process of being revised	Not applicable
	Regional electricity market platforms and trading	Target regional wholesale market design is part of the recently approved M&I Framework and SAPP is already in place	Facilitated the design of the regional wholesale market design	Not applicable	Competitive electricity market trading platform (MTP) is already in place	Other players such as power brokers or traders are allowed to participate in and compete for the market
	Market oversight and dispute resolution	None from a regional perspective given the suspension of the SADC Tribunal	None from a regional perspective but within the purview of the SADC MS	Not applicable	Currently self-regulating market with disputes at SADC MS to be resolved by the SADC Tribunal	Not applicable
<i>Administrative and operational structures</i>	Established agency or section for RE development	SADC (Secretariat) has no dedicated section or officer	A Renewable Energy External Expert (REEEx) is being funded by IRENA for	Established as a dedicated regional entity for RE but not yet operational	Has an Environment Officer who is also tasked with RE related matters	None at the regional level though numerous are in place at MS level

Elements	Pertinent Issues	Status				
		SADC	RERA	SACREEE	SAPP	Others
		responsible for RE development	up to 2 years			
	Capacity of RE agency or section	Highly capacity constrained	Highly capacity constrained	Not yet operational but would be adequately resourced	Capacity constrained	Fewer regional structures are capacity constrained
	Operational and decision-making rules	Some frameworks and guidelines in place at a high level and a great level of in the recent REEESAP	Some frameworks and guidelines in place though not necessarily specific but can be applicable to RE related matters	Not yet operational	Most of the frameworks, guidelines and rules generally in place though not necessarily specific but can be applicable to RE matters	Generally, in place though not necessarily specific to RE related matters
	Efficiency, predictability and accountability of agency or section	No dedicated section and generally perceived bureaucratic	Lots of scope for improvements given capacity constraints	Not yet fully functional/operational	Lots of scope for improvements in view of some capacity constraints	Generally perceived efficiency though not necessarily accountable for their actions
<i>Processes and mechanisms</i>	Stakeholder consultations, engagements, negotiations, mediation and bargaining	No elaborate public consultation and engagement processes	No elaborate public consultation processes but recently developed a 'Communication Strategy'	Not yet operational but recently developed 'Communication Strategy' as part of REEESAP	No elaborate public consultation and engagement processes	Most NGOs and DPs have fairly well articulated advocacy and engagement strategies
<i>Culture and attitudes</i>	Perception or attitude towards RE	Rhetorically good in the founding documents but not practically demonstrable	Good but could be much better with the resolution of the capacity constraints	Not yet operational but anticipated to be excellent	Lukewarm	Excellent from development partners but lukewarm from the general public
	Receptiveness to regional RE development and regional electricity trading					

3.4.1 Legitimation

In terms of the purpose, responsibilities and legal basis including the requisite rules for possible interventions in the regional renewable energy development and cross border power trading, the status is varied and with wide scope for improvement.

i) Legal basis

SADC and SAPP have some legal basis for promoting regional renewable energy development and utilisation. In the case of SADC, its legal basis is in terms of Article 22 of the SADC Treaty that provided the basis for the SADC Protocol on Energy signed in 1996 but came into force in 1998 after ratification by at least two-thirds of the Member States (SADC, 1996). One of the objectives of the Protocol is promote the regional development and utilisation of new and renewable sources of energy (NRSE). The revised Inter-Governmental Memorandum of Understanding (IGMOU) on SAPP was signed in 2006 (SARDC, 2012). Incidentally, the revised IGMOU only refers to hydro and not any other type of renewable energy that could be harnessed for electricity generation. This is also true with respect to other SADC energy sector instruments such as the SADC Energy Co-operation Policy and Strategy (1996), the SADC Energy Sector Action Plan (1997) and the SADC Energy Activity Plan (2000) (Zhou, 2012).

Unlike SAPP that was established through an IGMOU signed by the SADC MS, RERA was established differently in that it was through a decision of the SADC Ministers responsible for Energy at a meeting held in 2002 in Maseru, Lesotho (Sichone & Roets, 2011). Therefore, no legal instruments at MS level were deposited with the SADC Secretariat for its formation. However, RERA's Member Regulators are legally empowered under their respective enabling legislations to attach licensing conditions that would promote renewable energy development and create a level playing field for renewable energy IPPs in line with the policy aspirations of the SADC MS (Kugel, 2009). SADC has approved the establishment of SACREEE and a draft Inter-Governmental Memorandum of Agreement Understanding (IGMOA) is in the process of being finalised for the operationalization of this new SADC subsidiary organisation (SACREEE, 2017; Ndhlukula, 2017). Initially, it was agreed to establish SACREEE by signing an IGMOU but a decision made later on to have a more legally binding IGMOA following a recommendation from the Legal Officers from the SADC MS. As soon as the IGMOA is signed by at least two-thirds of the SADC MS, SACREEE shall be officially launched to commence its operations.

Although the SADC Protocol on Energy and some IGMOUs are in place, the enforceability of the same remains a major challenge for two main reasons. Firstly, the decisions of SADC and its subsidiary organisations (RERA, SACREEE and SAPP) are not mandatory or binding but voluntary on the SADC MS to implement. This means that enforceability of decisions at the regional level is more by persuasion than using the legal arm of the founding instruments. By contrast, the EU (2017) is able to issue 'Directives' that are mandatory or binding on the

EU MS to implement such as the 2020 package, a set of binding legislation enacted in 2009 to ensure the EU meets its climate and energy targets for the year 2020 as follows:

- 20% cut in greenhouse gas emissions (from 1990 levels);
- 20% of EU energy from renewables; and
- 20% improvement in energy efficiency.

Secondly, the SADC Tribunal that is supposed to ensure adherence to and interpretation of the various SADC legal instruments, and adjudicate upon disputes is currently suspended (SADC, 2017; IJRC, 2017). According to IJRC (2017), the revised mandate of the SADC Tribunal no longer includes international human rights norms to the adjudication of inter-State disputes arising from the SADC Treaty and its Protocols. The revised SADC Protocol on the Tribunal was signed in 2014 but it is yet to receive the required minimum number of ratifications from the SADC MS to enter into force. The suspension of the SADC Tribunal could pause challenges to the SAPP in the event of any dispute since Article 6 of the SAPP IGMOU refers the adjudication of disputes to the Tribunal and its decisions shall be final and binding on the parties (SADC, 2006).

ii) Private sector participation

With regard to the legal and regulatory framework for private sector in renewable energy development, the SADC Protocol on Energy alludes to the creation of a conducive environment for private sector participation in the energy development in the region (SADC, 1996). The governing documents of the SAPP including the IGMOU also allow for the participation of IPPs subject to meeting specified requirements (SADC, 2006). In the case of SACREEE, which is in the process of being established, the proposed governing structure provides for an observer status of a representative of the private sector (Moyo, 2016). Although there is no legal basis from RERA's perspective at regional level, the Member Regulators in the SADC MS are under different policy, legal and regulatory practices shown in Table 3.2 that promote private sector participation in energy sector (Stiles & Murove, 2015).

A number of IPPs including those in the renewable energy sub-sector have been licensed to operate as REIPPs in the SADC MS, some of which are also participating on the regional competitive market operated by the SAPP under the members category of 'Independent Power Producers 'IPP' (Chikova, 2017). Currently, the competitive market comprises nine (9) out of twelve (12) mainland SADC MS that are interconnected to the regional electricity grid

and the State-Owned Utilities (SOU) from these countries are categorised as ‘Operating Members’ (OP) under the SAPP membership categories. Only Angola, Malawi and Tanzania are yet to be interconnected to the regional electricity grid and the SOU from these three (3) countries are categorised ‘Non-Operating Members’ (NP) under the SAPP. Other categories of the SAPP membership include ‘Independent Transmission Company’ (ITC) and ‘Observers’ (OB).

Table 3.2. Renewable energy support policies in SADC Member States

	Renewable energy targets	Regulatory policies						Fiscal incentives and public financing		
		Feed-in tariff/ premium payment	Net metering	Biofuels obligation/mandate	Grid code revisions	Tradable renewable Energy credits (RECS)	Tendering	Capital subsidy, grant or rebate	Investment or production tax credits	Reductions in sales, energy, CO ₂ , VAT or other taxes
Angola	X									
Botswana	X	X					X			
DRC	X									
Lesotho	X									
Madagascar	X									
Malawi	X			X						
Mauritius	X	X	X		X		X	X		
Mozambique	X			X	X					
Namibia	X	X	X				X			
Seychelles	X						X			
South Africa	X		X	X	X	X	X	X	X	X
Swaziland				X						
Tanzania	X	X						X		
Zambia	X	X		X	X			X		X
Zimbabwe	X	X	X	X	X		X	X		

(Source: Adapted from Stiles and Murove, 2015)

Despite the fact that the legal basis for the participation of the private sector as IPPs is generally in place, most of the sub-Saharan Africa including the SADC MS have not been able to attract the private sector investments, as IPPs, in the electricity supply industry (Eberhard *et al.*, 2016; Eberhard *et al.*, 2017). Kugel (2009) argues that the legislation

remains as statements of intent at high-level and has not been translated into details outlining how the private sector would be attracted in the energy sector in general and renewable energy sub-sector in particular. Besides, the sector reforms in the SADC MS that were intended, among other policy objectives, to create conducive environments for private sector participation in the electricity supply industry have either stalled or abandoned (Kugel, 2009). As an illustration of the sector reforms, Eberhard (2016) and Eberhard *et al.* (2016) outline the restructuring process in Figure 3.6 necessitated by the power challenges, and the need to attract private sector participation and introduce some form of competition.

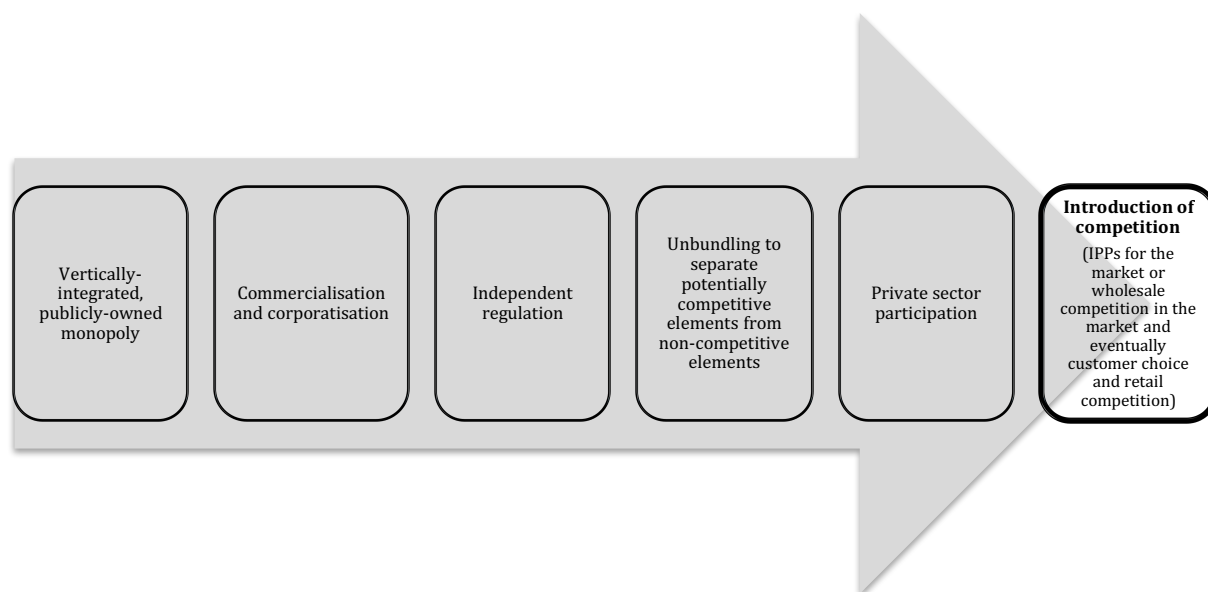


Figure 3.6. Electricity sector reforms

(Source: Adapted from Eberhard, 2016)

iii) Market design structure

A competitive electricity market in the Southern African region was envisioned by the SAPP from its inception in 1995 (Theron, 2012). Until June 2016, regional competitive market structure was not defined and the SADC region did not have a regional electricity supply industry wholesale market design shown in Figure 3.7 that was approved by the SADC Ministers responsible for Energy in Gaborone, Botswana (Deloitte, 2016). RERA was very

instrumental in mobilising support from the development partners³ to develop the regional market model and implementation framework. The implementation of the market model is not intended to be a revolutionary but evolutionary approach involving about six stages over a period up to 2026. Currently, the private sector participants, as IPPs, are allowed to participate in the regional electricity trading market operated by the SAPP (Beta, 2016). Once operational, SACREEE will be expected to undertake regional RE initiatives that would catalyse the electricity generation from RE resources on a scale that would allow for cross border electricity trading.

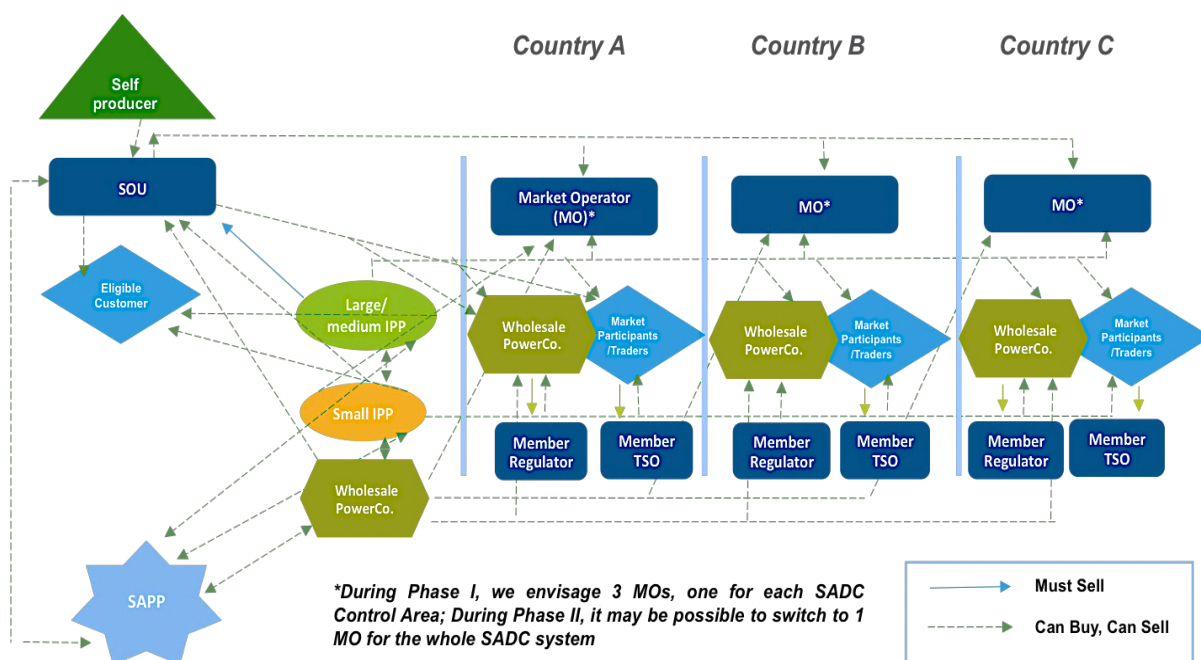


Figure 3.7. Wholesale electricity market model for the SADC region

(Source: Deloitte, 2016)

Although the regional market is now in place and part of which is operating competitively through the SAPP, Kugel (2009) argues that the legal and regulatory environment in the region is not presently geared towards facilitating cross-border electricity trade. All of the SADC MS have introduced some form of power sector reforms since the 1990s as shown in

³ The Market and Investment Framework for SADC Power Projects (M&I Framework) was funded by the U.S. Department of State, Bureau of Energy Resources, Power Sector Program but does not necessarily reflect the views of the United States Government.

Figure 3.6 but most of the reforms have not been successfully completed. The SOUs remain very dominant market players and serve as ‘Single Buyers’ in the market with IPPs contracted to them. While a dominant SOU can play a useful role in aggregating demand and entering into long-term contracts with new private sector investors, Eberhard and Shkaratan (2012) also argue that there are few advantages in assigning it rights to exclusively do power trading in-country and across the borders, a situation that obtains in most of the SADC MS. It is hardly surprising that only one IPP from Zambia (Lunsemfya Hydropower Company, LHC) is currently a member of the SAPP (Chikova, 2017).

Under a liberalised or unbundled power market structure coupled with non-discriminatory grid access and enabling licensing framework, IPPs could be able to enter into willing seller–buyer arrangements with customers within their countries of business operation and across the national borders (Kugel, 2009; Eberhard & Shkaratan, 2012). IPPs could also trade on the SAPP competitive market, as is currently the case with LHC from Zambia. However, reality in most of the SADC MS is that the power systems are too small for fully liberalised or unbundled power market structures and therefore, Eberhard and Shkaratan (2012) observe that hybrid power markets shown in Figure 3.7 are the most common power industry structure in Africa with SOUs still retaining their dominance but also allow for the private sector participation as IPPs. It is also in line with the long-term of the SAPP vision to give the end user a choice of electricity supply (SAPP, 2016).

iv) Political commitment to and rules for the RE development

Some regional aspirations for the RE related developments in Southern Africa are covered in legal instruments such as the Protocol on Energy and memoranda of understandings, and a number of approved frameworks and action plan and strategy documents. It is evident, however, that the pace of realisation of most of the regional RE development aspirations has been at very slow rates resulting in insignificant share of RE in the energy mixes at both national and regional levels. With the approval of the establishment of SACREEE and the implementation of the REEESAP, some level of political commitment towards RE development has been demonstrated. There is also political commitment to involve other stakeholders in RE development though the mechanisms of doing so are not elaborate, consistent and definitive. Despite the positive developments, the inertia to operationalise SACREEE through the signing and ratification of the IGMOA by two-thirds of the SADC MS is clear sign of lack of resolute political will and commitment. RERA, which is in the process of being transformed into a Regional Regulatory Authority, could also suffer the same fate as SACREEE in its transformation process. Without political will and commitments, the

independence of regulators to administer full cost recovery electricity tariffs and prices would also be in jeopardy.

Undoubtedly, the current levels of political will and commitment towards RE development are inadequate and characterised more by rhetoric than pragmatism. Unlike the EU with its legislated 2020 package, SADC has no regional RE targets and enforceable rules for intervention in RE development at regional level. Unless there is clear and demonstrable political will and commitment coupled with some binding legislative requirements, it is highly unlikely that Southern Africa would scale up RE development into the foreseeable future. The influences of politics and political factors are paramount and cannot be over-emphasised since they transcend all the facets of human endeavours and spheres of development.

v) Policies and programmes for RE development

Specific regional RE related policies are not in place but the approved REEESAP contains various regional RE initiatives that would have profound impacts on the RE development, if implemented. While RERA and the SAPP have their own regional RE initiatives, a number of others arise from approved REEESAP, which SACREEE will champion in terms of its implementation. The SAPP Pool Plan that is in the process of being revised would be expected to play a pivotal role in scaling up regional RE development in the next two decades. The DPs, as lenders and the private sector, as IPPs, also have diverse interests in RE programme and projects. While RE policies at regional level are lacking, Southern Africa is not short of RE programmes and projects. Going forward, it is important for Southern Africa to develop the enabling regional RE policies and ensure that there is political will and commitment to implement the enunciated regional RE programmes and projects.

vi) Financial resources and controls

At regional level, there is lack of a dedicated budgetary provision of financial resources for RE development. SADC and its subsidiary organisations are unable to generate sufficient income from the general membership to support dedicated RE staff complements and implement the RE programmes and projects. Hence the implementation of regional RE programmes and projects by SADC and its subsidiary organisations is heavily dependent on international cooperating partners (ICPs). Other than for the general public and consumer organisations, financial resources are not a deterrent to the private sector and DPs provided there are bankable projects to finance for implementation. For sustainability of and commitment to its regional initiatives, it is of absolute necessity that SADC and its subsidiary

organisation devise funding mechanisms to support the implementation of programmes and projects. Internal controls on the use of own and ICP funds are robust and subject to annual external audits.

3.4.2 Functions

Functionally, it is imperative to assess the available resources that should form part of the development plans for harnessing tradable renewable energy electricity on a credible and independent regional electricity market.

i) RE resource assessment

Energy resources are important in the context of any energy system because they are an integral part of a relatively simplified structure comprising three segregated branches, namely, resources, conversion processes and demand (Connolly, Lund & Mathiesen, 2016). From the perspective of harnessing renewable resources, Izadyar *et al.* (2016) argue that resource assessment is essential in developing any renewable energy system because it brings to the fore the energy that could potentially be generated from the available renewable energy resources through appropriate conversion processes and under given constraints. The constraints could manifest in form of natural and climatic limiting factors, geographical limitations, technical limitations, techno-economically unviable, economically uncompetitive and market barriers (Painuly, 2001; Izadyar *et al.*, 2016). Salehin *et al.* (2016) argue that optimisation of the various factors imposing limitations on energy scenario analysis could be beneficial to the policy makers and researchers in assessing the renewable energy systems. Cognisant of the constraints, an important consideration in deciding on the appropriateness of the renewable energy resource to use in a renewable energy system has been a subject numerous research studies (Özkale *et al.*, 2017).

A variety of global renewable energy mappings are also in existence or in the process of being developed that provide indicative information on the various types of available renewable energy resources for utilisation (IRENA, 2014; ESMAP, 2017; NREL, 2017; GENI, 2017). Martinot (2016) acknowledges that IRENA and other organisations provide region-wide pre-feasibility assessments of various types of renewable energy that could serve as an important precursor to making investment decisions. For instance, the Global Atlas for Renewable Energy (2016 – Global Atlas) developed by IRENA and its partners have been extensively used in the producing the Renewable Readiness Assessments (RRAs) for a number of SADC MS for their renewable energy resources in general or specific types of renewable energy resources such as wind, solar and hydro (IRENA, 2017). It has also been

used in developing the Renewable Energy Zones for the Africa Clean Energy Corridor (ACEC) that are cost-effective for the development of wind, solar photovoltaic and concentrating solar power in the countries of the Eastern and Southern African Power Pools (Wu *et al.*, 2015; Wu, 2017).

It is evident that there are numerous renewable energy resource assessments, as cited and irrespective of the methodology applied, that provide informative perspectives on the resource potential in Southern Africa (Hermann, Miketa & Fichaux, 2014; Stiles & Murove, 2015). For instance, an assessment of the geographical potential of concentrated solar power (CSP), solar photovoltaic (PV) and wind solar by Hermann *et al.* (2014) show that Southern Africa is well endowed with such sources of renewable energy as presented in Table 3.3. SADC (2012) also shows in Table 3.4 that only negligible amounts of the technical potential of the renewable energy resources are utilised for power generation. The geographic potential considers available land areas that are suitable and can be utilised for renewable energy deployment, and is often perceived as an immediate assessment towards determining the technical potential that takes in account the conversion losses and other technological, structural, ecological, and legislative restrictions and requirements (Hermann *et al.*, 2014).

Table 3.3. Geographical potential for RE for power generation in Southern Africa

Total Area (km ²)	CSP (TWh/year)	PV (TWh/year)	Wind (TWh/year)			
			Overall	All areas with wind turbine CF greater than 20%	All areas with wind turbine CF greater than 30%	All areas with wind turbine CF greater than 40%
6 555 480	149 610	162 817	108 235	108 235	10.011	1.707

(Source: Adapted from Hermann *et al.*, 2014)

Table 3.4. Technical potential for RE for power generation in Southern Africa

Technology	Potential (TWh/year)	Present Utilisation (TWh/year)
Hydro	660	~ 50
Wind	800	Negligible
Bioenergy	>11 000	~10
Geothermal	20-25	Negligible
Solar	>20 000	Negligible

(Source: Yamba *et al.*, 2012)

Building on the work of IRENA on renewable energy resource assessments and the RRAs, and what has been done in the North African countries, SADC could develop and disseminate an assessment framework to determine SADC MS readiness for deployment of renewable energy technologies (Hawila *et al.*, 2014). Mourmouris and Potolias (2013) also advocate for an evaluation and/or decision-making framework that supports rational energy planning and exploitation of renewable energy sources at a regional level taking into account the complexity of socio-economic and environmental issues. SACREEE is expected to spearhead the development and application of the requisite renewable energy frameworks as part of its planned regional initiatives, once fully operational. It is also expected that the subsequently revision of the regional SAPP Pool Plan would go beyond large hydro as a potential renewable energy source for future electricity generation and utilise multi criteria planning approaches in addition to the traditional least-cost planning methodology (Oree, Hassen & Fleming, 2017). Undoubtedly, renewable energy resource assessments including the exploitation maps, some of which are at the disposal of the SADC region from many sources such as IRENA, are part of the prerequisite steps of decision analysis for regional energy planning (Mourmouris & Potolias, 2013; Hermann *et al.*, 2014).

ii) Regional Planning

With the current available assessments and maps indicating that the SADC region is well endowed with renewable energy resources, planning is important not only in developing optimal regional energy mix but also transitioning to a sustainable regional electricity generation future (Sithole, 2016; Oree, Hassen & Fleming, 2017). The SADC region is not short of its driven energy and other infrastructural plans indicated in Figure 3.2. The development of the regional electricity generation mixes in all the plans was heavily influenced by the SAPP Pool Plan that was initially developed in 2001 and subsequently revised in 2009 and currently under further revision (2017). In addition, there are other plans

prepared by international organisations that allude to Southern Africa either as separate region or as part of the sub-Saharan Africa, the most recent and notable report by Miketa and Merven (2013) on planning and prospects for renewable energy in the SAPP.

The processes of developing the plans for the SADC region, particularly the SAPP Pool Plan and the IRENA report, are not without some notable observations and implications. It is worth pointing out that the SADC region does not have an adopted regional wide integrated planning framework that supports rational electricity planning including the exploitation of renewable energy sources at a regional level taking into account the complexity of socio-economic and environmental issues. It is also quite obvious that the SAPP, through its consultants, uses some form of a planning framework, model or criteria for the development of the Pool Plan. However, whatever planning tools being used by the SAPP, they remain a preserve of its Member Utilities only and are tantamount to being 'black boxes' to rest of the stakeholders. In other words, it is only the SAPP Members and Pool Plan consultants who have the knowledge of what informs the development of the Pool Plan and are best placed to interrogate its outputs.

The IRENA report examining the 'renewable scenario' uses a modelling tool developed by IRENA and tested in cooperation with the South African National Energy Development Institute (SANEDI) and the Southern African Development Community (SADC) called the System Planning and Test (SPLAT) Model (Miketa & Merven, 2013). Unlike the SAPP Plan, the SPLAT model and its sources of data are readily though the Model is not very user friendly unless well trained to use it. The SAPP and its Member Utilities have been exposed to SPLAT but it is not evident that this Model is being utilised by the utilities in the planning processes. Be that as it may, the planning tools used in the SAPP Pool Plan and the IRENA report could serve as a good basis to consider in developing a planning framework or model for the SADC region.

Notwithstanding the highlighted challenges with the planning tools, both the SAPP Pool Plan and IRENA report provide indicative renewable electricity targets for the SADC region. The planning of the SAPP from the perspective of renewable electricity generation is heavily inclined towards large hydropower in line with its founding documents (SADC, 2006; SAPP, 2007). Inevitably, the renewable targets indicated the SADC infrastructural plans such as the RIDMP are essentially a summation of the proportions of all the hydropower capacities intended for development by its MS. According to the RIDMP, SADC is targeting the renewable energy mix in the grid of 33% and 39% in 2020 and 2030, respectively (Zhou, 2012). Unfortunately, the recently adopted SADC Renewable Energy and Energy Efficiency

Strategy and Action Plan (REEESAP) missed the opportunity to develop ambitious but realistic targets by maintaining the current targets while waiting for the review of the SAPP Pool Plan (SADC, 2016a). Under the IRENA Renewable Promotion Scenario, the share of renewable in the total generation capacity would increase from 20% in 2010 to 62% in 2030 provided the transmission capacity constraints are also addressed (Miketa & Merven, 2013).

It is evident from the targets that the RIDMP target is less ambitious in that almost 100% increase in the share of renewable is anticipated by 2030 whereas the IRENA Scenario projects an ambitious 200% increase. In the case of the RIDMP target, it is not a mandatory for the SADC region and also difficult to gauge with a good level of certainty whether it would be achieved given the different planning horizons by the SADC MS and the challenges in project preparation including bankability. The target under the IRENA Scenario is only indicative and more encompassing by including hydro as well as other renewables such as solar (PV and thermal), wind and biomass. Although the IRENA target is indicative, specific initiatives such as the ACEC and RE Zones are intended to contribute to increasing the share of renewables in the regional energy supply mix (Ndhlukula, Radojicic & Mangwengwende, 2015; Wu *et al.*, 2015; Wu, 2017). By 2030, IRENA envisages regional electricity trade flows using a regional trading platform as shown in Figure 3.8.

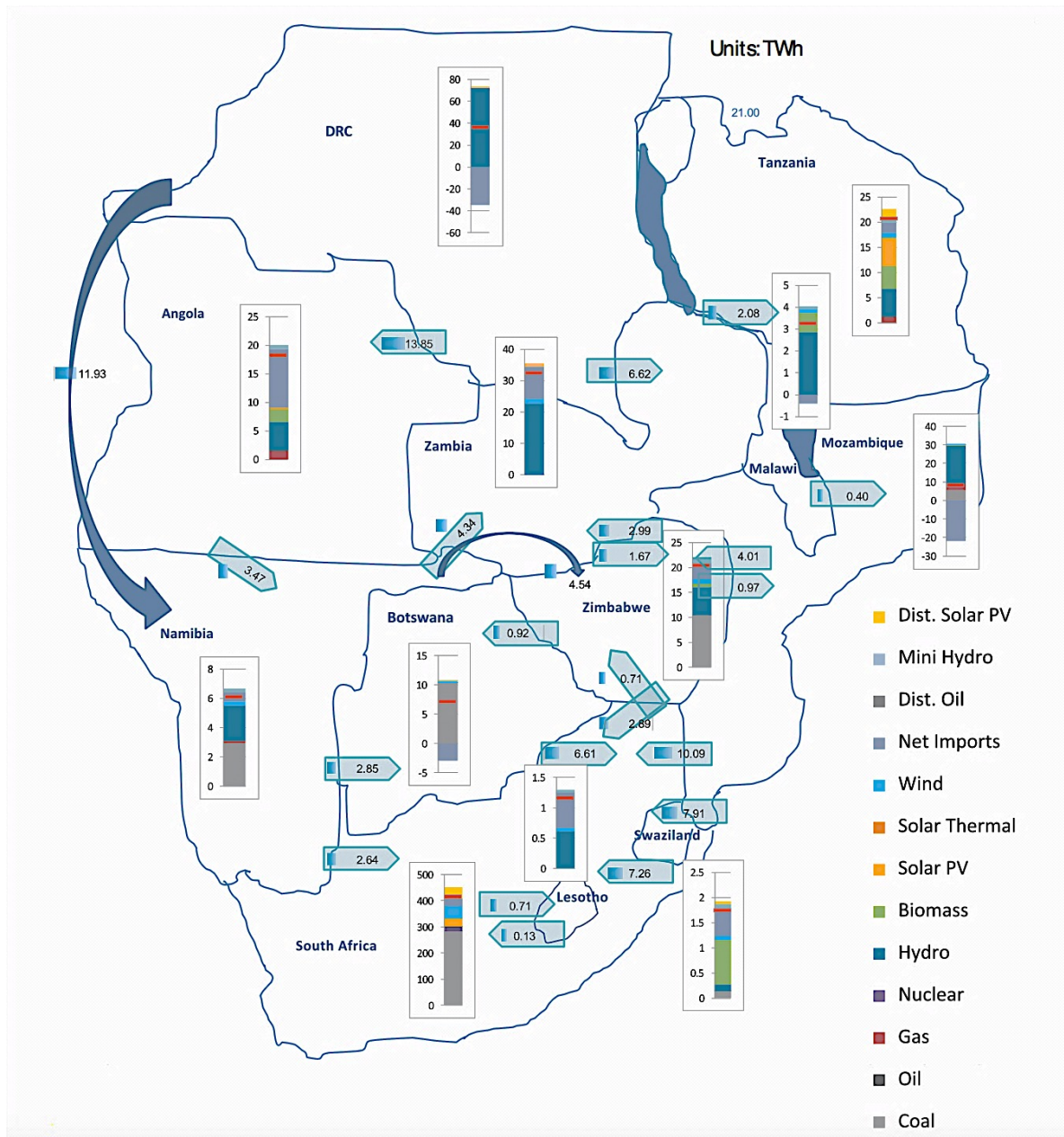


Figure 3.8. Regional trade under the IRENA renewable promotion scenario by 2030

(Source: Miketa & Merven, 2013)

iii) Regional market trading platform

Prior to the development of the regional electricity-trading platform by the SAPP, electricity trading was done through contracts between bilateral parties under mutually agreed arrangements (Beta, 2016). Such trading arrangements in the SADC region pre-date the establishment of the SAPP and started as far back as the 1950s when the Democratic

Republic of Congo (DRC) and Zambia got interconnected followed by the interconnection between Zambia and Zimbabwe in 1960s, and the Mozambique and South Africa in the 1970s (Theron, 2012). Bilateral trading arrangements still retain the largest market with about 85% though the volumes traded on the competitive market have considerably increased since 2014 (Chikova, 2017).

The SAPP Competitive Market has remarkably developed and evolved from the Short-Term Energy Market (STEM) that started in 2001 to the latest inclusion of the Intra-Day Market (IDM) and the Forward Physical Markets (week ahead and month ahead) in 2016 (Beta, 2016). Figure 3.9 shows the milestones for the evolution of all the different types of markets that are under the SAPP Competitive Market. According to Beta (2016), the SAPP plans to introduce other types of markets, namely, the Balancing Market (2018) and the Financial Markets (2019). As shown in Figure 3.10, the different markets are intended to complement as opposed to competing with each other given the different purposes for which they serve.

Beta (2016) outlines the objectives of the SAPP trading portfolios and in so doing demonstrates the complementarity of the roles of the different markets. Bilateral trading serves the main purpose of not only meeting long-term demand and supply balance but also underpinning investments in generation and transmission infrastructure mainly through power purchase agreements (PPAs). The short-term demand and supply balance is served by the Forward Physical Markets (Weekly and Monthly). With regard to the Day Ahead Market (DAM) and the Intra Day Market (IDM), the objectives of these two markets are to optimise supply and demand portfolios in the quest to minimise cost of supply and thereby maximising the profitability of the market participants. They also play important roles in supporting the managements of load and generation fluctuations.

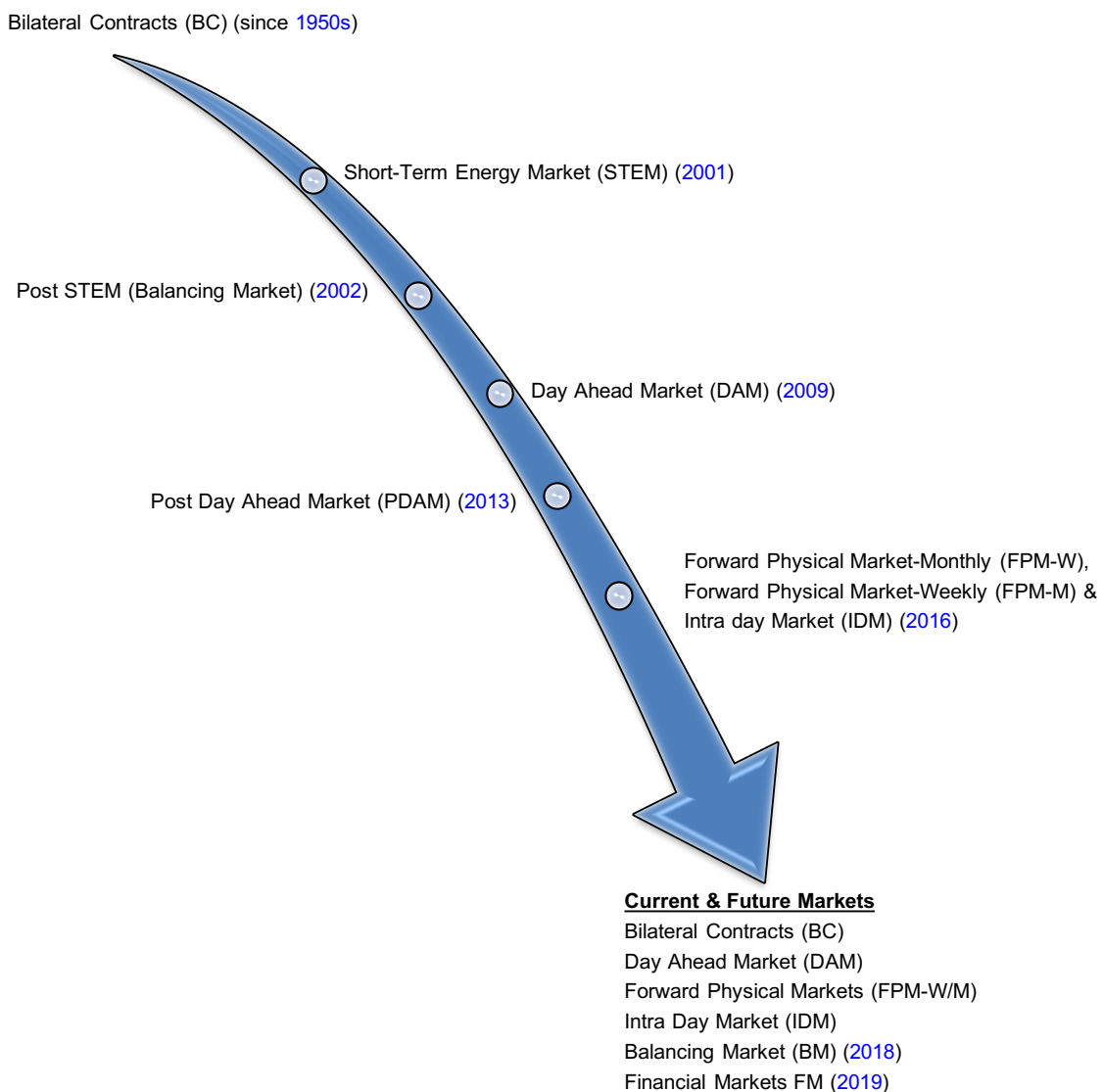


Figure 3.9. Evolution of the SAPP Competitive Market

(Adapted from Beta, 2016)

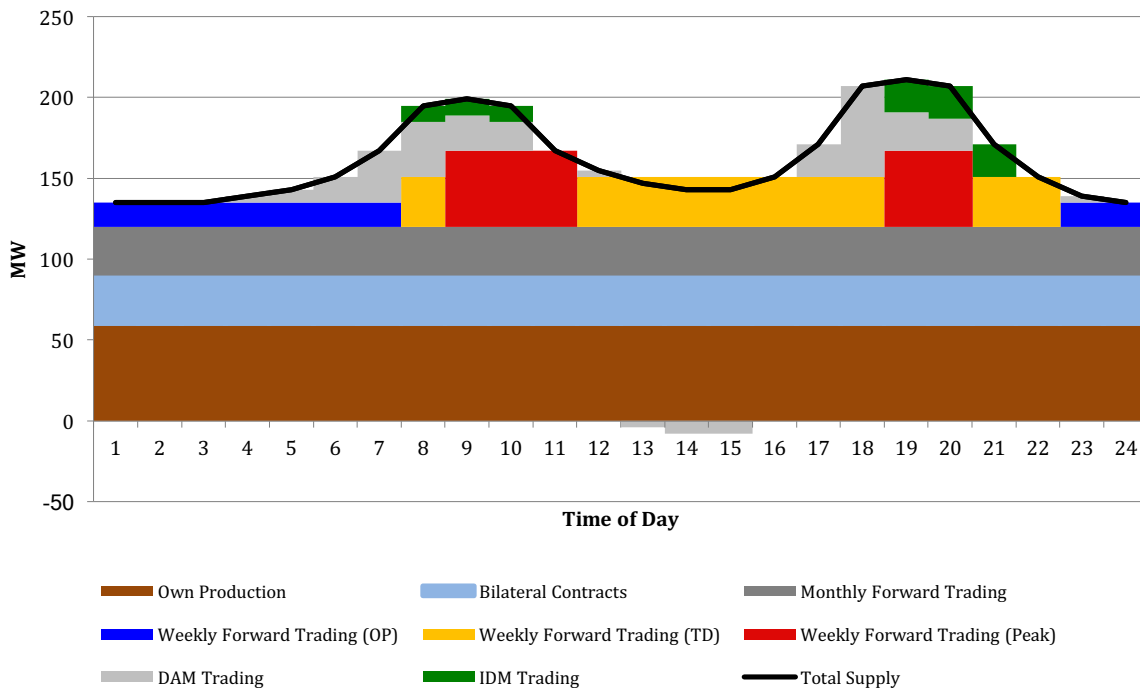


Figure 3.10. Roles of the different SAPP markets

(Adapted from Beta, 2016)

Worth noting is the fact that the SAPP has its own tailor-designed and secure 'Market Trading Platform (MTP)', which started being developed in 2014 and went live on 01 April 2015 commencing its operations or functionality with the Day Ahead Market (DAM) (Beta, 2016). The Forward Physical Market - Monthly (FPM-M) and Forward Physical Market – Weekly (FPM-W) were commissioned in August 2015 went into live operation on 01 April 2016. As regards the Intra Day Market, it was commissioned in October 2015 and became operational on 01 March 2016. The MTP also incorporates 'energy imbalance calculations' and 'bilateral wheeling and losses settlements' that were commissioned in January 2016 commenced operation on 01 April 2016.

The MTP is the first of its kind on the African Continent and moreover, the SAPP is currently the only Power Pool out of the five (5) continental Power Pools with a functional regional competitive electricity trading market. The sellers and the buyers submit their bids (volumes and prices) electronically via the Internet and the MTP automatically matches them as well as determines the 'Market Clearing Price (MCP)' for the various types of markets. The SAPP is also looking into a possibility of using secure 'Cloud' live applications for its market operations.

According to Chikova (2017), the average share of the SAPP Competitive Market was 11% in the period from April 2016 to March 2017. Shown in Figure 3.11 are the shares of the cumulative traded volumes during the period from April 2016 to January 2017. During the same period, a total of 2,779,223 MWh was matched but only 1,023,056 MWh was actually traded due to transmission constraints. This implies that about 66% of the matched volume could not be traded because of transmission infrastructure bottlenecks on the regional transmission network as shown in Figures 3.12 and 3.13 (Hajduka, 2017; Chikova, 2017).

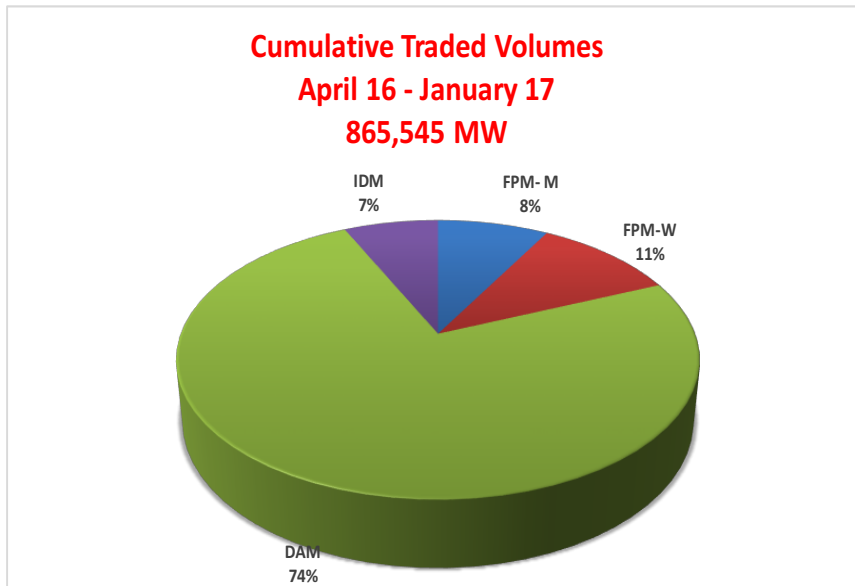


Figure 3.11. Share of cumulative traded volumes – April 2016 to January 2017

(Source: Chikova, 2017)

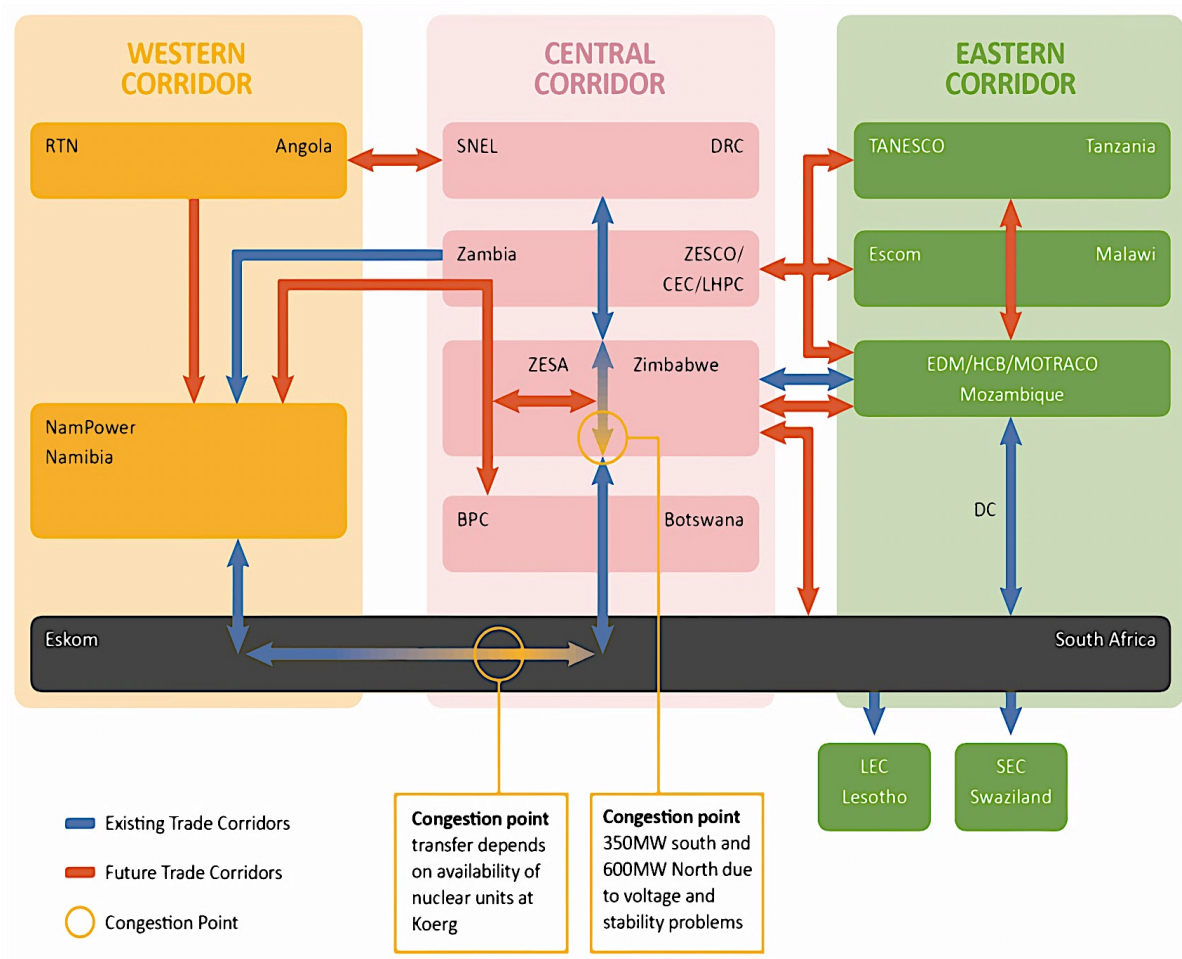


Figure 3.12. Existing and future regional transmission corridors

(Source: Hajduka, 2017)

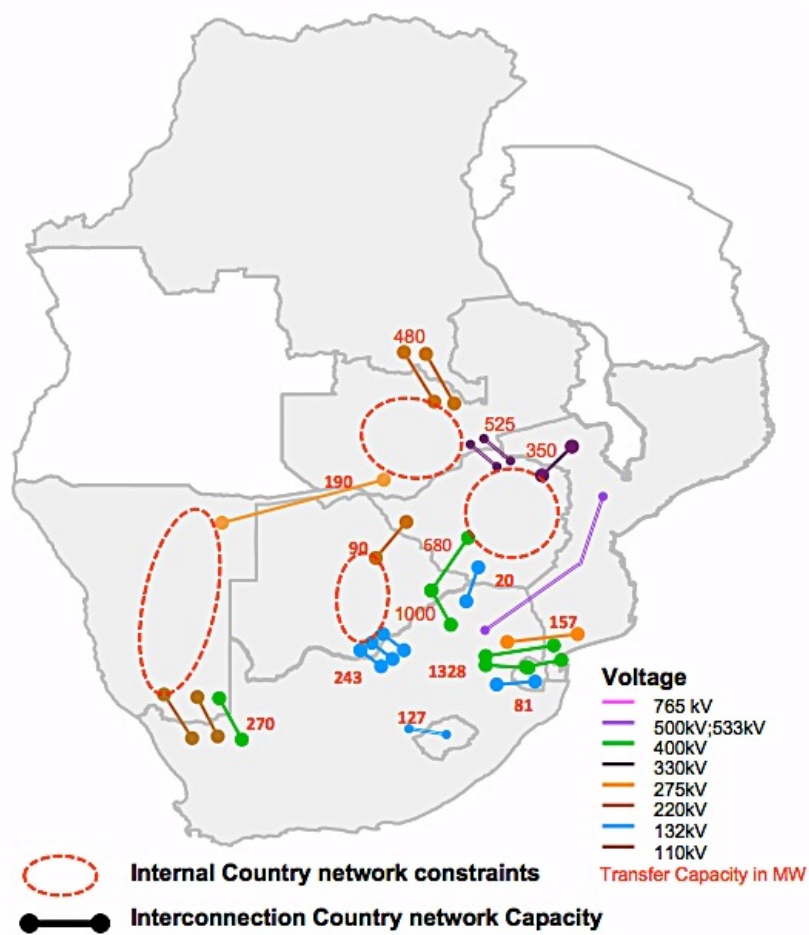
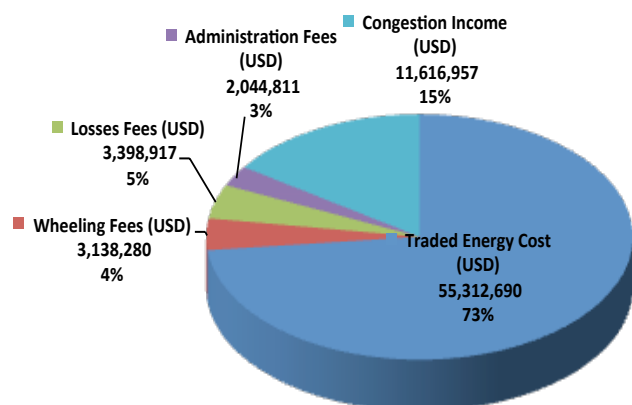


Figure 3.13. Regional transmission network capacity and constraints

(Source: Chikova, 2017)

Despite the transmission constraints, the SAPP Competitive Market recorded a total revenue of US\$75.5 million from April 2016 to March 2017 and shares for the various revenue streams are shown in Figure 3.14 (Chikova, 2017). The ranges of the market clearing prices (MCP) during the off-peak, standard and peak periods were 3-6 US\$/kWh, 4-10 US\$/kWh and 10-14 US\$/kWh. The recent winning tariffs/prices from the auctions in sub-Saharan Africa in Table 3.5 clearly show that electricity generated from renewable energy would be quite competitive on the SAPP Competitive Market (Kruger, 2017). Predatory pricing could be a potential unruly behaviour in market in the absence of some overarching regulatory oversight and ability to sanction errant market participants (Oseni & Pollitt, 2016). Market oversight and ability to resolve disputes are also important to the market participants in order to avoid price collapse and exercise of market power (Ela *et al.*, 2014).



Revenues on the Competitive Market in 2016/17

(April 2016 to March 2017)

Figure 3.14. SAPP competitive market revenue turnover – April 2016 to January 2017

(Source: Chikova, 2017)

Table 3.5. Recent Renewable Energy Auctions in sub-Saharan Africa

	Uganda	Zambia	Ghana	Namibia	Malawi	Ethiopia
Year Announced	2014	2016	2016	2017	2017	2017
Auction Demand	4 x 5 MW Solar PV	2 x 50 MW Solar PV	1 x 20 MW Solar PV	1 x 37 MW Solar PV	Max 80 MW Solar PV (4x sites)	1 x 100 MW Solar PV
Site Selection	Developer (3km - grid)	Selected by govt.	Developer (multiple)	Selected by govt./ utility	Substations identified by govt.	Selected by govt.
Local Content	None	None	20%	None but 30% local shareholding	5% devt & construction. 20% O&M	15%
Evaluation	70:30 Price: Technical	Price	Not clear	70:30 Price: Technical	Price	70:30 Price: Technical
PPA	20 Years	25 Years	20 Years	20 Years	25 Years	20 Years
Guarantees	Sovereign & Liquidity	Sovereign & Liquidity	Sovereign & Liquidity	None	Sovereign & Liquidity	Sovereign (?)
Winning Price (US\$/kWh)	16,37	6,02	11,47	6,02	7,35 - 10,35 (TBC)	Below US\$6 (TBC)
Currency	US\$	US\$	US\$	NA\$	US\$	US\$
Financial Close	Yes	No	No	No	No	No

(Source: Adapted from Kruger, 2017)

iv) Market oversight and dispute resolution

Oseni and Pollitt (2016) argue that effective integrated power markets or pools need oversight and the ability to sanction unruly behaviour from the market participants. In most competitive and international power markets, the oversight function is performed mainly through pro-competitive market surveillance mechanisms that are institutionalised and independent for purposes of monitoring the markets (Bigerna, Bollino & Polinori, 2014; Brown & Olmstead; 2015). With the integration and impact of variable renewable energy generation such as wind and photovoltaic, market surveillance is of interest to the consumers, suppliers, risk managers, traders and regulators from the perspective of assessing the market risks related to the price distributions on the different markets, especially the DAM and IDM (Hagfors *et al.*, 2016).

Unlike the Nord Pool Market that established its market surveillance in 2001 after fully integrating the markets of four countries⁴ in 2000, the SAPP Competitive Market commenced its operations with success without any institutionalised market regulatory oversight and surveillance in place (Oseni & Pollitt, 2016). This, notwithstanding, the SAPP (2017) had recognised the market surveillance was key in a competitive electricity market and made a decision in 2008 to commence the commercial operations of the DAM once the necessary market surveillance systems were in place and in particular the following:

- establishment of the Markets Sub Committee (MSC); and
- appointment of the Markets Monitoring & Surveillance Team (MMST).

According to the SAPP (2017), the envisaged market surveillance is supposed to ensure good market behaviour and operation through:

- Good market practices that is based on fairness, accuracy/correctness, equal treatment of all players, adherence to market rules, enforcement of penalties for defaulters, transparency and confidentiality;
- Data collection and analysis;
- Strategies to minimise/prevent market abuse; and
- Good reporting structures (information flow, analysis, transfer and sharing).

⁴ 1991: Norwegian market deregulated. 1993: Nord Pool established by Norwegian TSO. 1996: Sweden joins. 1998: Finland joins. 2000: fully integrated as Denmark joins

With access to the database of the Market Operator, the following three main reports are anticipated from the SAPP market surveillance activities:

- evaluation of the market pricing;
- evaluation of the individual participants' behaviour; and
- status/trend analysis in the development of fundamental figures with potential influence on pricing.

Whereas, the MSC has already been established as part of the operational structures of the SAPP and developed key governance documents⁵ for the operations of the SAPP Competitive Market, the MMST was never appointed. However, the SAPP approved its market surveillance structure in March 2017 as shown in Figure 3.15 and developed elaborate terms of reference (TOR) for the MMST. For ease of access to information, the market monitoring and surveillance (MMS) function will be located at the SAPP Coordination Centre in Harare, Zimbabwe, which hosts the power exchange but will be operating independently from the market operator and other market participants. The envisaged independence of the MMS function will be largely dependent on the design of the enabling operational, financial and governance frameworks and the extent to which they would be adhered to. As regards the recruitment of the MMST, it would be phased in and the required initial support from an experienced external expert to build the capacity of the MMS function would also be mobilised. Once fully operational, MMST will be expected to perform sanctions for and on behalf of the SAPP Management Committee (MANCO) (Molubi, 2017).

⁵ SAPP Market Guidelines, SAPP Market Book of Rules and SAPP Market Participation Agreement

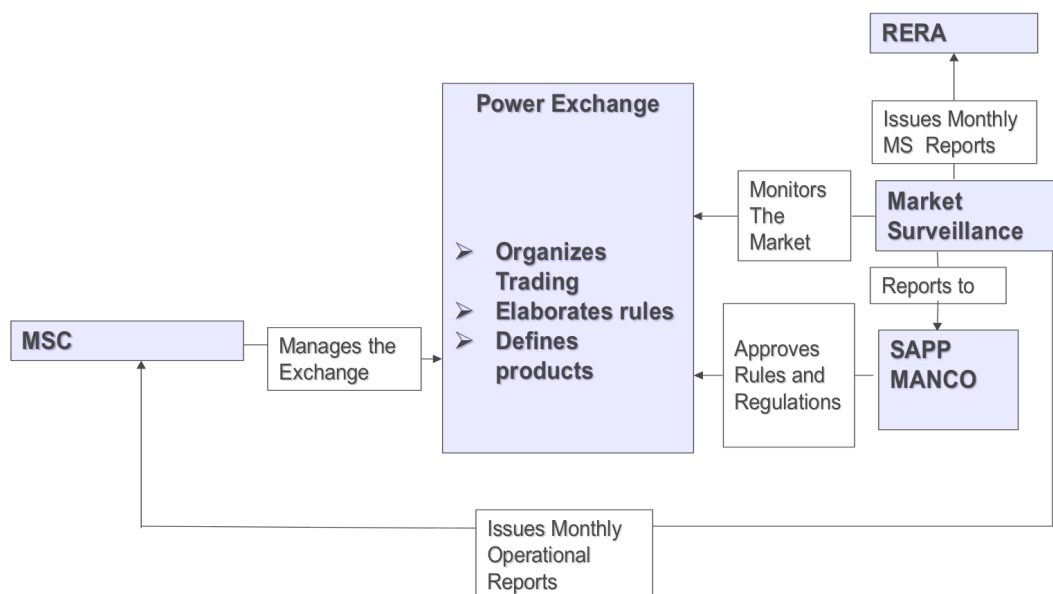


Figure 3.15. SAPP competitive market monitoring and surveillance structure

(Source: Chikova, 2017)

In terms of dispute resolution, the SAPP is currently a self-regulated market with an elaborate but untested dispute resolution mechanism outlined under Article 20 of the Inter-Utility Memorandum of Understanding (IUMOU) (SAPP, 2007). This mechanism involves the use of mediation and arbitration processes depending on the nature of the dispute referred to the SAPP Coordination Centre (CC). If the nature of the dispute were at the level of the SADC MS, the SADC Tribunal would be expected to play its part. As already indicated, the SADC Tribunal was suspended and reconstituted but not yet ratified by the two-thirds majority of the SADC MS to commence its operations. This raises pertinent questions on the availability and adequacy of regional administrative and operational structures to execute their mandates professionally, objectively and timely.

3.4.3 Administrative and operational structures

Administrative mechanisms and structures are critical in the development of successful integrative processes and have been used in other sectors such as environment, particularly in the Environmental Policy Integration (EPI), as a basis to evaluate whether the relevant ones are in existence or not (Adelle & Russel, 2013). The SADC region, like the European Administrative Space (EAS), involves a number of regional organisations operating independently as its subsidiary entities (SAPP, RERA and SACREEE) but also striving for some level of integration of administrative capacity to promotion regional integration in the

various sectors including energy (Trondal & Peters, 2013). This Section delves in the existing administrative structures in the SADC region, their capacities, decision-making rules and performance attributes such as efficiency, predictability and accountability.

i) Structures/sections for RE development

Other than the yet to be fully operational SACREEE established as a dedicated regional entity for renewable energy development, the rest of the regional structures such as the SADC Secretariat, SAPP and RERA do not have specific sections with their organisational arrangements dealing with renewable energy development despite the different levels of renewable energy related mandates. However, the Environment Section under the SAPP deals with renewable energy related matters on an ad-hoc basis while RERA secured interim support from the International Renewable Energy Agency (IRENA) for a position of Renewable Energy External Expert (REEEx) for the same for a period of 2 years ending in 2018. The situation is different at SADC MS level in that most of the countries have organisations with dedicated renewable energy sections with varying degrees of mandates.

ii) Capacity of RE structures/sections

Although SACREEE is yet to be fully operational, it has some limited capacity to promote the development of renewable energy in the region using staff either supported or seconded by the United National Industrial Development Organisation (UNIDO) and the Government of the Republic of Namibia, being its host country. SACREEE's current staff complement relative to its mandate and planned regional initiatives under the SADC Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) are far from being adequate. With no dedicated renewable energy staff at the SADC Secretariat, the ad-hoc arrangements under the SAPP using its Environment Section and the interim IRENA supported mobilised by RERA, these SADC structures are highly capacity constrained. Renewable energy capacity constraints are also prevalent in most of the SADC MS given the challenges of staff retention.

iii) Operational and decision-making rules

The SADC Secretariat has some frameworks, guidelines, strategies and plans that allude to renewable energy in documents such as the Protocol on Energy of 1996 and the REEESAP approved in July 2017, and have a bearing on renewable energy operational and decision-making in the region. The Protocol on Energy is a high-level document while the REEESAP is fairly detailed and allocates specific responsibilities and time-bound initiatives to the SADC

Secretariat, the SAPP, RERA and SACREEE. As a dedicated SADC structure responsible for promoting the development of renewable energy and energy efficiency, SACREEE is tasked with spearheading and coordinating the implementation of the REEESAP. In the case of RERA, it has some general regulatory related documents dealing with cross border power trading, supportive framework conditions for mini-grids employing renewable and hybrid generation in the SADC Region, and the regional market development under the M&I Framework.

According to Beta (2016), the SAPP has the following governing documents and rules concerning regional electricity trading on a bilateral and competitive market basis:

1. Agreement between Operating Members⁶;
2. Operating Guidelines;
3. Market Guidelines and Rules;
4. Transmission capacity allocation and wheeling pricing;
5. Handling of energy imbalances; and
6. Handling of outages, non-delivery and system emergency situations.

It is quite apparent that most of the rules are in numerous documents, some of which have been formally adopted by the SADC Ministers responsible for energy and others are independently championed on a regional basis by the individual organisations such as the SAPP. Furthermore, most of the rules, from an operational perspective, are applicable to dispatchable and not non-dispatchable power generation plants. Deloitte (2015) refers to dispatchable generation as sources of electricity that can be dispatched at the request of power grid operators; that is, generating plants that can be turned on or off, or can adjust their power output on demand in time intervals of anywhere between a few seconds and 2-3 hours. In contrast, non-dispatchable refers power sources cannot be relied upon to meet demand in a short amount of time and includes all nuclear power plants, most coal power plants, run-of-river hydroelectric plants, and intermittent energy sources such as wind, solar photovoltaics and wave energy. From an operation perspective of grid connected independent power producers (IPPs), Deloitte (2015) recommends the development of

⁶ Operating Members are those utilities that are interconnected to regional electricity grid and able to trade bilaterally and/or on the SAPP Competitive Market.

model contracts, codes and regulations are divided up into dispatchable and non-dispatchable technologies as shown in Figure 3.16.

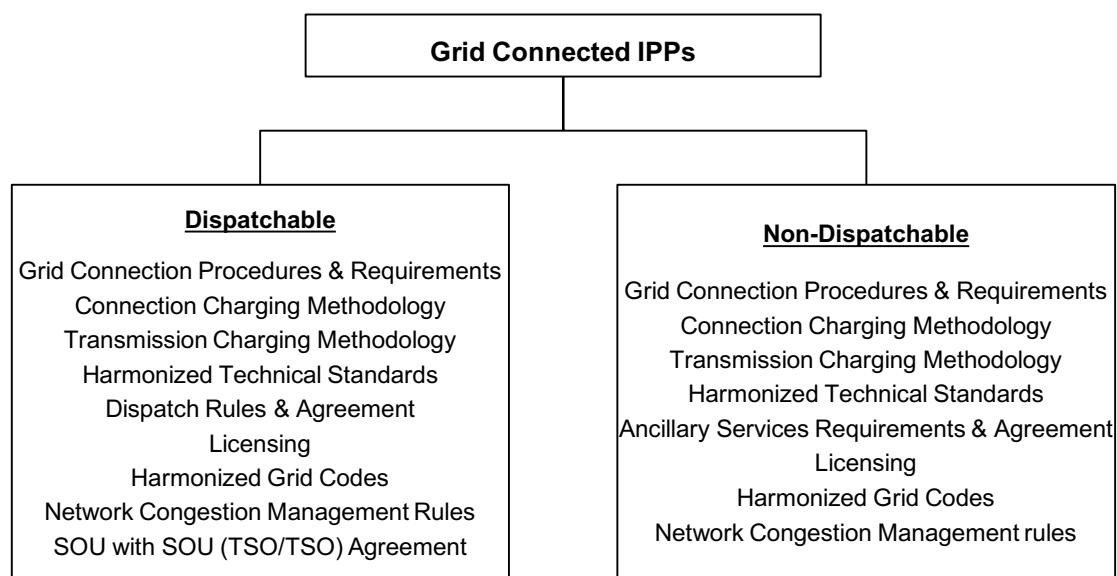


Figure 3.16. Operating framework for grid connected IPPs

(Adapted from Deloitte, 2015)

iv) Performance attributes

The efficiency, predictability and accountability of the SADC structures are relatively low and have lots of scope for improvement. As indicated, most of them have no dedicated renewable energy sections and are also under capacitated. SACREEE, which was approved in 2015 as a dedicated structure to promote the development of renewable energy, is not fully functional in view of the delays in concluding and signing the IGMOA. The low share of renewable energy excluding large hydropower in the region's electricity supply mix, inability of most SADC MS to meet their peak demand despite the abundant renewable energy resources, and the long lead time (bureaucratic delays) to conclude and sign the IGMOA on SACREEE is a clear manifestation of the poor performance attributes of the SADC structures collectively. Compounding the poor performance attributes are challenges associated with processes and mechanisms for consulting and engaging with the stakeholders (Martin & Rice, 2015).

3.4.4 Processes and mechanisms

The processes and mechanisms pertain to stakeholder consultations, engagements, negotiations, mediation and bargaining in developing renewable energy projects. Research studies have shown that 360° deep engagement with stakeholders and getting their inputs can be beneficial in reducing the approval timeframes and associated costs for the renewable energy projects (Martin & Rice, 2015). SADC structures such as the SADC Secretariat and the SAPP have no elaborate public consultation and engagement processes and mechanisms. Martin and Rice (2015) state that “*inefficient multi-layered government hierarchies, convoluted approvals processes, local activism and ‘Not in My Back Yard’ (NIMBY) movements, fossil fuel-centric electricity networks, and aggressive litigation can result in lengthy and costly delay of project approvals*”.

The processes and mechanisms for stakeholder engagement at a regional level remain challenge. Inasmuch as SADC seeks to involve all the regional stakeholders in its programmes and initiatives, there are no explicit frameworks, strategies and guidelines to do so. Most of the regional programmes and project initiatives are developed, discussed and approved without necessarily the active participation of all the relevant stakeholders or at levels that would be far from being considered as 360° deep engagement. Regional programmes and project initiatives are, by and large, a preserve of the public officials from the SADC MS and its subsidiary organisations (SAPP, RERA and SACREEE) that operate at arms-length (independently). As a case in point, the REEESAP was developed with some semblance of stakeholder consultations but those consultations were superficial in that the stakeholders were not engaged until the end of the process of validating and approving it.

Another example is the SAPP Pool Plan, a least cost or an optimised regional power generation plan, under review at a cost of more than US\$1 million and yet it was being reviewed without any agreed or approved regional planning framework and assumptions involving the relevant and affected regional stakeholders, and the review process was mainly confined to the SAPP Member Utilities (Chikova & Beta, 2017). The Draft Final Report on SAPP Pool Plan was delivered in August 2017 and final report expected at the end of October 2017. A Stakeholder Workshop comprising of representatives from the Ministries of Energy, Regulators, Utilities, International Cooperating Partners was planned in the 4th Quarter 2017 or the 1st Quarter 2018. Not even key stakeholders such as the SADC MS, SADC Secretariat, RERA and SACREEE have provided any inputs thus far or reviewed any preliminary Draft SAPP Pool Plan but have to wait until the end of the process of reviewing it.

The SAPP Pool Plan remains a 'black box' to most of the regional stakeholders and it is hardly surprising that the previous two Pool Plans have never been formally or officially adopted at regional level for implementation and SADC MS opt for implementation of their national plans that are necessarily least cost or optimised. Misgivings in the regional processes and mechanisms of consultations could compel the SADC MS to be inward looking with national interests overriding regional interests in the quest for ensuring national energy/electricity security. RERA and SACREEE have realised the importance of stakeholder engagements by developing communication strategies though they are not comprehensive to entrench 360° deep engagement attributes. The communication strategy for RERA is a general one while that of SACREEE is specific to the implementation of the REEESAP. Undoubtedly, the cultural beliefs and attitudes could have a part to play in not recognising and fully appreciating the importance of stakeholder consultations and engagements in developing and implementing regional programmes and project initiatives.

3.4.5 Culture and attitudes

The transition from a fossil dominated energy supply system to a more sustainable energy future involving the utilisation of renewable energy cannot be without challenges given the cultural dimensions of and attitude towards change of energy systems (Halder *et al.*, 2016; Urmee & Md, 2016). Positive attitudes play a cardinal role in scaling up the development of renewable energy using the various technologies to accomplish the desired energy and developmental policy goals and targets (Karlstrøm & Ryghaug, 2014). Cultural themes such as governance, motivation, and social values are also important to consider in changing the energy development paradigm given the common notion that some (energy) cultures are resistant to change or result in low uptake (Aune *et al.*, 2016; Urmee & Md, 2016; Shortall & Kharrazi, 2017). Shortall and Kharrazi (2017) argue that taking cognisance of and understanding culture can lead to better insights of what influences policy and strategies leading to the sustainable energy systems.

At SADC level, the culture and attitudes towards renewable energy is rhetorically good but not practically demonstrable in terms of implementation as evidenced by the small share of renewable electricity out of large hydropower since the Protocol on Energy came into effect in 1996. The Energy Division at the SADC Secretariat is highly capacity constrained with one officer dealing with all the energy sub-sectors and it has not been easy to focus on regional renewable energy development without external technical support from the international cooperating partners (ICPs). However, the recent development of the REEESAP and establishment of SACREEE are important and game changer developments that could give

added impetus to the regional renewable energy development and utilisation. RERA, like the SADC Secretariat, is culturally and attitude-wise committed to playing its role in promoting renewable energy but is also capacity constrained and dependent on the ICPs to undertake its renewable energy related regulatory initiatives. In the case of SACREEE, its culture and attitude towards regional renewable energy development is anticipated to be excellent, as mandated to champion and coordinate the implementation of the REESAP.

The SAPP and its Member Utilities are uniquely positioned to play a crucial role in regional development of renewable electricity and facilitate cross border power trading. However, one of the governing documents of the SAPP (IUMOU) appears to be a reflection of its attitude towards renewable energy in that it places more emphasis on hydropower and current regional electricity generation mix is a true reflection of a large share of large hydropower (SAPP, 2007; Chikova & Beta, 2017). An apparent shift was observed during the precarious electricity supply situation in most of the SADC MS with a good number of the SAPP Member Utilities embarking on renewable electricity projects using other renewable energy technologies such as solar photovoltaic, concentrated solar power (CSP) and wind to bridge the supply deficit.

With the easing in demand for electricity in some of the SADC MS due to a combination of factors such as economic downturns and additional generation capacity, the attitude of some of the SAPP Member Utilities have changed and they are no longer pursuing other renewable energy technologies with the same vigour exhibited during the period of tight power supply situation. It would appear that the pursuance of other renewable energy technologies was temporal and tantamount to being a 'green fix' to manage the power crisis (Holgersen & Malm, 2015). Some of the SAPP Member Utilities like Eskom of South Africa have stalled the implementation of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) by delaying the signing of some of the power purchase agreements (PPAs) guaranteed by the South African Government on the basis that solar photovoltaic (PV) and wind-generated power were too expensive (Kruger, 2017). Whereas the reason advanced by Eskom may have been true for power procured during the early windows of the REIPPPP, Figure 3.17 shows that renewable energy prices are declining and quite competitive to the Eskom average tariff/price (Kruger, 2017). With its large coal fleet and many years of experience operating coal fired power generation plants, technology 'lock-in' and 'lock-out' in favour of Eskom's conventional coal technologies at the expense of innovative technologies including renewables cannot be discounted (Neuhoff, 2005).

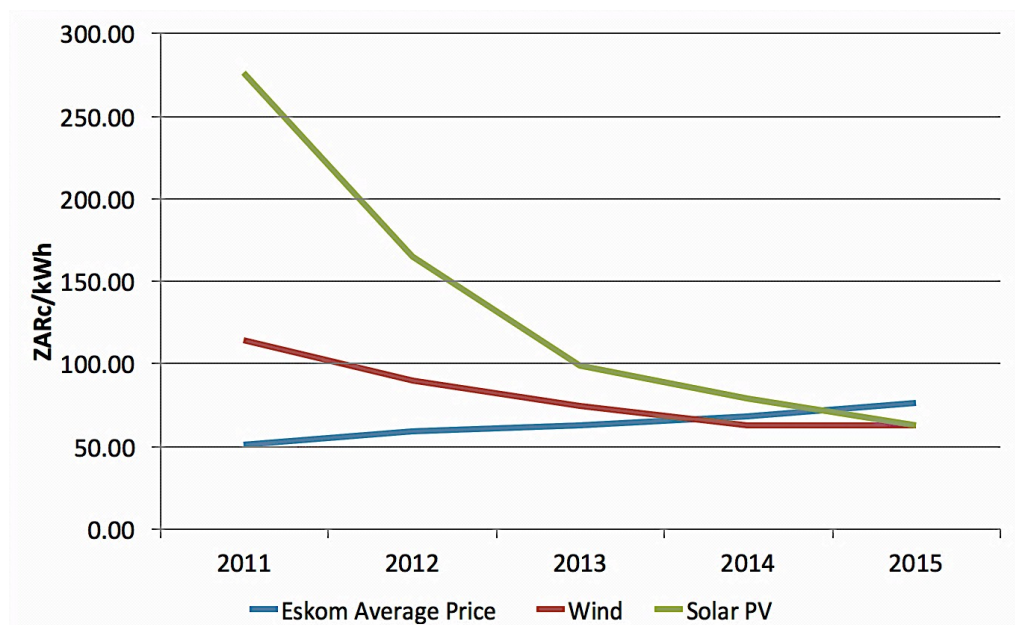


Figure 3.17. Average bid prices - REIPPPP

(Source: Kruger, 2017)

3.5 Conclusion

The SADC region has abundant renewable energy resources with great potential to make significant contribution to the region's electricity generation mix. Of the total installed electricity generation capacity of 67,190 MW, the contribution of renewable electricity generation to the regional electricity supply mix of about 8.04% (5,402 MW) excluding large hydropower and about 29.06% (19,525 MW) including large hydropower (Chikova & Beta, 2017). The current regional electricity supply mix shows large scope for increased share of renewable electricity in the future. The planned new regional generation capacity between 2017 and 2022 entails an additional capacity of about 13,445 MW (about 17%) of renewable electricity as shown in Figure 3.18 (Chikova & Beta, 2017). State-Owned Utilities would contribute 78% and the remainder of 22% from the independent power producers (IPPs), a positive sign of increased private sector participation in the energy sector.

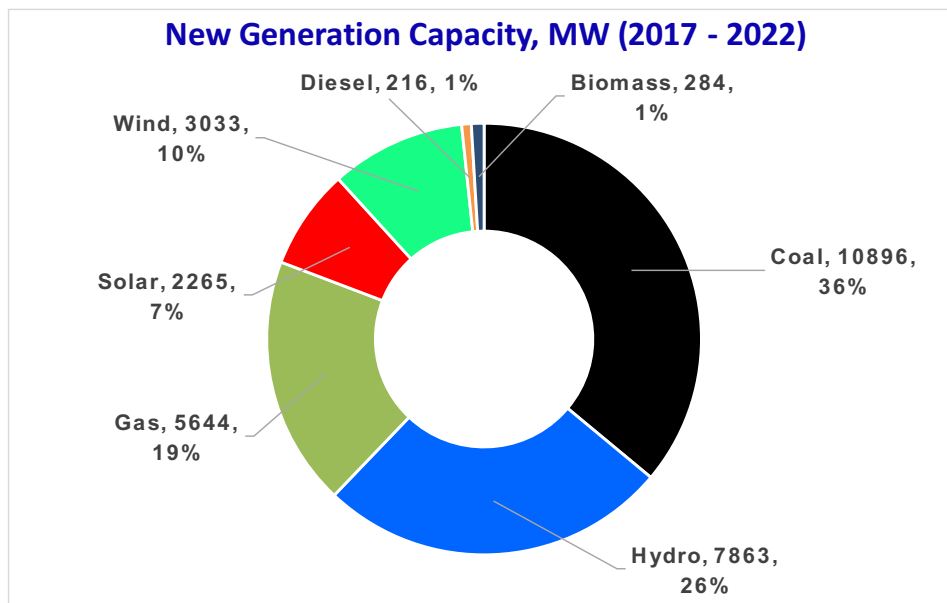


Figure 3.18. New generation capacity 2017 - 2022

(Source: Chikova & Beta, 2017)

In order to harness the immense renewable energy potential and generate renewable electricity for cross border trading, it is imperative to address among other impediments, the institutional barriers. In terms of legitimation, the legal basis and enforcement mechanisms for regional renewable energy development are weak. SADC relies more on voluntary as opposed to mandatory implementation of its decisions and those of the subsidiary organisations. A regional market structure has been developed that allows for participation of renewable energy independent power producers (REIPPs). Functionally, a number of readily available resource assessments offer good prospects for planning taking cognisance of renewable energy resources for commercial electricity generation. However, integrated resource planning at both regional and national levels is generally weak and few SADC MS have integrated resource plans (IRPs). Notwithstanding the absence of independent regional market oversight, the SAPP market-trading platform (MTP) is very developed and allows for competitive trading of electricity including renewable generated electricity.

The administrative and operational structures are not only under-resourced but also capacity constrained from a human resource perspective and with poor performance attributes in terms of efficiency, predictability and accountability. Operational and decision rules are largely though tailored for dispatchable power generation plants. With increasing grid connected REIPPs with non-dispatchable power generation plants, due consideration should be given to the development of model contracts, codes and regulations divided up into

dispatchable and non-dispatchable technologies. From the perspective of stakeholder consultations and engagements, elaborate processes and mechanisms are not in place and need urgent attention given important regional initiatives such as the review of the SAPP Pool Plan with profound implications on the development of renewable energy. It is vital to have regionally agreed frameworks for important initiatives such as the Pool Plan and processes and mechanisms to promote 360° stakeholder engagements. RERA and SACREEE have made initial steps in that regard and developed communication strategies.

The culture and attitudes towards renewable energy are rhetorically good but little was being done by way of up-scaling the development of the immense potential of renewable in the region. Renewable electricity appears to be a 'green fix' to deal when tight power supply situations are being encountered and continued commitments beyond the crises remain a challenge in that they tend to fizzle out for implausible reasons. Although numerous institutional barriers are prevalent, they are not insurmountable. The underlying factors for scaling up renewable electricity for cross border trading are largely in place and the steps being taken at SADC level and through the subsidiary organisations offer better prospects for the regional development of renewable energy in future.

Chapter 4: Conclusion

4.1 Overall findings of the study

Institutional barriers are not often discussed and do not have adequate empirical support because there has been relatively little research into these barriers (Gillingham & Sweeney, 2012). Some researchers agree with this observation by pointing out that most previous studies have not recognised the importance of the institutional environment and its contextual factors (Glasson & Gosling, 2001; Yiu & Makino, 2002).

The study delved into a general proposition that institutional perspectives provide a better understanding of the barriers to exploiting renewable energy opportunities through an integrated regional power system than the conventional lens that does not necessarily take into account the contextual aspects (Yiu & Makino, 2002). It is the first study analysing and providing a better understanding of the institutional perspectives that traverse the barriers to exploit renewable energy opportunities in a coordinated and integrated system in the Southern African region. It was also motivated by the desire to contribute meaningfully in dealing with practical problems impeding renewable energy development in Southern Africa using a different analytical lens.

The study highlights that the SADC has abundant technical potential for renewable energy for power generation of more than 32,485 TWh per annum but only a negligible amount of approximately 60 TWh per annum of this potential is exploited in the case solar, wind, geothermal and bioenergy (Yamba *et al.*, 2012; Chikova & Beta, 2017). Of the hydro potential, less than 10% has been harnessed (IRENA, 2013). Renewable electricity contributes 8.04% and 29.06% to the regional electricity generation mix excluding and including hydropower, respectively (Chikova & Beta, 2017). The findings are congruent with other studies confirming the paradox of having immense potential of renewable sources of energy and yet their estimated annual contribution to the global primary energy mix and final energy consumption is relatively low (UNEP FI, 2012; WEC, 2013, REN21, 2013). They are also in line with other studies indicating that the potential of renewable energy (RE) resources of most sub-Saharan countries, if harnessed using the proven renewable energy technologies (RETs), is theoretically several times their current levels of energy demand (Deichmann *et al.*, 2010; Moriarty & Honnery, 2012; Moriarty & Wang, 2015).

As expected, there are barriers hindering the exploitation of renewable energy opportunities inclined more towards non-technical than technical challenges at both national and regional levels (WEC, 2013; Lior, 2012; Moriarty & Honnery, 2011; Lenzen, 2010; Foxon & Pearson,

2007; McCormick & Kaberger, 2007; Lidula *et al.*, 2006; Foxon, 2002; Painuly, 2001; Costello & Finnell, 1998). Consistent with previous research studies, the findings indicate that there is little research on institutional barriers that should be addressed to enable the growth of the market for the deployment of renewable energy technologies, especially in the early stages of planning and commercialisation processes (Gillingham & Sweeney, 2012; Eleftheriadis & Anagnostopoulou, 2015; Peck *et al.*, 2015; Andrews-Speed, 2016; Yaqoot, Diwan & Kandpal, 2016).

The study applied the institutional theory and a conceptual framework for analysis of institutional barriers with five institutional elements: legitimation, functions, administrative structures, processes and mechanisms, and culture and attitudes; all being dynamic, interrelated, and interdependent. The applied analytical framework was in line with other previous studies that analysed institutional barriers and consistent with the description of institutional barriers as *'barriers that exist in how humans relate to the energy resources through laws and regulations, and through values and culture'* and as *'the rules of the game (formal and informal) in a society and/or the humanly devised constraints that shape human interaction'* (North, 1990; Painuly, 2001; Glasson & Gosling, 2001; Nykvist & Nilsson, 2009; Verbruggen *et al.*, 2010; Dunstan *et al.*, 2011; Biesbroek, 2013).

In terms of legitimation, the study shows that the legal basis and enforcement mechanisms for regional renewable energy development are weak and that SADC relies more on voluntary as opposed to mandatory implementation of its decisions and those of the subsidiary organisations. From the perspective of functions, the findings indicated a number of accessible resource assessments but planning for development of the renewable energy resources are weak at all levels within the region. Notwithstanding the absence of independent regional market oversight, the SAPP market-trading platform (MTP) facilitates competitive electricity trading of electricity including renewable generated electricity and allows for the participation of REIPPs.

Quite apparent from the study is that the administrative and operational structures are capacity constrained (both financially and human resource wise) and exhibit poor performance attributes in terms of efficiency, predictability and accountability. With respect to rules applicable for regional system operations and the SAPP Markets (both bilateral and competitive) though largely tailored for dispatchable power generation plants and not so much for the increasing grid connected with non-dispatchable power generation plants. Developing model contracts, codes and regulations divided up into dispatchable and non-dispatchable technologies would be helpful in that regard. The processes and mechanisms

for stakeholder consultations and engagements are not explicit but done on an ad-hoc and limited basis depending on specific regional programmes and project initiatives. However, the findings of the study are that some of the SADC structures such as RERA and SACREEE have developed communication strategies that are general (for RERA) and project specific (for REEESAP), respectively. The study found the culture and attitudes towards renewable energy to be lukewarm and not typified by long-term and sustained commitment from all the key SADC structures and stakeholders to scale-up the development of the immense potential of renewable in the region.

4.2 Critique of the study and its contributions

Design issues present one of the main limitations of this study. The research design adopted was that of a 'non-empirical research' premised on literature analyses using secondary data, personal observations and reflections, and regional and international energy related events (Mouton, 2012; Harriman & Patel, 2014; Haddaway *et al.*, 2015). From the perspective of the generalisability of the findings or results of the study, an empirical research would have enhanced the validity of the findings of this study. This is more so for the case study focusing on one region - SADC or Southern Africa region (Saunders *et al.*, 2009; Mouton, 2012). Notwithstanding the issues pertaining to the generalisability of the findings of this study, the literature review provides theoretical insights and conceptual framework developed could be applied to the analyses of institutional perspectives on regional renewable energy development barriers of other regional economic communities (RECs) or groupings of countries. Some limitations might also be related to collecting the textual data and interpreting the findings that relied heavily on the researcher's observations and reflections that could not entirely be devoid of personal biases.

Regardless of its limitations, the study gives insights on institutional barriers from the perspective of the institutional theory to explain the large gap between the current levels of the exploitation of renewable energy opportunities in the SADC region, and the potentials that are technically feasible using the available renewable energy technologies (Painuly, 2001; Foxon, 2002; Lidula *et al.*, 2006; Foxon & Pearson, 2007; Lenzen, 2010; Moriarty & Honnery, 2011; Lior, 2012; WEC, 2013). Consequently, all the relevant stakeholders, particularly the SADC structures, should direct more of their attention at addressing institutional barriers in the development and implementation of regional renewable energy programmes and projects with dimensions of cross border power trading. This is consistent with the findings of other studies that that institutional perspectives or conditions have a significant pervasive bearing on renewable energy barriers in general and exploiting

renewable energy opportunities in a coordinated and integrated system in particular (Dunstan *et al.*, 2011; Gillingham & Sweeney, 2012).

This study also provides strong support for addressing the institutional barriers limiting the development of renewable energy using an integrated regional approach in Southern Africa. It also reaffirms the argument by Oseni and Pollitt (2016) that strong, efficient and independent institutional arrangements coupled with appropriate regulatory and market design are necessary preconditions for an effective integrated power market.

4.3 Recommendations for further research

The confidence in and generalisability of the findings of the study could be strengthened and benefit more from an empirical research setting with a sample size deemed acceptable and large enough without a potential threat to the validity of the findings.

Future consideration could also be given to explaining or theorising the relationships and influences among the institutional conditions using appropriate model(s) and statistical tests such as chi-square, among others.

The current research was limited to institutional barriers but in a generalised manner considering all the institutional perspectives or elements in the proposed conceptual framework. Future work could also conduct and examine in greater details each of the institutional perspectives or conditions insofar as it traverses and/or limits the development of renewable energy using an integrated regional approach in Southern Africa.

References

- Adelle, C. & Russel, D. 2013. Climate Policy Integration: A Case of Déjà Vu? *Environmental Policy and Governance*, 23(1):1-12.
- Andrews-Speed, P. 2016. Applying Institutional Theory to the Low-Carbon Energy Transition. *Energy Research & Social Science*, 13:216-225.
- Ashworth, R., Boyne, G. & Delbridge, R. 2009. Escape from the Iron Cage? Organizational Change and Isomorphic Pressures in the Public Sector. *Journal of Public Administration Research & Theory*, 19(1):165-187.
- Aune, M., Godbolt, Å.L., Sørensen, K.H., Ryghaug, M., Karlstrøm, H. & Næss, R. 2016. Concerned Consumption. Global Warming Changing Household Domestication of Energy. *Energy Policy*, 98:290-297.
- Bahar, H. & Sauvage, J. 2013. Cross-Border Trade in Electricity and the Development of Renewables-Based Electric Power: Lessons from Europe. *OECD Trade and Environment Working Papers*, 2013(2):1.
- Barrios-O'Neill, D. & Schuitema, G. 2016. Online Engagement for Sustainable Energy Projects: A Systematic Review and Framework for Integration. *Renewable and Sustainable Energy Reviews*, 54:1611-1621.
- Bazilian, M. 2012. Energy Access Scenarios to 2030 for the Power Sector in sub-Saharan Africa. *Utilities Policy*, 20(1):1-16.
- Beta, M. 2016. *SAPP Promoting a Regional Electricity Market*. [PowerPoint presentation]. Pretoria, South Africa: SAPP.
- Biesbroek, G.R. 2013. On the Nature of Barriers to Climate Change Adaptation. *Regional Environmental Change*, 13(5):1119-1129.
- Bigerna, S., Bollino, C.A. & Polinori, P. 2014. Market Power and Transmission Congestion in the Italian Electricity Market.
- Bozkurt, C. & Destek, M.A. 2015. Renewable Energy and Sustainable Development Nexus in Selected OECD Countries. *International Journal of Energy Economics and Policy*, 5(2).

- Brent, A.C. 2012. *An investigation into the challenges of transdisciplinary R&D: Values, culture and the case of the BLOSSAM Project. Unpublished thesis.* Stellenbosch, South Africa: Stellenbosch University. Master of Philosophy in Sustainable Development Planning and Management.
- Brew-Hammond, A. 2010. Energy Access in Africa: Challenges Ahead. *Energy Policy*, 38(5):2291-2301.
- Chikova, A. 2017. *Southern African Power Pool (SAPP) Presentation to SADC Senior Energy Officials.* [PowerPoint presentation]. Ezulwini, Swaziland: SAPP.
- Chikova, A. & Beta, M. 2017. SAPP Presentation to the SADC Energy Thematic Group (ETG) Meeting. [PowerPoint presentation]. Gaborone, Botswana: SAPP.
- Connolly, D., Lund, H. & Mathiesen, B. 2016. Smart Energy Europe: The Technical and Economic Impact of One Potential 100% Renewable Energy Scenario for the European Union. *Renewable and Sustainable Energy Reviews*, 60:1634-1653.
- Connolly, D., Lund, H., Mathiesen, B.V. & Leahy, M. 2010. A Review of Computer Tools for Analysing the Integration of Renewable Energy into various Energy Systems. *Applied Energy*, 87(4):1059-1082.
- Cortner, H.J., Shannon, M.A., Wallace, M.G., Burke, S. & Moote, M.A. 1996. Institutional Barriers and Incentives for Ecosystem Management: A Problem Analysis.
- Costello, R. & Finnell, J. 1998. Institutional Opportunities and Constraints to Biomass Development. *Biomass and Bioenergy*, 15(3):201-204.
- Cronin, C. 2014. Using Case Study Research as a Rigorous Form of Inquiry. *Nurse Researcher*, 21(5):19-27.
- Dacin, M.T. 1997. Isomorphism in Context: The Power and Prescription of Institutional Norms. *Academy of Management Journal*, 40(1):46-81.
- Deloitte Financial Advisory Services, LLP (Deloitte). 2015. Market and Investment Framework for SADC Power Projects - Recommended Market Model. Unpublished thesis. Arlington, VA 22209, USA: Deloitte Financial Advisory Services, LLP (Deloitte).
- De Massis, A. & Kotlar, J. 2014. The Case Study Method in Family Business Research: Guidelines for Qualitative Scholarship. *Journal of Family Business Strategy*, 5(1):15-29.

Department for Business, Innovation and Skills (BIS). 2011. *Regional Integration and Trade in sub-Saharan Africa*. [Online].

Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32466/11-978-regional-integration-and-trade-africa.pdf [25 October 2017].

DiMaggio, P. & Powell, W. 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 48(2):147-160.

Eberhard, A. 2016. Independent Power Projects in sub-Saharan Africa: Investment and Procurement Trends. Cape Town, South Africa: University of Cape Town.

Eberhard, A., Gratwick, K., Morella, E. & Antmann, P. 2016. *Independent Power Projects in sub-Saharan Africa: Lessons from five key countries*. World Bank Publications.

Eberhard, A., Gratwick, K., Morella, E. & Antmann, P. 2017. Accelerating Investments in Power in sub-Saharan Africa. *Nature Energy*, 2:17005.

Eberhard, A. & Shkaratan, M. 2012. Powering Africa: Meeting the Financing and Reform Challenges. *Energy Policy*, 42:9-18.

Economic Consulting Associates (ECA). 2010. *The potential regional power sector integration: Literature review*. [Online].

Available: http://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_The%20Potential%20of%20Regional%20Power%20Sector%20Integration-Literature%20Review.pdf [25 October 2017].

Ela, E., Milligan, M., Bloom, A., Botterud, A., Townsend, A. & Levin, T. 2014. *Evolution of wholesale electricity market design with increasing levels of renewable generation*.

Eleftheriadis, I.M. & Anagnostopoulou, E.G. 2015. Identifying Barriers in the Diffusion of Renewable Energy Sources. *Energy Policy*, 80:153-164.

Energy Sector Management Assistance Program (ESMAP). 2017. *Global solar atlas*. [Online]. Available: <http://globalsolaratlas.info> [25 October 2017].

Engelken, M., Römer, B., Drescher, M., Welp, I.M. & Picot, A. 2016. Comparing Drivers, Barriers, and Opportunities of Business Models for Renewable Energies: A Review. *Renewable and Sustainable Energy Reviews*, 60:795-809.

- European Union (EU). 2017. *Europe 2020 Strategy*. [Online]. Available: https://ec.europa.eu/info/business-economy-euro-0/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/europe-2020-strategy_en [25 October 2017].
- Fine, S. & Mihlmeister, P. 2017. *Disruptive innovation - how DERs are impacting the US electric sector*. [Online]. Available: <https://www.usea.org/sites/default/files/event-/ICF%20USEA%20DER%20Impact%20on%20US%20Electric%20Sector%2002.28.17-final.pdf> [26 October 2017].
- Foxon, T.J. 2002. Technological and institutional 'lock-in' as a barrier to sustainable innovation. *Imperial College Centre for Policy and Technology Working Paper*.
- Foxon, T.J. & Pearson, P.J. 2007. Towards Improved Policy Processes for Promoting Innovation in Renewable Electricity Technologies in the UK. *Energy Policy*, 35(3):1539-1550.
- Francis, Y., Zhou, P.P., Mzezewa, C. and Cuamba, B. & Meena, H. 2012. SADC Renewable Energy Strategy and Action Plan.
- Gabriel, C. 2016. What is Challenging Renewable Energy Entrepreneurs in Developing Countries? *Renewable and Sustainable Energy Reviews*, 64:362-371.
- Gillingham, K. & Sweeney, J. 2012. Barriers to Implementing Low-Carbon Technologies. *Climate Change Economics*, 3(04).
- Glasson, J. & Gosling, J. 2001. SEA and Regional planning - overcoming the institutional constraints: Some Lessons from the EU. *European Environment*, 11(2):89-102.
- Glasson, J. 1995. Regional Planning and the Environment: Time for a SEA Change. *Urban Studies (Routledge)*, 32(4):713-732.
- Global Energy Network Institute (GENI). 2017. *Renewable energy resources in AFRICA*. [Online]. Available: <http://www.geni.org/globalenergy/library/renewable-energy-resources/world/africa/index.shtml> [25 October 2017].
- Haddaway, N.R., Collins, A.M., Coughlin, D. & Kirk, S. 2015. The Role of Google Scholar in Evidence Reviews and its Applicability to Grey Literature Searching. *PloS One*, 10(9):1-17.

Hagfors, L.I., Paraschiv, F., Molnar, P. & Westgaard, S. 2016. Using Quantile Regression to Analyze the Effect of Renewables on EEX Price Formation. *Renewable Energy and Environmental Sustainability*, 1:32.

Hajduka, A. 2017. *Introducing Africa Green Regional Energy: Efficient, New and Creditworthy Offtaker (AFRICA GREENCO)*. [PowerPoint presentation]. Lusaka, Zambia: Africa GreenCo.

Halder, P., Pietarinen, J., Havu-Nuutinen, S., Pöllänen, S. & Pelkonen, P. 2016. The Theory of Planned Behavior Model and Students' Intentions to use Bioenergy: A Cross-Cultural Perspective. *Renewable Energy*, 89:627-635.

Hammersley, M. 2010. Unreflective Practice? Case Study and the Problem of Theoretical Inference.

Harriman, S. & Patel, J. 2014. The Ethics and Editorial Challenges of Internet-Based Research. *BMC medicine*, 12(1):1.

Hart, C. 1998. *Doing a literature review: Releasing the social science research imagination*. Sage.

Hawila, D., Mondal, M.A.H., Kennedy, S. & Mezher, T. 2014. Renewable Energy Readiness Assessment for North African Countries. *Renewable and Sustainable Energy Reviews*, 33:128-140.

Hermann, S., Miketa, A. & Fichaux, N. 2014. *Estimating the renewable energy potential in Africa: A GIS-based approach*. [Online]. Available: http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_Resource_Potential_Aug2014.pdf [25 October 2017].

Holgersen, S. & Malm, A. 2015. "Green Fix" as Crisis Management. Or, in which World is Malmö the World's Greenest City? *Geografiska Annaler: Series B, Human Geography*, 97(4):275-290.

Hussein, A. 2015. The use of Triangulation in Social Sciences Research: Can Qualitative and Quantitative Methods be Combined? *Journal of Comparative Social Work*, 4(1).

International Panel on Climate Change (IPCC). 2011. IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation.

International Renewable Energy Agency (IRENA). 2017. *Reports and papers*. [Online]. Available: <http://www.irena.org/Publications/Publications.aspx?mnu=cat&PriMenuID=36&CatID=141&type=all> [25 October 2017].

International Renewable Energy Agency (IRENA). 2014. *Global atlas for renewable energy*. [Online]. Available: http://www.irena.org/DocumentDownloads/Publications/GA_Booklet_Web.pdf [25 October 2017].

Izadyar, N., Ong, H.C., Chong, W. & Leong, K. 2016. Resource Assessment of the Renewable Energy Potential for a Remote Area: A Review. *Renewable and Sustainable Energy Reviews*, 62:908-923.

Karlstrøm, H. and Ryghaug, M. 2014. Public Attitudes Towards Renewable Energy Technologies in Norway. the Role of Party Preferences. April 2014.

Komendantova, N., Patt, A., Barras, L. & Battaglini, A. 2012. Perception of Risks in Renewable Energy Projects: The Case of Concentrated Solar Power in North Africa. *Energy Policy*, 40:103-109.

Kruger, L. 2017. Eskom's Standoff on SA's Renewable Energy Resources. *Farmer's Weekly*, 2017(17016):6-7.

Kruger, W. 2017. *Renewable Energy Support Systems and Auctions*. [PowerPoint presentation]. Cape Town, South Africa: Graduate School of Business, University of Cape Town.

Kugel, L. 2009. *Regional licensing framework for cross-border power projects in the SADC region: Technical Report*. [Online]. Available: http://pdf.usaid.gov/pdf_docs/PNADU853.pdf [25 October 2017].

Lenzen, M. 2010. Current State of Development of Electricity-Generating Technologies: A Literature Review. *Energies*, 3(3):462-591.

Leopold, A. 2016. Energy Related System Dynamic Models: A Literature Review. *Central European Journal of Operations Research*, 24(1):231-261.

- Lidula, N., Mithulananthan, N., Ongsakul, W., Widjaya, C. & Henson, R. 2007. ASEAN Towards Clean and Sustainable Energy: Potentials, Utilization and Barriers. *Renewable Energy*, 32(9):1441-1452.
- Liu, X. & Fu, H. 2012. Literature-Based Knowledge Discovery: The State of the Art. *arXiv preprint arXiv:1203.3611*.
- Liu, J. 2015. Sustainability. Systems Integration for Global Sustainability. *Science (New York, N.Y.)*, 347(6225):1258832.
- Martin, N. and Rice, J. 2015. Improving Australia's Renewable Energy Project Policy and Planning: A Multiple Stakeholder Analysis. September 2015.
- Martinot, E. 2004. *Renewable Energy Information on Markets, Policy, Investment and Future Pathways*.
- Martinot, E. & McDoom, O. 2000. *Promoting energy efficiency and renewable energy: GEF climate change projects and impacts*. Global Environment Facility.
- Masini, A. & Menichetti, E. 2013. Investment Decisions in the Renewable Energy Sector: An Analysis of Non-Financial Drivers. *Technological Forecasting and Social Change*, 80(3):510-524.
- McBride, H. 2015. *Africa can quadruple share of renewable energy by 2030*. [Online]. Available: http://www.irena.org/News/Description.aspx?NType=A&mnu=cat&PriMenuID=16&CatID=84&News_ID=425 [25 October 2017].
- McCormick, K. & Kåberger, T. 2007. Key Barriers for Bioenergy in Europe: Economic Conditions, Know-how and Institutional Capacity, and Supply Chain Co-Ordination. *Biomass and Bioenergy*, 31(7):443-452.
- Miketa, A. & Merven, B. 2013. *SOUTHERN AFRICAN POWER POOL: Planning and prospects for renewable energy*. [Online]. Available: <http://www.irena.org/DocumentDownloads/Publications/SAPP.pdf> [25 October 2017].
- Mitchell, B. & Pigram, J.J. 1989. Integrated Resource Management and the Hunter Valley Conservation Trust, NSW, Australia. *Applied Geography*, 9(3):196-211.

- Molubi, T. 2017. Markets Subcommittee (MSC) Report to the SAPP Management Committee. [PowerPoint presentation]. Bulawayo, Zimbabwe: SAPP.
- Moriarty, P. & Honnery, D. 2012. What is the Global Potential for Renewable Energy? *Renewable and Sustainable Energy Reviews*, 16(1):244-252.
- Mounton, J. 2012. *How to succeed in your masters and doctoral studies*. Hatfield, Pretoria: Van School Publishers.
- Mourmouris, J. & Potolias, C. 2013. A Multi-Criteria Methodology for Energy Planning and Developing Renewable Energy Sources at a Regional Level: A Case Study Thassos, Greece. *Energy Policy*, 52:522-530.
- Moyo, N. 2016. Mandate of the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE). Unpublished thesis. Swakopmund, Namibia: SACREEE.
- National Renewable Energy Laboratory (NREL). 2017. *Renewable resources maps & data*. [Online]. Available: https://www.nrel.gov/renewable_resources/ [25 October 2017].
- Ndhlukula, K., Radojicic, T. & Mangwengwende, S. 2015. *Africa clean energy corridor: Analysis of infrastructure for renewable power in eastern and southern Africa*. [Online]. Available: http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_CEC_infrastructure_2015.pdf [25 October 2017].
- Neale, P., Thapa, S. & Boyce, C. 2006. *Preparing a case study: A guide for designing and conducting a case study for evaluation input*. Pathfinder International Massachusetts.
- Negro, S.O., Alkemade, F. & Hekkert, M.P. 2012. Why does Renewable Energy Diffuse so Slowly? A Review of Innovation System Problems. *Renewable and Sustainable Energy Reviews*, 16(6):3836-3846.
- Neuhoff, K. 2005. Large-Scale Deployment of Renewables for Electricity Generation. *Oxford Review of Economic Policy*, 21(1):88-110.
- North, D.C. 1995. The new institutional economics and third world development, *The new institutional economics and third world development*. Vol. 21. Routledge, London and New York.
- North, D.C. 1990. *Institutions, institutional change and economic performance*. Cambridge university press.

- North, D.C. 1991. Institutions STÖR. *The Journal of Economic Perspectives*, 5(1):97-112.
- Nykvist, B. & Nilsson, M. 2009. Are Impact Assessment Procedures Actually Promoting Sustainable Development? Institutional Perspectives on Barriers and Opportunities found in the Swedish Committee System. *Environmental Impact Assessment Review*, 29(1):15-24.
- Oree, V., Hassen, S.Z.S. & Fleming, P.J. 2017. Generation Expansion Planning Optimisation with Renewable Energy Integration: A Review. *Renewable and Sustainable Energy Reviews*, 69:790-803.
- Oseni, M.O. & Pollitt, M.G. 2016. The Promotion of Regional Integration of Electricity Markets: Lessons for Developing Countries. *Energy Policy*, 88:628-638.
- Özkale, C., Celik, C., Turkmen, A.C. and Cakmaz, E.S. 2017. Decision Analysis Application Intended for Selection of a Power Plant Running on Renewable Energy Sources. April 2017.
- Painuly, J.P. 2001. Barriers to Renewable Energy Penetration; a Framework for Analysis. *Renewable Energy*, 24(1):73-89.
- Panwar, N., Kaushik, S. & Kothari, S. 2011. Role of Renewable Energy Sources in Environmental Protection: A Review. *Renewable and Sustainable Energy Reviews*, 15(3):1513-1524.
- Patton, M.Q. 1990. *Qualitative evaluation and research methods*. SAGE Publications, Inc.
- Peck, P., Grönkvist, S., Hansson, J., Voytenko, Y. and Lönnqvist, T. 2015. Investigating Socio-Technical and Institutional Constraints to Development of Forest-Derived Transport Biofuels in Sweden: A Study Design. Paper presented at 23rd European Biomass Conference & Exhibition, 1-4 June Wien Austria.
- Petticrew, M. & Roberts, H. 2006. How to Appraise the Studies: An Introduction to Assessing Study Quality. *Systematic reviews in the social sciences: A practical guide*, 125-163.
- Phillips, D.J. & Zuckerman, E.W. 2001. Middle-Status Conformity: Theoretical Restatement and Empirical Demonstration in Two Markets. *American Journal of Sociology*, 107(2):379-429.
- Powell, W.W. & Colyvas, J.A. 2008. Microfoundations of Institutional Theory. *The Sage handbook of organizational institutionalism*, 276:298.

Rai, V. & Beck, A.L. 2015. Public Perceptions and Information Gaps in Solar Energy in Texas. *Environmental Research Letters*, 10(7):074011.

Rajasekar, S., Philominaathan, P., & Chinnathambi, V. (2013). Research Methodology. [Online]. Available: <http://arxiv.org/pdf/physics/0601009.pdf> [5 February 2018].

Renewable Energy Policy Network for the 21st Century (REN21). 2013. *Renewables 2013 global futures report*. [Online].

Available: http://www.ren21.net/Portals/0/REN21_GFR_2013_print.pdf [25 October 2017].

Renewable Energy Policy Network for the 21st Century (REN21). 2016. *Renewables 2016 Global Status Report*. [Online]. Available: http://www.ren21.net/wp-content/uploads/2016/06/GSR_2016_Full_Report_REN21.pdf [25 October 2017].

Ritchie, J., Lewis, J., Nicholls, C.M. & Ormston, R. 2013. *Qualitative research practice: A guide for social science students and researchers*. Sage.

Rosnes, O. & Shkaratan, M. 2011. *Africa's power infrastructure: Investment, integration, efficiency*. World Bank Publications.

Rother, E.T. 2007. Systematic Literature Review X Narrative Review. *Acta Paulista de Enfermagem*, 20(2):v-vi.

Rycroft, M. 2013. Summary of REIPPP Round Three Projects. *Industry News*.

SADC Centre for Renewable Energy and Energy Efficiency (SACREEE). 2017. *History of SACREEE*. [Online]. Available: <http://www.sacreee.org/content/history-sacreee> [25 October 2017].

Salehin, S., Ferdaous, M.T., Chowdhury, R.M., Shithi, S.S., Rofi, M.B. & Mohammed, M.A. 2016. Assessment of Renewable Energy Systems Combining Techno-Economic Optimization with Energy Scenario Analysis. *Energy*, 112:729-741.

Saunders, M., Lewis, P., Thornhill, A. & Wilson, J. 2009. Business Research Methods. *Financial Times, London*.

Scott, W.R. 2008. Approaching Adulthood: The Maturing of Institutional Theory. *Theory and society*, 37(5):427-442.

- Sen, S. & Ganguly, S. 2016. Opportunities, Barriers and Issues with Renewable Energy development - A Discussion. *Renewable and Sustainable Energy Reviews*.
- Sharifi, A. & Yamagata, Y. 2016. Principles and Criteria for Assessing Urban Energy Resilience: A Literature Review. *Renewable and Sustainable Energy Reviews*, 60:1654-1677.
- Shortall, R. & Kharrazi, A. 2017. Cultural Factors of Sustainable Energy Development: A Case Study of Geothermal Energy in Iceland and Japan. *Renewable and Sustainable Energy Reviews*, 79:101-109.
- Sichone, E. C. & Roets, D. 2011. *RERA and its regional initiatives on energy regulation and security of supply*. [Online]. Available: http://www.icer-regulators.net/portal/page/portal/ICER_HOME/activities/ICER_Events/ICER_SoS_Workshop/13.%20debbie%20roets.pdf [25 October 2017].
- Sithole, H. 2016. Developing an Optimal Electricity Generation Mix for the UK 2050 Future. *Energy*, 100:363-373.
- Slack, T. & Hinings, B. 1994. Institutional Pressures and Isomorphic Change: An Empirical Test. *Organization Studies*, 15(6):803-827.
- Smith, L.G. 2014. *Impact assessment and sustainable resource management*. Routledge.
- Southern African Development Community (SADC). 2016a. *Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) 2016 - 2030: Booklet*. [Online]. Available: http://www.aler-renovaveis.org/contents/lerpublication/sadc_2016_reeesap-2016-2030-booklet.pdf [25 October 2017].
- Southern African Development Community (SADC). 2016b. *SADC Ministerial Workshop on Water and Energy Crisis in the SADC Region: Outcome Statement*. Gaborone, Botswana. 20 June 2016.
- Southern African Development Community (SADC). 2015. *SADC industrialization strategy and roadmap 2015 - 2063*. [Online]. Available: http://www.sadc.int/files/2014/6114/9721/Reprinting_Final_Strategy_for_translation_051015.pdf[25 October 2017].

Southern African Development Community (SADC). 2012. *SADC tribunal*. [Online]. Available: <http://www.sadc.int/about-sadc/sadc-institutions/tribun/> [25 October 2017].

Southern African Development Community (SADC). 2006. *Revised Memorandum of Understanding regarding the Southern African Power Pool (SAPP)*. Unpublished thesis. Gaborone, Botswana: SADC Secretariat.

Southern African Development Community (SADC). 1996. *Protocol on energy in the southern African development community (SADC) region*. [Online]. Available: http://www.sadc.int/files/3913/5292/8363/Protocol_on_Energy1996.pdf [25 October 2017].

Southern African Power Pool (SAPP). 2017. *Market Surveillance*. [Online]. Available: <http://www.sapp.co.zw/market-surveillance> [25 October 2017].

Southern African Power Pool (SAPP). 2016. *SAPP Annual Report 2016*. [Online]. Available: <http://www.sapp.co.zw/annual-reports> [25 October 2017].

Southern African Power Pool (SAPP). 2007. *Southern African Power Pool (SAPP) Inter-Utility Memorandum of Understanding*. Unpublished thesis. Harare, Zimbabwe: SAPP.

Southern African Research and Documentation Centre (SARDC). 2012. *SAPP should have more authority to promote energy development*. [Online]. Available: <https://www.sardc.net/en/southern-african-news-features/sapp-should-have-more-authority-to-promote-energy-development/> [25 October 2017].

Stiles, G. & Murove, C. 2015. SADC Renewable Energy and Energy Efficiency Status Report.

Strantzali, E. & Aravossis, K. 2016. Decision Making in Renewable Energy Investments: A Review. *Renewable and Sustainable Energy Reviews*, 55:885-898.

Suzuki, M. 2015. Identifying Roles of International Institutions in Clean Energy Technology Innovation and Diffusion in the Developing Countries: Matching Barriers with Roles of the Institutions. *Journal of Cleaner Production*, 98:229-240.

Tellis, W.M. 1997. Application of a Case Study Methodology. *The qualitative report*, 3(3):1-19.

- The International Justice Resource Center (IJRC). 2017. *Southern African Development Community (SADC) Tribunal*. [Online]. Available: <http://www.ijrcenter.org/regional-communities/southern-african-development-community-tribunal/> [25 October 2017].
- Theron, W. 2012. *The Southern African Power Pool*. [Online]. Available: https://sari-energy.org/oldsite/PageFiles/What_We_Do/activities/BhutanCrossBorderWorkshopAug2012/Presentations/SAPP_Presentation__29_August_2012.pdf[25 October 2017].
- Thomas, G. 2011. A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative inquiry*, 17(6):511-521.
- Trondal, J. & Peters, B.G. 2013. The Rise of European Administrative Space: Lessons Learned. *Journal of European Public Policy*, 20(2):295-307.
- Twidell, J. & Weir, T. 2015. *Renewable energy resources*. Routledge.
- United Nations Environment Programme Finance Initiative (UNEP FI). 2012. *Financing renewable energy in developing countries: Drivers and barriers for private finance in sub-Saharan Africa*. [Online]. Available: http://www.unepfi.org/fileadmin/documents/Financing_Renewable_Energy_in_sub-Saharan_Africa.pdf [25 October 2017].
- Urmee, T. & Md, A. 2016. Social, Cultural and Political Dimensions of Off-Grid Renewable Energy Programs in Developing Countries. *Renewable Energy*, 93:159-167.
- Verbruggen, A. 2010. Renewable Energy Costs, Potentials, Barriers: Conceptual Issues. *Energy Policy*, 38(2):850-861.
- Wang, X., Nathwani, J. & Wu, C. 2016. Visualization of International Energy Policy Research. *Energies*, 9(2):72.
- World Energy Council (WEC). 2013. *World Energy Resources 2013 Survey: Summary*. [Online]. Available: http://www.worldenergy.org/wp-content/uploads/2013/10/WEC_Resources_summary-final.pdf [25 October 2017].
- Wu, G. C., Deshmukh, R., Ndhlukula, K., Radojicic, T. & Reilly, J. 2015. *Renewable Energy Zones for the Africa Clean Energy Corridor*. [Online]. Available: http://www.irena.org/DocumentDownloads/Publications/IRENA-LBNL_Africa%20RE%20CEC_2015.pdf [25 October 2017].

Wu, G.C. 2017. Strategic Siting and Regional Grid Interconnections Key to Low-Carbon Futures in African Countries. *Proceedings of the National Academy of Sciences of the United States of America*, 114(15):E3004-E3012.

Yaqoot, M., Diwan, P. & Kandpal, T.C. 2016. Review of Barriers to the Dissemination of Decentralized Renewable Energy Systems. *Renewable and Sustainable Energy Reviews*, 58:477-490.

Yin, R.K. 2013. *Case study research: Design and methods*. Sage Publications.

Zhou, P. 2012. Regional Infrastructure Development Master Plan: Energy Sector Plan. *Southern African Development Community (SADC): Gaborone, Botswana*.

Zucker, D.M. 2009. How to do Case Study Research.

Zucker, L.G. 1987. Institutional Theories of Organization. *Annual review of sociology*, 13(1):443-464.

Zyadin, A., Halder, P., Kähkönen, T. & Puhakka, A. 2014. Challenges to Renewable Energy: A Bulletin of Perceptions from International Academic Arena. *Renewable Energy*, 69:82-88.