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Regional integration in southern Africa: A platform for electricity sustainability

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INTRODUCTION[1]

A global transition towards sustainable models of growth and development is unfolding as a response to multiple crises of sustainability on economic, social, environmental and governance fronts. Energy systems, which are prerequisites for the smooth functioning of the economic, political and social spheres, underpinning socio-economic development are at the core of this transformation. The energy sector is also a cornerstone of the transition due to its primary role in the existing sustainability issues in many countries, from the reliance on fossil fuels and the lack of access to modern energy to the absence of energy security and the persistence of governance problems (IEA, 2015).

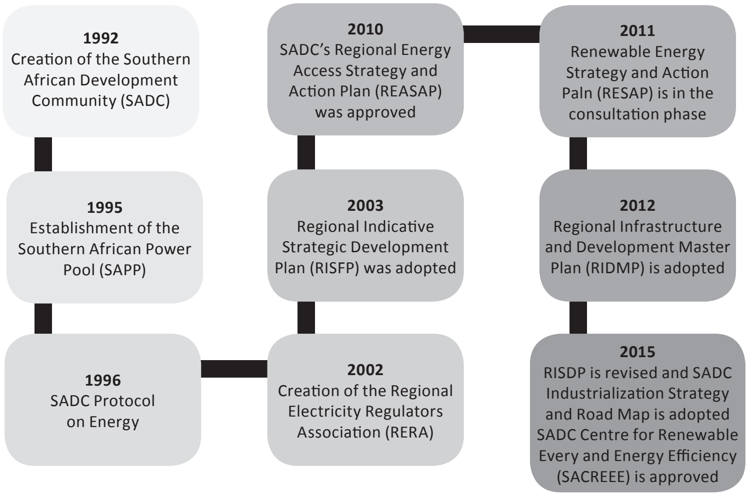
The energy sector in the southern African region follows such dynamics. Numerous initiatives, backed by political commitments, are shifting the region towards sustainable (energy) pathways to leverage the favourable regional endowment in renewable resources (Mutanga and Simelane, 2015). In line with the United Nations Sustainable Development Goal 7, which aims to ensure 'access to affordable, reliable, sustainable and modern energy for all' (United Nations, 2015), endeavours are driven primarily by the objective of ensuring energy access and security for all populations and businesses. This is notably characterised by an increased emphasis on new energy technologies, principally renewable energy-based and gas-based systems (Santley, Schlotterer and Eberhard, 2014; REN21, 2015). Waves of reform in the energy supply industries are also taking place in the region, with the aim of improving the efficiency of energy systems (Eberhard et al, 2011; Promethium Carbon, 2016).

At the regional level, the Southern African Development Community (SADC) has recognised the importance of regional integration as a means to address the current energy issues. This is in line with developments at the continental level and, in its Agenda 2063, the African Union identifying energy as one of the key infrastructure pillars for connecting the continent (African Union, 2015).

This is evident in the various initiatives, plans and strategies deployed in the region (Figure 4.1). After a period of regional energy integration, characterised by bilateral energy trading based on independent neighbours trying to reduce their dependency on apartheid South Africa, the Southern African Power Pool (SAPP) was established in 1995, initiating a new phase structured around the institutionalisation of a regional energy market (Vanheukelom and Bertelsmann-Scott, 2016). Under the auspices of the SADC, 14 electricity companies from 12 southern African countries are gathered under the SAPP (SAPP, 2015).[2] The SAPP was founded to establish a network for national electricity generation utilities under the SADC – it provides a common market for electricity through an interconnected power grid between member countries to promote regional energy trade.

Regional energy integration, aimed at supporting energy security through integrated markets and cross-border infrastructure development, has been high on the political agenda since then, relying on cheap, abundant electricity from South Africa. Electricity trade has been viewed as an efficient way to ensure reliable and low-cost energy security, based on mutual benefits for importing and exporting members of the SAPP. Countries have either exported their excess supply of electricity or imported electricity from members, thereby eliminating the cost of

Figure 4.1: Timeline of regional cooperation and energy integration in SADC



Source: Authors' composition, based on REN21 (2015)

investing in local generation capacity (Vanheukelom and Bertelsmann-Scott, 2016).

This process has been supported by the 1996 SADC Protocol on Energy, which promotes the harmonious development of national energy policies and matters of common interest for the balanced and equitable development of energy throughout the region, particularly through data and information exchange (SADC, 1996). Accordingly, the SADC's Directorate for Infrastructure and Services has a vision to ensure the availability of sufficient, least-cost, environmentally sustainable energy services in the region.

The Regional Infrastructure Development Master Plan (RIDMP) 2012–2027 Energy Sector Plan pursues the access to 'adequate, reliable, least cost, environmentally sustainable energy' (SADC, 2012) to promote economic growth and poverty alleviation, while the Regional Energy Access Strategy and Action Plan (REASAP) aims to 'harness regional energy resources to ensure, through national and regional action, that all the people of the SADC region have access to adequate, reliable, least-cost, environmentally sustainable energy services' (SADC, 2010). The Revised Regional Indicative Strategic Development Plan (RISDP) 2015–2020 further supports the development of 'sufficient, reliable, and least-cost energy services' (SADC, 2015), notably through greater cooperation, interconnectedness, power pooling and the connecting of national electricity grids. In addition, the 2015 Industrialisation Strategy and Roadmap 2015–2063 stresses the need to address energy security concerns to underpin the success of the industrialisation strategy.

Most recently, the SADC designed a Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) for the 2016–2030 period, and established the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE), a Windhoek-based regional platform to promote the implementation of the REEESAP (SADC, 2016).

Notwithstanding these political commitments, regional energy integration still appears to be on the back foot. The 2007 electricity crisis in South Africa triggered a new stage for regional energy cooperation with the transition of the regional hegemon from an exporter of low-cost electricity to an importer of power. The recent drought has further put energy security to the test in the region, particularly in countries that rely on hydropower.

This situation has strengthened individualism throughout the region, with the development of numerous new power generation projects in the southern African region (both in South Africa and other countries) (SAPP, 2015) and governments focusing more on national, bilateral or sub-regional interests and initiatives than regional integration. Despite the numerous plans and strategies in place at the SADC level, regional energy integration has progressed at a slow pace, as illustrated by the weak level of interconnection between southern African countries (Mutanga and Simelane, 2015).

The demise of some national utilities, such as Eskom in South Africa, has also led to the emergence of new players in the region's energy markets through independent power producers (IPPs) and small-scale embedded generators, challenging the market position of state-owned utilities and reshuffling the cards of regional energy integration (Das Nair, Montmasson-Clair and Ryan, 2014; Montmasson-Clair and Ryan, 2014; Mutanga and Simelane, 2015; Vanheukelom and Bertelsmann-Scott, 2016).

Considered together, the sustainability transition, the rise in individualism and the emergence of new players in the sector call for a renewed approach to regional energy integration in the southern African region in support of sustainable energy development and a critical analysis of regional energy dynamics with the aim of improving energy sustainability.

Building on a conceptual framework inspired by the World Energy Council (WEC, 2013) and the International Energy Agency (IEA, 2016), three key dimensions, depicted in Figure 4.2, can be considered to assess energy sustainability in the region:

- *energy security*, ie, the effective management of energy supply, the reliability of the energy infrastructure and the ability to meet energy demand;
- *energy equity,* ie, the accessibility and affordability of energy supply across the population; and
- *environmental sustainability,* ie, the achievement of demand- and supply-side energy efficiencies and the development of energy supply from renewable and low-carbon technologies.

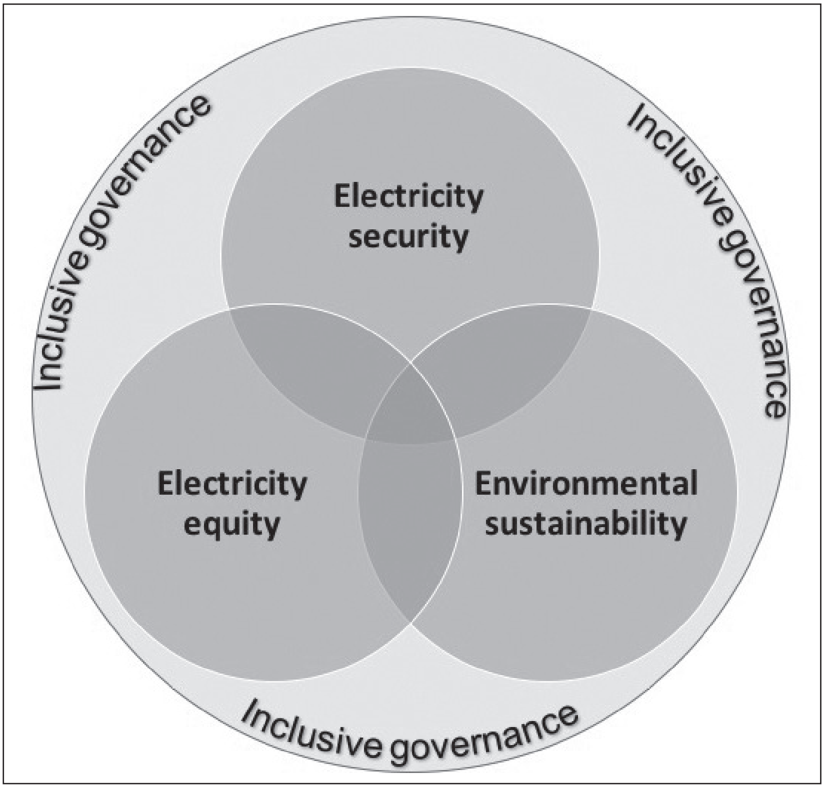
These dimensions speak to a number of factors, from energy availability (adequacy and access), and acceptability (socio-political and environmental, including resource extraction and waste production), to affordability (prices and paying ability) and efficiency (productivity in the use of energy resources) (Narula and Reddy, 2016). While these three dimensions provide a useful framework for assessing energy sustainability, a further dimension must also be considered, namely the governance of energy systems, including institutional capability. An important determinant for the delivery of energy sustainability is whether there is a robust, transparent and inclusive energy governance system with built in accountability and consequences.

Importantly, these dimensions complement one another and must be achieved altogether to reach energy sustainability. For example, some countries may rely on low-carbon energy sources (such as hydropower) but have (very) low electrification rates and poor resilience levels, which weakens their real performance in terms of electricity security and equity. In addition, improving access through traditional means is likely to put further strain on electricity supply due to increased demand. Relying on large-scale coal-based power generation and centralised grid extension can contribute to security of supply but is incompatible with environmental sustainability and electricity equity principles. Exclusive governance structures can, in turn jeopardise, the sustainability of energy systems altogether.

While traditional approaches tend to oppose them (eg, by framing environmental sustainability against security of supply), in reality, multiple co-benefits exist between the different dimensions of electricity sustainability. Thinking of them in an integrated fashion results in the emergence of innovative solutions. For example, renewable energy technologies, particularly small-scale systems (either grid-tied or off-grid), offer an avenue to achieve electricity security, electricity equity and environmental sustainability at the same time. Such systems provide an opportunity to roll out affordable, fit-for-purpose energy solutions, empowering consumers (to become prosumers)[3] based on clean, renewable and socially acceptable energy sources.

This chapter explores the potential to improve southern Africa's energy sustainability through regional integration, harnessing the emerging opportunities associated with new energy sources and technologies, and energy supply structures. It focuses on the electricity component of the energy picture and, as such, does not discuss issues pertaining to liquid fuels. Acknowledging that the region comprises a diversity of situations, this chapter depicts the heterogeneity of the southern African countries in its analysis.

Figure 4.2: The three dimensions of electricity sustainability



Source: Authors' composition, inspired by WEC (2016) and IEA (2016)

This chapter reviews the performance of the SAPP in terms of electricity sustainability, and then goes on to analyse the role of regional institutions in the electricity sector, before exploring avenues to harness regional integration to improve electricity sustainability in southern Africa.

THE STATE OF PLAY

Electricity sustainability, which is vital to any well-functioning, inclusive, sustainable and modern economy and society, has gained increased attention at the regional level and progress has been made in a number of areas. Further improvements are, nevertheless, required to achieve electricity sustainability, particularly in dealing with the interplay between electricity security, electricity equity and environmental sustainability.

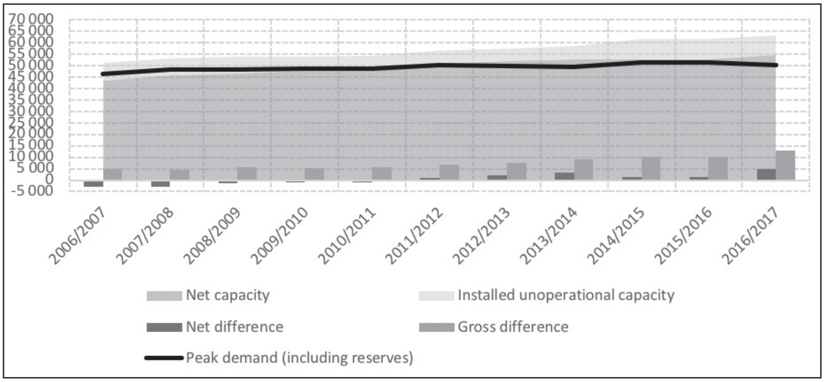
Electricity security: Matching supply and demand

Southern Africa's electricity security situation, although diverse, generally looks bleak. The region has been suffering from electricity shortages, with severe implications for economic growth and social development. Over the past decade or so, Botswana, Namibia, South Africa, Tanzania, Zambia and Zimbabwe have had to resort to load shedding as a stop-gap measure to conserve energy (SADC and SARDC, 2016). Many people in these countries still have no access to modern energy services.[4] The use of traditional biomass continues to be significant in the region, primarily but not only in rural areas, further accentuating the security of supply challenge.

Looking at the electricity supply–demand balance, as illustrated in Figure 4.3, the supply deficit is evident in many countries, despite the region operating a surplus of 1 507 megawatts (based on 2015/16 data). As a regional group, SAPP member countries had a net capacity of 52 760 megawatts (compared to 61 362 megawatts of installed capacity) for a peak demand (including reserve margins) of 51 253 megawatts. The region has, moreover, displayed a net surplus since 2011/12, with a peak at 3 437 megawatts in 2013/14.

By contrast, at the country level, only Angola and Mozambique display favourable positions, with a net generation capacity comfortably above their demand and reserve requirements. Mozambique's journey to security of supply, furthermore, centred on the development of the Cahora Bassa hydroelectric dam, further illustrates the possibility to turn fortune around (see IRENA, 2012, and Cuamba et al, 2013, for details on Mozambique's energy sector). Other countries are either in a precarious situation (such as the Democratic Republic of the Congo [DRC], Malawi, Tanzania and South Africa, although the situation has recently improved for the latter) or experiencing serious supply shortfalls (Botswana, Lesotho, Namibia, Swaziland and Zimbabwe).

Figure 4.3: Installed capacity and net capacity over the peak demand and reserve requirements for SAPP countries from 2006/07 to 2015/16 (in GWh)



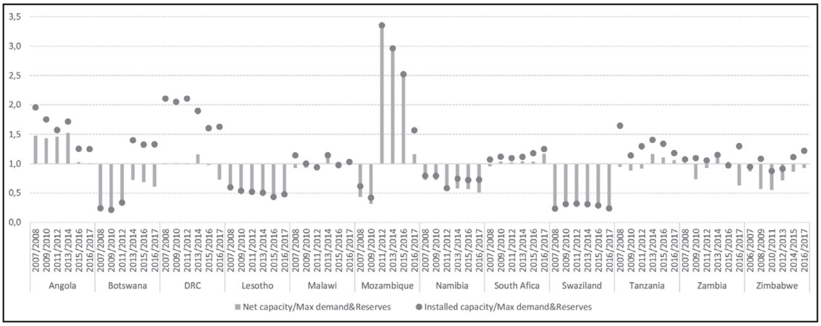
Source: Authors' composition, based on data from SAPP Annual Reports

Note: Reserve margins – required to guarantee system reliability, allow for unexpected surges in the demand for power and allow for plant maintenance – are equivalent to 10.2 per cent of peak demand as per the SADC's best practices.

Importantly, in a number of cases, the absence of security of supply is not related to the lack of generation capacity, but rather to a maintenance backlog and the poor state of the existing power plants (illustrated in Figure 4.4 by the difference between the installed and net capacities). This condition is neatly demonstrated in the DRC, where generation capacity is mostly inoperative.

This unfavourable supply picture is confirmed by the state of electricity trade in the region (Figure 4.5). Only two countries effectively (ie, continuously) export electricity in the region, namely Mozambique (from the Cahora Bassa hydroelectric power plant) to South Africa, and South Africa to the rest of the region. Some countries, such as Namibia and Zambia, are ad hoc exporters, as they rely on hydropower and depend on weather conditions. As discussed later, Angola, Malawi and Tanzania do not trade electricity with other SAPP members because they are not yet connected to the regional grid.

Figure 4.4: Ratios of installed capacity and net capacity over the peak demand and reserve requirements for SAPP countries from 2006/07 to 2015/16



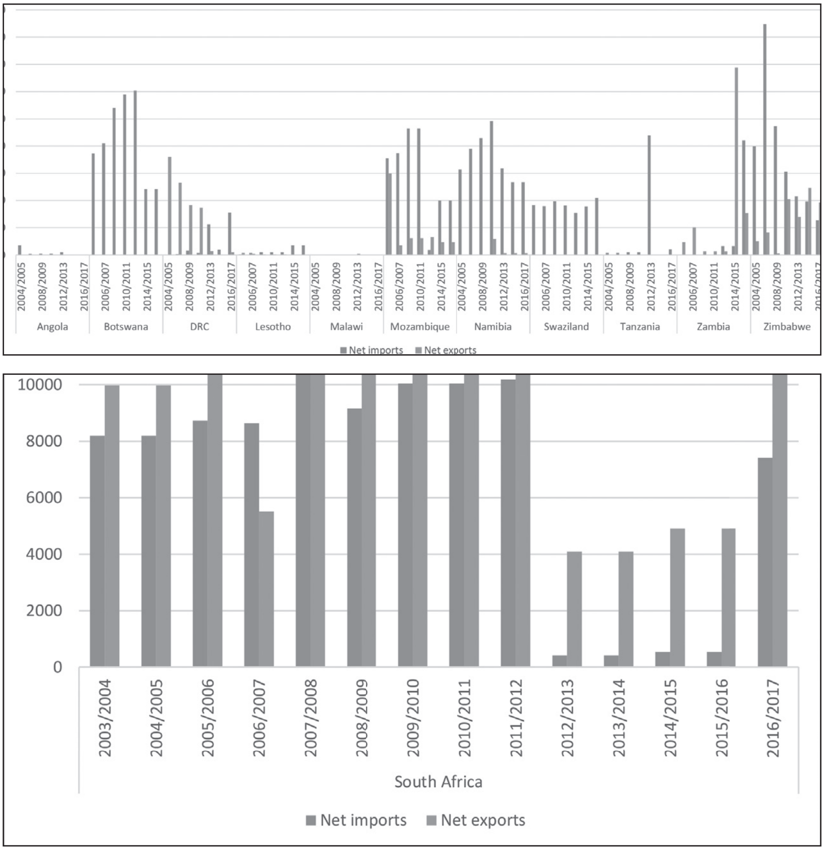
Source: Authors' composition, based on data from SAPP Annual Reports

Note: Reserve margins – required to guarantee system reliability, allow for unexpected surges in the demand for power and allow for plant maintenance – are equivalent to 10.2 per cent of peak demand as per the SADC's best practices. A ratio of 1 corresponds to an exact match between peak demand (including reserve margins) and generation capacity. Ratios of 2 and 0.5, respectively, indicate that generation capacity amounts to twice and half the peak demand (including reserve margins).

Against this background, the region benefits from tremendous electricity generation potential, notably from renewable energy technologies. The southern African region enjoys a wide array of both renewable and non-renewable energy resources (UNEP and AfDB, 2017). Furthermore, these resources are spread across the region, laying the ground for regional trade.

The region hosts large deposits of coal, gas and uranium. Large reserves of coal can be found in Botswana, Mozambique, South Africa and Zimbabwe, while Mozambique, Namibia, South Africa and Tanzania

Figure 4.5: Net imports and exports from 2003/04 to 2015/16 for SAPP countries (in GWh)



Source: Authors' composition, based on data from SAPP Annual Reports

Note: the scale differs between the two graphs because of the large amount traded by South Africa compared to other SAPP countries.

are developing natural gas fields. Significant reserves of uranium also exist in the region, with mining taking place in Namibia and South Africa, and exploration underway in Botswana and Zimbabwe (IEA, 2014a).

Large low-cost hydroelectric dams, especially the Inga Reservoir in the DRC and the Kariba Dam on the Zambia–Zimbabwe border, have the potential to generate up to 150 gigawatts of electricity, against the current 12 gigawatts of installed capacity. According to Karhammar (2014), the SADC has the potential to generate 1 080 terrawatt hours per year of electricity from hydroelectric dams, however, only 31 terrawatt hours per year is being used.

With new renewable technologies, the SADC region benefits from outstanding solar irradiation (2 500 hours of sunshine a year), translating into a generation capacity potential of 20 000 terrawatt hours annually. The potential for wind-based generation is mostly constrained to the coastal regions, but meaningful too, reaching around 800 terrawatt hours per year. Last but not least, geothermal energy (about 4 000 megawatts) can be harnessed in the countries along the Rift Valley (Tanzania, Malawi, Mozambique and Zimbabwe) (UNEP, 2012; Miketa and Merven, 2013).

Although power generation projects are underway in all member states aimed at seizing existing opportunities (totalling 30 646 megawatts for the 2017–2022 period, including 48 per cent in South Africa), this large electricity generation potential remains mostly untapped. The International Renewable Energy Agency (IRENA) estimates that only about 1 per cent of the solar and wind potential of the region has been captured so far (Miketa and Merven, 2013). Unfortunately, as discussed in later, southern African countries are adopting a national (or bilateral) rather than a regional approach to electricity security (Madakufamba, 2010). Such a stance is likely to further exacerbate the regional generation surplus while not preventing some countries from experiencing shortages.

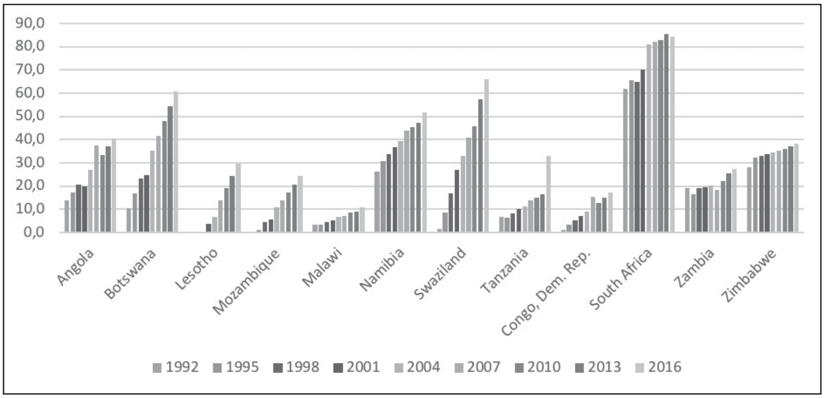
Electricity equity: Achieving affordable access to modern electricity

The performance of the SAPP in achieving electricity equity in the region, despite some notable progress in the last two decades, remains problematic. The SAPP is the worst performing African regional power pool – only 24 per cent of residents have access to electricity, against

36 per cent in the East African Power Pool and 44 per cent in the West African Power Pool (IEA, 2014b).

Although this disappointing picture is dominated mainly by the DRC and Tanzania (which, respectively, account for 35 per cent and 21 per cent of the regional population without access to electricity), this is reflected in the individual performance of most southern African countries. Indeed, Figure 4.6 shows that, despite some overall progress over the last two decades in terms of electrification, electricity access remains very limited in most countries.

Figure 4.6: Access to electricity in SAPP countries (in percentage of population) from 1992 to 2016



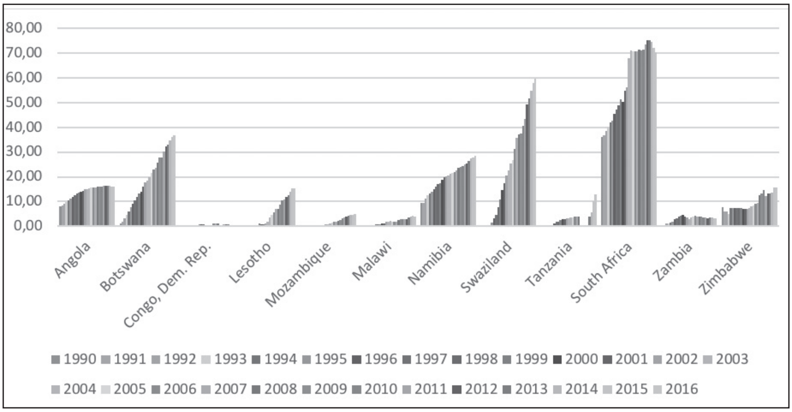
Source: Authors' composition, based on data from World Bank

Furthermore, a clear divide exists between rural and urban areas. Only 5 per cent of the region's rural residents have access to electricity in the SAPP coverage area (Figure 4.7). About 45 per cent of energy consumption in SADC countries arises from the use of solid fuel (that is, traditional biomass such as charcoal and wood) (SADC and SARDC, 2016) and the divide between the urban and rural populations is evident, except in countries where the use of solid fuels is widespread throughout the population (the DRC, Malawi, Mozambique, Tanzania, and Zambia to some extent) (Figure

4.8). The large use of traditional biomass is a key indicator of the lack of access to modern energy services, notably electricity. Only South Africa shows a favourable situation, thanks to an ambitious electrification programme rolled out since democracy in 1994. Electrification improved from around 50 per cent in 1994 to close to 90 per cent at the end of 2016, as a result of the government-led Integrated National Electrification Programme (INEP), which provides both grid and non-grid connections, as well as the Free Basic Electricity (FBE) policy, which provides households connected to the national grid with 50 kilowatt hours of free electricity a month (Madakufamba, 2010; Wilkinson, 2015; DoE, 2016; Le Cordeur, 2017; Montmasson-Clair, 2017).

Electricity equity is further hampered by tariffs considered to be both too low to stimulate investment and too high for most of the population (RERA, 2016). While tariffs may be higher than the average cost of generation (see Figure 4.9), additional costs, such as those relating to losses, transmission and distribution, can add US $60–100 per megawatt hours to the total cost of electricity supply. Furthermore, only Namibia and Tanzania have achieved cost-reflectivity (Creamer, 2015) and most countries are embarking on utility-scale, centralised investment programmes, therefore paving the way for further increases in other countries.

Figure 4.7: Access to electricity in SAPP countries (in percentage of rural population) from 1990 to 2012

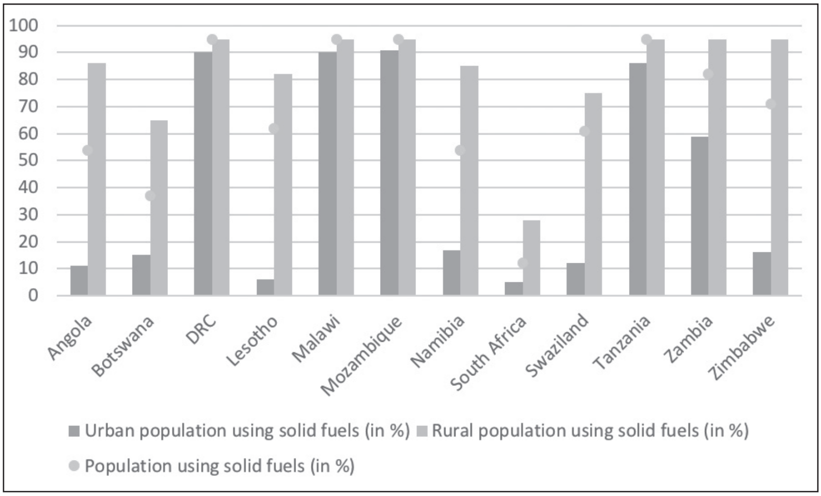


Source: Authors' composition, based on data from World Bank

However, electricity deficits in southern Africa, coupled with unaffordable tariffs for the poor, continue to reinforce (energy) poverty. Insufficient and/or inadequate access to modern energy services limits inclusive growth. As such, without universal and affordable access to modern electricity, SADC's socio-economic development targets are virtually unattainable.

Centralised electricity systems in southern Africa have been essentially designed to cater for the needs of industrial conglomerates and high-income groups (Scott, 2015). All SAPP countries continue to struggle with low electrification rates and/or widespread energy poverty. While a number of social tariffs and free electricity schemes target the poorest households in most countries, this situation is extremely problematic, all the more so given that electricity tariffs are already unaffordable to large groups of the population (SADC and SARDC, 2016).

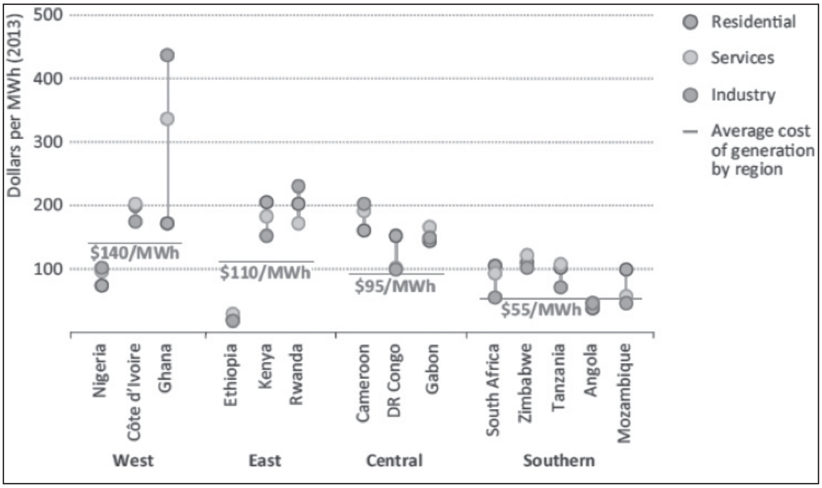
Figure 4.8: Use of solid fuels in SAPP countries in 2013 (in percentage of population)



Source: Authors' composition, based on data from the IEA

Despite a degree of progressive cost subsidisation between industrial users and the poorest consumers in the case of South Africa, the most vulnerable households continue to pay the highest tariffs and have access to the least advanced infrastructure. By contrast, energy-intensive users can benefit from special pricing agreements, like the aluminium-smelting company, South32 (previously BHP Billiton), in South Africa and Mozambique (TIPS, 2013). The repressiveness of this unbalanced situation, structured on centralised and vertically integrated systems, has undermined the sustainability of the region's economic growth and energy systems, and hampered the emergence of more sustainable alternatives.

Figure 4.9: Grid electricity prices by end-use sector in selected countries in 2013



Source: IEA, 2014b

Note: The average cost of generation in southern Africa stood at US $55 per megawatt hour in 2013, materially lower than in other African regions. Electricity prices are in most countries substantially higher than the cost of generation, particularly for residential customers.

As discussed later, the introduction of renewable energy technologies, particularly small-scale systems, offers an opportunity to break this deadlock through new, cost-effective and sustainable solutions to electricity security and electricity equity.

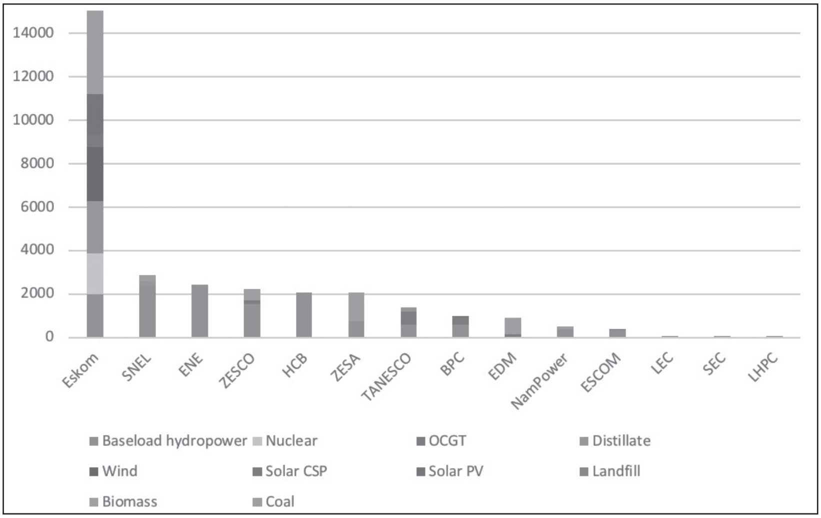
Environmental sustainability: Ensuring resilience and efficiency

The electricity sustainability performance of the region is further weakened by the poor environmental sustainability of the electricity supply industries. While the region hosts electricity systems of various sizes, structures and qualities, the lack of diversity of energy sources leads to a poor resilience. As displayed in figures 4.10 and 4.11, the region virtually relies on only two sources of electricity, namely hydropower and coal.

Countries can be divided into three groups: coal-based countries (South Africa and Botswana), hydro-based countries (Mozambique, Malawi, Angola, Lesotho, the DRC, Namibia, Zambia and Swaziland), and countries relying on a mix of hydropower and coal (Tanzania and Zimbabwe). Although other technologies are slowly emerging (gas is growing fast and solar and wind technologies are rising), they remain too small to meaningfully diversify electricity supply and improve the resilience of electricity systems at this stage. New generation projects, such as new coal-based power stations in South Africa (primarily Kusile and Medupi) and Botswana (Morupule B), are expected to entrench the current picture in coal-based countries (Eskom, NDa; Eskom, NDb; World Bank, 2017). Similarly, several projects – on the Congo (DRC), Zambezi (Zambia–Zimbabwe), Kwanza (Angola) and Ruhuhu (Tanzania) rivers – will further enhance the domination of hydropower in other countries (Miketa and Merven, 2013).

Resilience is primarily a challenge for hydropower-based countries, as illustrated by the electricity shortages triggered by the drought in 2015–2016. In the long run, the region is likely to suffer from the effects of climate change and the stronger El Niño-induced weather conditions, which have seen dam levels in most countries dropping (IEA, 2016). Zambia's experience illustrates the erratic nature of hydroelectric power in the region. Zambia's large hydropower initiatives supply 99 per cent of the country's electricity. Despite the scope of resources available in the country, energy security has been a recent challenge, as the country continues to grapple with electricity deficits, arising from dwindling water reserves due to the recurring drought across the African continent (Miketa and Merven, 2013; Mills, 2016).

Figure 4.10: Electricity mix in 2016/17 for SAPP producers (in MW)



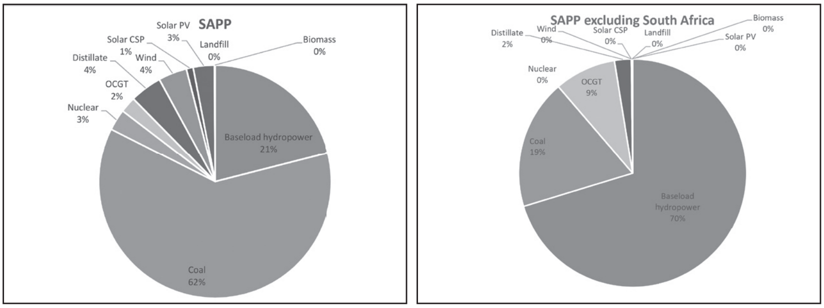
Source: Authors' composition, based on data from SAPP Annual Reports

Note: For readability, South Africa's generation capacity, which reaches 46 963 MW, including 35 721 MW from coal-fired power plants, is not fully displayed in the graph.

Resilience can, however, also be a challenge for coal-based countries. While originating from multiple causes, South Africa's recent load-shedding crises (in 2008–2009 but also in 2014–2015) were, for example, exacerbated by poor coal-stock management (Das Nair et al, 2014).

By contrast, the reliance of the region on hydropower brings important benefits for electricity sustainability. While the socio-environmental drawbacks of large hydropower systems (such as population displacement) must be acknowledged, the low-carbon nature of the water-based schemes results in most southern African countries displaying a relatively low carbon intensity (Figure 4.12). South Africa is a notable exception in this respect due to the country's essentially coal-based electricity system.

Figure 4.11: Electricity mix in SAPP countries in 2016/17 (in percentage of total)



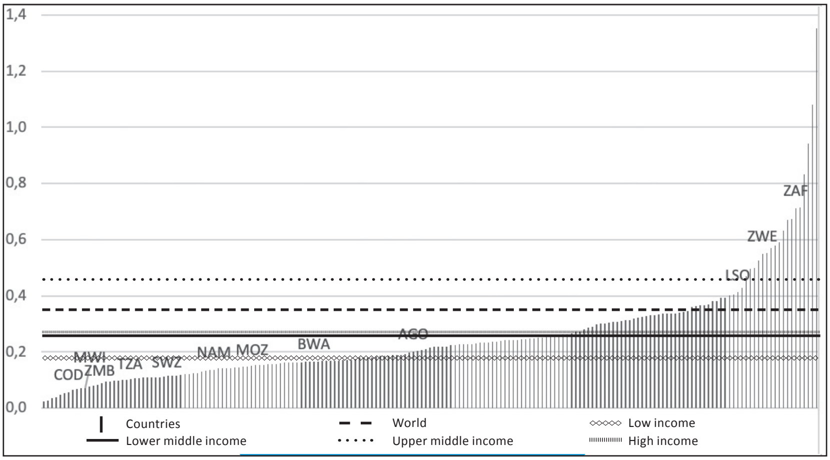
Source: Authors' composition, based on data from SAPP Annual Reports

Note: Both charts must be considered independently due to the overwhelming domination of South Africa, which accounts for more than three-quarters of the region's total generation capacity.

The low-carbon feature of the region, however, masks the deep energy inefficiency of the southern African economies, which largely perform worse than global benchmarks (Figure 4.13). A high degree of diversity, both in carbon and energy intensity,[5] must, nevertheless, be noted in the region due to the differences in electricity mixes, levels of economic development and industrial structures.

The potential for energy efficiency improvement in the region therefore remains significant. A 2012 estimate by Eskom identified an energy demand savings potential in South Africa alone of 12 933 megawatts (IDC, 2013). This is significantly more than what has been achieved and is ambitioned throughout the region. According to the SAPP Secretariat, demand-side management measures in the region already achieved savings of 4 561 megawatts from 2009 to September 2015, including 3 461 megawatts from compact fluorescent lamp (CFL) and light-emitting diode (LED) programmes and 700 megawatts from commercial lighting energy savings. Still far from the regional potential, these savings are expected to gradually increase to about 7 000 megawatts by 2020, notably thanks to the phase out of incandescent light bulbs (effective since 31 December 2017) and improved energy efficiency in industrial and residential sectors (SADC and SARDC, 2016).

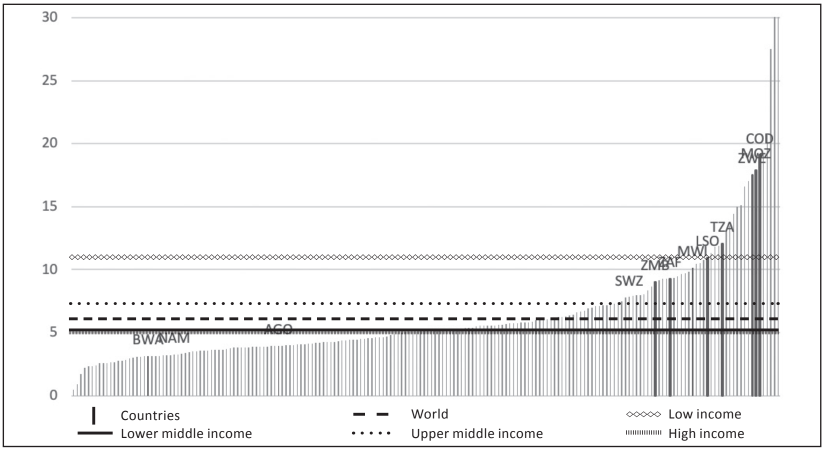
Figure 4.12: Carbon intensity per country in 2013 (in kgCO2e per 2011 PPP US $ of GDP)



Source: Authors' composition, based on data from the World Bank

The poor state of transmission and distribution networks in the region further aggravates the inefficiency of the electricity systems (Economic Consulting Associates, 2009). While poor data on the issue make it difficult to paint a true picture of the quality of the electricity wires in the region, SAPP data, shown in Figure 4.14, provide a general idea of the situation, with several countries experiencing high transmission losses (Angola, the DRC and Lesotho, for example) and deteriorating performance.[6]

Figure 4.13: Energy intensity per country (in MJ per 2011 PPP US $ of GDP)



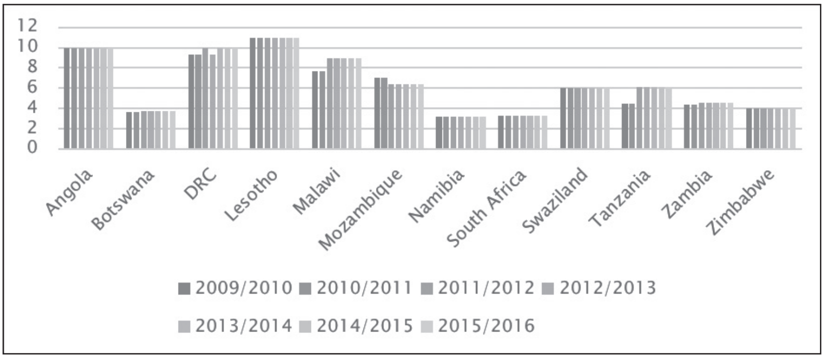
Source: Authors' composition, based on data from the World Bank

Preliminary conclusions: Bringing it together

Southern African countries have historically performed poorly in terms of electricity sustainability due to strong energy supply concerns, limited access to modern energy and the lack of diversity of electricity supply. Based on the WEC (2016), which ranks countries in terms of energy sustainability (that is, not just electricity but also liquid fuels), South Africa, SAPP's best-ranking country, stands at the 84th position (out of 125 countries ranked by the WEC). Botswana and Swaziland rank 94th and 95th, respectively, while Zimbabwe, the DRC and Malawi close the table at the 113th, 117th and 120th, respectively. The general poor performance of the region must not, however, mask regional disparities, as SADC member countries are at different developmental stages, partly explaining the variation in ranking and scores, and pockets of strong performance.

Importantly, while some countries display a relatively strong performance on one of the metrics (that is, electricity security, electricity equity or environmental sustainability), their situation is undermined by their weak performance in other dimensions. No country in the region

Figure 4.14: Transmission losses from 2009/10 to 2015/16 for SAPP countries (in percentage of total)



Source: Authors' composition, based on data from SAPP Annual Reports

manages to leverage the co-benefits existing between the three areas and perform well on all dimensions. As raised in the introduction, the dimensions of electricity sustainability are complementarity in nature and have the potential to reinforce one another. The challenge is not to find ways to make the three core dimensions compatible but to implement the right policies (and inclusive governance) to harness the co-benefits between them.

The region benefits from huge natural (renewable) resources, which are largely untapped. Maximising the potential of regional resources (particularly through renewable energy technologies) would lead to increased regional trade, cost savings and a substantial improvement in electricity sustainability.

Based on modelling from Miketa and Merven (2013), the SADC's identified renewable energy potential can assist the region to achieve universal access to modern electricity while reducing costs in the long term. The share of renewable energy technologies, excluding large hydropower, in electricity production in the region could increase from the current level of 10 per cent to as high as 46 per cent by 2030. This is confirmed by a 2009 SAPP Regional Generation and Transmission Expansion Plan study (Nexant, 2009), which indicated possible cost savings of up to US $48 billion (over a 2006–2025 period) providing countries coordinated better and pursued projects collectively as a region. Seizing this potential requires harnessing the benefits of regional integration in the southern African sub-continent, which is the focus of the next section.

THE ROLE OF REGIONAL INTEGRATION: STATUS QUO AND THE WAY FORWARD

The need for further progress in achieving electricity sustainability in the SADC region has been highlighted. This section analyses the existing role of regional integration in the electricity sector and explores the main channels through which it can contribute to an improvement in electricity sustainability. Three key areas, namely harmonised policies and regulatory frameworks, adequate common institutions and technical infrastructure and the development of human capabilities, are considered. Importantly, there is no need for new institutions, as regional integration can be driven through enhanced and empowered regional and domestic capacity and institutions.

Harmonising policies, frameworks and regulations

The first area of regional intervention revolves around the development and harmonisation of policies, frameworks and regulations in the energy sector. Energy policy and regulation have been progressing in the region, with 11 out of 12 SAPP countries having a national regulatory body as of April 2017,[7] both clarifying and complexifying the legal and regulatory landscape.

The Regional Electricity Regulators Association of Southern Africa (RERA) was launched in 2002 to support the harmonious development of policy and regulatory frameworks in the region.[8] The association took an important concrete step towards the harmonisation (ie, compatibility) of national regulatory systems with the development of regulatory guidelines, approved by the SADC Energy Ministers in April 2010 (Sichone, 2015).

The guidelines aim to ensure that efficient cross-border deals are not constrained by unclear or complicated processes for making regulatory decisions. They focus on large-scale/long-term transactions, which are predominant and more likely to influence investment decisions, the efficiency of electricity interconnections and electricity trade in the region.

The regulatory guidelines seek to:

- clarify how regulators carry out their powers and duties in regulating cross-border electricity transactions to minimise regulatory risks for power investors and electricity consumers;
- promote efficient and sustainable cross-border electricity transactions that are fair to selling and buying entities, are consistent with least-cost sector development, and can help to ensure security of supply; and
- promote transparency, consistency and predictability in regulatory decision-making.

While noteworthy, these guidelines have, however, no formal legal status and remain voluntary. Indeed, the RERA is primarily a forum through which national regulators share their experiences. Moreover, the guidelines are incomplete because they do not cover short-term/small transactions (less than a year and 20 megawatts of power) and the competitive market. As a result, they have had the unintended consequences of perpetuating and further entrenching the domination of long-term, bilateral transactions over the regional market (discussed later).

Indeed, the absence of a clear regulatory framework for decentralised, cross-border transactions renders such operations difficult and unpredictable. Concerns on the physical security of transmission infrastructure and contract security remain high in the region, particularly due to the absence of a regional regulatory framework. Importantly, the current framework is silent on measures to regulate pilferage of power imports meant for another country, leaving electricity importers with no control over the transmission infrastructure in other states through which their own imports pass (SADC and SARDC, 2016).

In addition, energy regulation is still nascent in the region and lacks capacity and skills in most countries and at the regional level. Energy policy appears fundamentally inadequate, with long-term planning being largely outdated in time and best practice, and lagging in implementation. Furthermore, regulators lack independence and remain pray to regulatory capture and political pressures.

The SADC has developed numerous regional plans and strategies in the energy space to attempt to remedy the situation, as raised in the introduction. The Regional Strategy for Increasing Energy Access (March 2010), the SADC Regional Energy Access Action Plan, the REEESAP (2016) and also the development of a Climate Change Adaptation Strategy are a few examples.

Common implementation frameworks are, furthermore, being progressively developed. The SAPP Energy Efficiency Framework, finalised in 2014/15, is one example. The framework proposes a tracking mechanism to ensure compliance and standardisation, especially in the measurement and verification of energy savings. It aims to inform how the power pool should roll out its energy efficiency programme, including the roles of the private sector and the energy service companies. It also developed a LED roll-out business case, specific programmes for CFL replacement involving 11 national utilities (SADC, 2016), and supports the development of a virtual power plant (VPP), as it seeks to augment ongoing efforts to increase electricity generation capacity to beat shortages in the region[9] (SADC and SARDC, 2016). The Smart Grid Concept Paper, prepared in 2014/15 to assist individual utilities in the migration to smart grids, is another instance.

The implementation of such plans, strategies and frameworks, as illustrated in the case of the SADC strategy and action plan for energy access, remains problematic. The *Regional Strategy for Increasing Energy Access* was published in March 2010. It aims, at the strategic level, to harness regional energy resources to ensure, through national and regional action, that all the people of the SADC region have access to adequate, reliable, least-cost and environmentally sustainable energy services. At the operational level, the strategy has an objective to ensure that the proportion of people without such access is halved within 10 years for each end use and halved again in successive five-year periods until there is universal access for all end users. A SADC Regional Energy Access Action Plan was also developed at the same time (2010) to operationalise the strategy. A three-year action plan, with clear strategic objectives, activities (with responsibilities), measurable outputs and expected outcomes was also designed (SADC, 2010). There is, unfortunately, no evidence, as of September 2018, that any of the actions envisaged in the three-year plan have been implemented.

Altogether, the SADC has limited clout to fast-track implementation and ensure adopted initiatives are adequately resourced and funded. In fact, energy policy is not integrated at the regional level in any way. The region's energy policy is more a collection of national situations than an integrated regional framework. For instance, no electricity planning takes place at the regional level, and policy and regulatory frameworks, including standards and labelling of equipment, are not harmonised.

The Market and Investment Framework for SADC Power Projects (previously known as the SADC IPP Framework), approved in June 2016, is the latest attempt of the regional body to fast-track implementation and introduce a set of harmonised legal and regulatory rules by 2022. This framework formulates ambitious targets, including the rollout of a Target Market Model Design based on unbundled electricity supply industries, the introduction of IPPs along national utilities and the development of a financial framework to develop bankable project structures, secure support from financiers and implement projects. From a legal and regulatory perspective, this framework plans to address numerous bottlenecks by:

- developing a regional licence, through regional coordination in terms of the types and content of licences, and the recognition of licences across borders;
- harmonising rules and standards for metering;
- developing a cross-border dispute settlement methodology;
- harmonising tariffs, particularly for transmission, and moving towards cost-reflective tariffs;

- managing transmission losses at the regional level;
- establishing common grid access rules for connecting to the networks;
- developing regional rules for interconnector congestion management;
- setting up a regional grid code; and
- coordinating generation and transmission asset development planning (Sichone, 2016).

As a response to low tariffs and the lack of investment in the region's energy sector, the framework has been complemented by the political calls of SADC energy ministers to achieve cost-reflective tariffs by 2013 (initially) and by 2019 (now).

Policy implications

Going forward, the implementation of the regional plans and strategies arises as the priority for the region from a policy and regulatory perspective. The SADC and the SAPP will be instrumental in addressing sovereignty concerns and ensuring that the development of regional regulation is not limited to the lowest common denominators. The ambition of regional integration should be to harmonise frameworks upwards and with a development (rather than private sector) focus. Caution must be raised on forcing a standardised approach on countries facing varied national circumstances. The aim of the Market and Investment Framework for SADC Power Projects to roll out a Target Market Model Design is problematic, as it attempts to mainstream particular market structures and tariffs methodologies in countries, potentially depriving governments of important policy levers.

In fact, even though a regional understanding on the role of the private sector was reached at the operational level in June 2015 (SAPP, 2017), the region displays a variety of situations and approaches with regard to the unbundling of vertically integrated national utilities and the introduction of competition, through IPPs, at the generation level (Eberhard et al, 2011). Harmonisation does not signify one-size-fitsall solutions. A harmonisation of the regulatory frameworks does not mean that the architecture of the electricity supply industries needs to be identical in every country. While common rules are required for a regional market to operate, the role of market players, such as state-owned enterprises and IPPs as well as tariff structures, can remain different from one country to the other.

While the calls for cost-reflective tariffs is understandable from the perspective of national utilities, which need to be financially sustainable, it is potentially problematic if it is not associated with a dramatic improvement in the performance of such entities and the elaboration of clear plans to mitigate negative impacts on low-income households and businesses. A general push towards small-scale, renewable energy-based systems would, in this respect, provide an elegant avenue to restructure the electricity supply industries in the region, circumvent tariff issues (by turning consumers into prosumers) and shift to sustainable (from an economic, social, environmental and governance perspective) energy solutions.

At the same time, such a situation also calls for reviewing the role and functions of the regional institutions and regulation and, as raised by Muller (2013:2), the 'challenges of network infrastructure provisions the twenty-first century'. Importantly, the region does not need new or additional institutions, and implementation can be driven by existing entities at the regional and national levels. In fact, the implementation difficulties experienced by previous plans and strategies warrant that the SADC, the SAPP and the RERA play a driving force in the operationalisation of a regional framework and the development of a regional *acquis* (SADC and SARDC, 2016). The development of a regional electricity plan, which can inform the national planning exercises in the future, is key to the success of regional integration. Similarly, establishing regulatory benchmarks are a prerequisite to any meaningful performance monitoring.

More broadly though, the past and present difficulties in delivering energy sustainability in the region suggest the need to review the forms of governance and regulation in the electricity sector in southern

Africa. In the case of South Africa, for example, the regulatory agency's approach has been overtly inadequate in preventing electricity supply crises and precipitated significant tariff increases at the expense of the economy and society (Muller, 2013; Das Nair et al, 2014). Improved regulatory performance is vital for regional development. This does not, however, reside solely in the realm of regulators. In addition to regulatory entities, capable states (that is, departments, municipalities and state-owned enterprises) and empowered stakeholders are required to ensure efficient and adequate regulation. As such, the region should explore complementing the regulatory agencies with alternative models and approaches. Such options include: retaining or (re)introducing direct regulatory oversight (ideally at the regional level) as part of governmental administrative functions; creating a framework for structure regulatory processes in which stakeholders can participate and actively influence regulatory decisions; and regulating by contract, specifically achieving the benefits of private-sector provision by allowing competitive bidding for the development and operation of new infrastructure, relying on contractual provisions to enforce conditions and protect investors and the state (Muller, 2013).

Another important avenue is the creation of effective linkages between the energy and industrial development frameworks in the region, with the aim of creating regional energy value chains and building local manufacturing and service capabilities. As regional energy integration occurs in the southern African region, a regional strategy to reap industrial development benefits should be designed accordingly. Markets for energy projects, technologies and services are fragmented along national boundaries and the experience of local economies with the development of local industrial capacity (see, for example, Montmasson-Clair and Das Nair (2015), for South Africa's experience) has shown the difficulty in sustaining industrial development in the sector. The creation of an integrated regional market for energy, rather than fragmented national markets, would enable the emergence of regional firms to manufacture the required energy technologies and service the market.

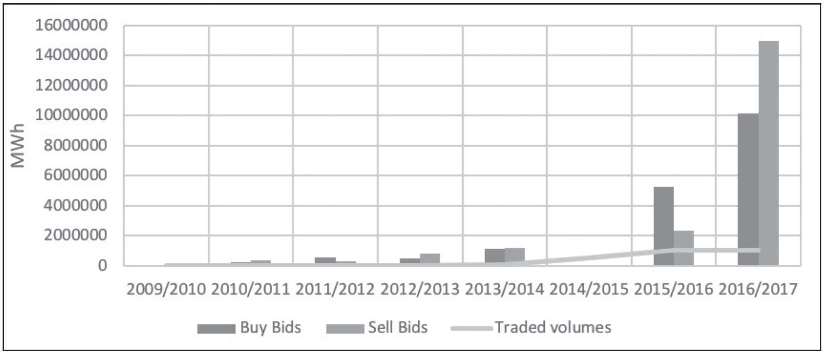
Further reflection should be done on the possibility of designing a regional (rather than local) content strategy, therefore creating a regional market. SADC countries should consider exploring cumulation[10] of local content rules for regional agreements. This would involve counting components sourced from the region as local, and thus allowing imports from the region to feed into the procurement of designated products. The creation of free movement areas for skills and competences among SADC countries would also be important in this respect.

Building common institutions and technical infrastructure

The second avenue for regional integration to assist with achieving electricity sustainability is the development of the technical infrastructure. Notable progress has been made in developing the regional electricity infrastructure since the creation of the SAPP in 1995, from the transmission networks to the trading platforms. Despite its limited role and functions, SAPP is regarded as the most advanced power pool on the African continent in terms of trading structures.

Regional trading was initially confined to bilateral contracts among member utilities, that is, fixed, long-term (generally from one to five years, but possibly longer) cooperative contracts between utilities. SAPP then operated the Short-Term Energy Market (STEM) from 2001 until 2007, when the region (that is, South Africa) ran out of surplus capacity. The STEM market catered for about 5 per cent of SADC's energy trade. Comprising daily and hourly contracts, mainly covering off-peak periods, the STEM was a precursor to the full competitive electricity market that was successfully developed in the form of the Day-Ahead Market (DAM). The development of the DAM started in 2003 and the market went live in December 2009. Volumes of power traded on the DAM have increased materially over the seven years of existence of the market, and especially in the last biennium, as showed in Figure 4.15, demonstrating the increased maturity of the market. In 2016, SAPP introduced a Forward Physical Market and an Intra-Day Market.[11]

Figure 4.15: Total energy requested, offered and traded on the competitive market from 2009/10 to 2016/17



Source: SAPP (2018)

However, the role of regional trading mechanisms remains limited. Indeed, the quest for regional electricity sustainability in the SADC involves a delicate balance between national and regional interests. Amid acute shortages, countries have favoured the sovereign route of attempting to attain national self-sufficiency, rather than depending on imports from other countries. For example, while the coal-based Mmamabula Power Station project, located in Botswana near the South African border, was initially meant as a regional initiative, Botswana decided, in the face of electricity shortages, to build the project on its own rather than wait for the long process of regional negotiations to take place (Jindal Africa, ND). Initiated by five member states to draw power from the DRC to Angola, Botswana, Namibia and South Africa, the Westcor Power Project is another illustration of the difficulty in building regional initiatives. The project is now moribund due to various factors, including national concerns over security of supply (Mathews, 2017).

Furthermore, when turning to the region, countries tend to favour a bilateral approach, striking long-term supply agreements. As shown in Table 4.1, while the regional, competitive market accounts for an increasing share, long-term bilateral transactions still dominate the market. For example, South Africa's Eskom and Namibia's NamPower signed a five-year electricity sales agreement in March 2017. The unidirectional deal does not have a fixed payment and will depend on the energy consumed, but the agreement should see Eskom supplying NamPower with a firm capacity of 200 megawatts, as well as an additional supply dependent on transmission capacity. NamPower also has power purchase agreements with the Zimbabwe Power Corporation (a subsidiary of the Zimbabwe Electricity Supply Authority) and Zambia's ZESCO of 80 megawatts and 50 megawatts, respectively. Similarly, Eskom already has long-term agreements in place with the Lesotho Electricity Company and the Swaziland Electricity Company, and it intends to conclude agreements with other SAPP members (Eskom, 2017; Shihepo, 2017).

Table 4.1: Share of electricity traded in the SAPP region according to trading channels

Share of electricity traded	2013/2014	2014/2015	2015/2016	2016/2017
Regionally	1%	6%	14%	11%
Bilaterally	99%	94%	86%	89%

Source: Authors' composition, based on data from SAPP Annual Reports

Regional trade has also been heavily constrained by the lack of adequate transmission infrastructure. While many more projects are underway and in the pipeline to improve the regional electricity grid (such as the connection of Malawi, Tanzania and Angola to the regional electricity grid by 2021), weak and limited electricity grid infrastructure has, indeed, limited regional integration.

Angola, Malawi and Tanzania are not yet connected to the rest of the region and the allocation of resources is not optimised. Figure 4.21 shows that, with the exception of 2016/17, electricity demand has been much larger than the supply offer on the regional market over the last few years, and highlights the potential for further regional trade, provided there is adequate planning. In addition, a share of possible transactions is not realised as a result of transmission infrastructure constraints. In other words, the maximum possible trade based on price, demand and supply at a given time (matched bids) is larger than the capacity of the network. Such matched but not traded bids can reach more than half of matched bids in the summer months of the Southern Hemisphere.

Policy implications

Going forward, the SADC, through the SAPP notably, should pursue planned cross-border projects, with a focus on connecting Angola, Malawi and Tanzania to the regional grid and enhancing key backbone links. While several projects are underway, the interconnection of the region remains limited and primarily structured around bilateral contracts.

The region should further investigate the role of super-grids, which consist of high-voltage direct current (HVDC) (or even ultra-high-voltage direct current) transmission networks. While HVDC lines are not new (the Cahora Bassa-to-Johannesburg transmission line was built from 1977–1979) (ABB, 2012), the super-grid concept suggests a network of HVDC transmission systems that are strategically designed and implemented to maximise efficiency and tap into the best available (renewable) resources (Hansen, 2016). HVDC lines may be more expensive to construct than high-voltage alternating current lines, but they generate cost savings in the long run due to high system efficiency, such as reduced transmission losses. Lower voltages of transmission or distribution lines, coupled with great distances, lead to high energy losses (RERA, 2016). In addition, super-grids are emerging in China, Brazil and India, opening opportunities for South–South cooperation and capacity building.

Complementing the development of large cross-border infrastructure, the SAPP should also pursue the deepening of the regional market. The limited but growing role of regional mechanisms (compared to bilateral deals) is promising. So far, the SAPP has been able to provide sufficient market-related conditions for regional trade to take place. For example, according to SAPP's Annual Reports, no market abuse has been recorded over the last few years. The trading system also provides online information to market participants, answering short-term market transparency needs. As the regional market grows and trade rises, stronger, particularly long-term, surveillance and improved financial security requirement measures (to minimise financial settlement risks) will be important. The need for increased coordination of maintenance and planned outages of generation and transmission equipment (concentrated in summer), resulting in reduced available power being offered on the market and reduced trade volumes, is also evident.

In addition to cross-border transactions, further work is required to support the local rollout of smart and micro-/mini-grids, particularly to support rural electrification. Small-scale, localised power generation technologies (based, for instance, on solar, wind, hydropower and/or biomass systems) are effective solutions for the electrification of areas that are not financially feasible for utility-grid connection, such as rural and remote locations within the SADC (ODI, 2016). The IRENA projected that 14 terrawatt hours of rural electricity could be provided by decentralised electricity systems in the region by 2030 (Miketa and Merven, 2013). For example, Tanzania's Rural Energy Agency and Rural Energy Fund have identified off-grid, solar-based technologies as a key driver of electrification in the country. Solar energy has, indeed, been prized as an effective measure to combat energy poverty, with off-grid solar-based systems providing electricity to around 15 per cent of the country's population (Bailey et al., 2012; ODI, 2016; Prinsloo, 2016).

More broadly, rooftop solutions are also adequate for most residential and commercial operations, and crucial empowerment channels for all consumers, providing the ability to become prosumers. The potential for micro-grid systems to promote local economic development and contribute to users' income should also be investigated. Promoting the ownership and productive uses of off-grid systems, while desirable, does require different public programmes from simple energy provision. Additional, short-term government programmes, such as user training, skills development (notably for operation and maintenance), cooperation schemes and entrepreneurship support are necessary to enhance the reliability and sustainability of the systems (particularly in the long run) and trigger the productive usages of energy access (Feron, 2016). Furthermore, such technologies constitute major manufacturing opportunities for the region (see Montmasson-Clair et al, 2017, for more details on the potential in the South African context), echoing the recommendation made earlier.

The economic sustainability of such systems, particularly for poor rural populations, often requires some public support, at least to cover both the initial investment and the operation and maintenance of the systems or for subsidising private investment in rural electrification (Ngoepe et al, 2016). The SADC, as part of the financial integration leg of the Market and Investment Framework introduced earlier, should look at funding models for embedded generation. Financial schemes, such as Botswana's Rural Electrification Collective Scheme (simultaneously combining cost recovery mechanisms with pro-poor financial incentives; see Jain, Jain and Dhafana, 2014, and Vyas, 2011, for more information) or South Africa's framework (INEP, FBE and VAT exemption on paraffin) can be established to assist low-income communities.

In this respect, the SADC needs to play a stronger role in effectively securing funding for energy projects in the region. There is currently limited support for bankable project preparation and a lack of capacity to initiate, implement and manage innovative projects. The SADC could actively drive fundraising for strategic and/or cutting-edge projects, notably by bundling similar small projects together for funding applications. The creation of a regional one-stop shop for potential project developers and investors would also help facilitate investment in the region. Such a clearing house could include the development and maintenance of a database covering all existing funding sources available to the region. The creation of a regional financing mechanism, including a regional fund, would also ease the implementation of multi-country, electricity-related projects in the region.

Fostering the development of human capabilities

The development of regional human capabilities is the third key avenue for regional integration. Given the nascent nature of energy regulation in the region and the rapidly evolving techno-economic environment in the energy space, the presence of well-capacitated and diverse teams and stakeholders with up-to-date knowledge, skills and competences is at the core of a successful regional integration.

The policy mandate to create a regional market for skills and competences is clear, as formulated by the RISDP, the SADC Regional Industrial Policy Framework and the Post-2015 Inclusive and Sustainable Industrial Development agenda.

Some capacity building and experience sharing is organised at the regional level, through the SADC, the SAPP and the RERA. Through the SAPP, the region hosts several technical sub-committees (on markets, planning, operating issues and environmental matters). In addition, experience-sharing workshops are regularly hosted with the support of international partners. Examples included an Energy Management and IPP Framework workshop in June 2015; a joint IRENA-SAPP workshop on Renewable Energy Zoning in the region (2014); workshops on the integration of renewable energy sources to the interconnected power grid (2014 and 2015); a workshop on a Framework for Open Access to the Transmission Grid (2014); a World Bank workshop on Water and Energy Nexus in the Zambezi Basin; and Training on Equator Principles and Due Diligence in 2014.

The RERA is also facilitating capacity-building activities. As part of an initiative to establish a regional platform for sustainable long-term capacity building for RERA's members, commissioners, and other technical and support staff, a RERA Training Needs Assessment was conducted with support from USAID, leading to the development of training curricula and modules for RERA. In addition, the European Union is supporting a four-year technical assistance programme to develop regulatory frameworks and strengthen local capacity, particularly with regard to renewable energy and energy efficiency. The IRENA is providing support to RERA as part of the Regulatory Empowerment Project to improve the governance of electricity planning and the integration of renewable energy (Magombo, 2016).

Furthermore, the Energy Thematic Group was created, based on the recommendations of a review of the 2006 Windhoek Declaration on a New Partnership between the SADC and the international cooperating partners. It is a multi-stakeholder group, including the SADC Secretariat, SADC subsidiary organisations, international cooperating partners, the Southern African Research and Documentation Centre, the private sector, and multilateral and bilateral financial institutions. The Energy Thematic Group serves as a technical coordination and advisory group, and acts as a forum for dialogue, networking, partnership building and the creation of shared understanding between the main regional partners (Moser, 2015). However, the absence of labour and civil society representatives in the group is a key hindering factor to inclusive governance in the sector.

Against that mandate, little progress has been made to develop national and regional experts as well as the capacities of stakeholders. There is notably limited capacity and awareness of available energy resources and technologies (particularly renewable energy and energy efficiency), and their techno-economic possibilities. Similarly, knowledge on the socio-environmental impacts and acceptability of various technologies is strongly lacking. Such a situation is correlated to the lack of expertise at vocational and university levels in the region. Outside of South Africa, there is little research and development capacity, particularly due to a dearth of funding. At the same time, regional cooperation between research institutions appears limited. Overall, the scale and reach of the existing initiatives remain too small to address the lack of experience sharing and capacity building (SADC and UNIDO, 2014).

In addition, most capacity-building programmes target existing human resources in the sector, higher education institutions and decision-makers. There is very little investment in building the capacity of communities or building a network of community practitioners, especially those engaged in the delivery of decentralised electricity systems. The result is that communities have little or no role in decision-making about the electricity systems being planned and delivered, and are not included in any governance structures. This oversight needs to be addressed if electricity sustainability (particularly electricity equity) is to be achieved. There are examples of community-based electricity systems in the region – for example in Tanzania – that can form the basis of a region-wide community network of learning.

The fiasco of the Grand Inga project in the DRC, often described as a 'white elephant', illustrates the lack of capacity to deliver large-scale projects. In 2016, the World Bank announced it had suspended its financial support to the project. The main reasons behind this decision revolve around the lack of transparency and independence, the failure to observe international good practice in terms of governance, high risks in terms of fiduciary responsibilities, and a lack of institutional capacity for implementation and technical design capacities (Fabricius, 2016). In South Africa, Eskom's extreme difficulty in delivering the two large-scale coal-fired power plants, Medupi and Kusile, on time and on budget, is another example of the lack of internal capacity (Yelland, 2016).

Most SADC's frameworks, plans and strategies also emphasise the need to build data and information databases and repositories to improve evidence-based decision- and policy-making. This is notably the case of the SADC Regional Strategy for Increasing Energy Access and its Action Plan discussed earlier. A number of areas are generally considered in this respect, namely the collection of baseline data and information on the current state of play, the access to up-to-date information on academic and professional knowledge (from a policy, regulatory, socio-economic, technical and technological perspective), and the development of forecasting and planning capabilities.

Information and data on energy, like many other topics, remain scarce and of poor quality in the region. As illustrated by the data discrepancies on energy losses, this poses significant challenges for decision-making in both policy and investment circles.

Policy implications

The lack of representativity of the regional institutions and governance structures, particularly the absence of labour unions and civil society, is a key obstacle to achieving inclusive growth in the sector. Significant effort must be directed towards broadening the inclusivity of multi-stakeholder institutions, like the Energy Thematic Group, and the genuine engagement with local stakeholders of regulatory institutions.

More broadly, inclusive regionalism (also known as new regionalism) should be actively pursued, through the involvement of a wide range of stakeholders and the creation of more networked forms of governance (see Muller, Chikozho and Hollingworth, 2015, for more details on such approaches).

Such a process should be complemented by a bottom-up, grassroots approach that prioritises capacity-building activities that are aligned to the needs of specific institutions and stakeholders, while considering their position in the regional arena (AfDB, 2013). This should be targeted particularly at community and civil society levels to foster inclusive governance in the region.

A regional cooperative framework should be established to assist with developing the 'human infrastructure' of the energy sector, as proposed by the African Development Bank (AfDB, 2013). The SAPP could act as the implementing agency in project development while, in the long term, the RERA could check and monitor national compliance.

Such a cooperative framework should include the development of regional knowledge programmes, through the harmonisation of regional curricula at tertiary institutions and centres of excellence, as well as the facilitation of the mutual recognition of (vocational) certifications. Establishing regional educational, training and electricity institutions, through the enhancement of existing national institutions, such as the South African Renewable Energy Technology Centre, which trains wind-turbine service technicians locally, as opposed to sending them abroad for training, or recruiting experts from developed countries, are other examples.

Moreover, the region should facilitate and organise enhanced cooperation between research and development institutions on energy issues. This could take the form of exchange programmes, joint research projects and/or knowledge-sharing workshops. Additionally, more efforts are required to engage and experiment with community-based initiatives. As raised earlier, the rollout of small-scale power solutions is a crucial pathway to empower communities in a sustainable fashion.

The SADC, through the SAPP and the RERA, should also play a central role in building capacity in countries and institutions requiring assistance to adapt to and implement regional standards. Regional institutions should foster experience and skills sharing in the region, particularly technical and non-technical capacity building of power pool member countries. This could take the form of an extensive platform for regional workshops, with the aim of bringing experts in particular fields to train and engage in knowledge sharing with local experts.

The SADC should also engage in lesson-drawing activities, borrowing or improving on ideas from other African regional economic zones, such as the Economic Community of West African States (ECOWAS), which has embarked on various capacity-building initiatives. These have included regional assessments of human infrastructural needs and subsequently developing tailor-made programmes for specific sectors and technologies (AfDB, 2013).

The SADC should spearhead negotiations for the creation of a regional free movement area to facilitate the mobility of local skills and expertise in the region. In this respect, the SADC should conduct an assessment of skills needed and a mapping of skills that are already available in the region. Furthermore, the SADC should consider the possible deployment of available skills from other industries.

A number of data- and information-related initiatives are also required to improve the state of knowledge about regional dynamics. The necessity to improve mapping tools for needs assessment and diagnostic (such as systems losses) is apparent in the region, as is enhancing monitoring and evaluation tools to assess the needs of populations in terms of energy sustainability. The SADC should develop a one-stop information system providing insight on planned and potential energy-generation projects along with the various sources of funding available for project conception, to feasibility studies and implementation phases. Under the auspices of the SADC, member states should develop country reports on the state of electricity sustainability in the region.

Regionally integrated, sector-specific, capacity-building initiatives, involving the multiple stakeholders mentioned, are of vital importance for infrastructure project development and implementation. Sustained capacity building must occur, ensuring that human capital is up-to-date with technological and policy advancements, especially since the SADC's access to competent skills and expertise could shape the energy landscape of the region.

CONCLUSION

The road to energy sustainability in southern Africa remains long and difficult. Countries, while diverse and facing unique challenges and circumstances, all remain far from achieving their potential and harnessing the synergies between the challenges of electricity security, electricity equity and environmental sustainability. Whereas these dimensions have been considered as conflicting and impeding one another, the co-benefits existing between them, as illustrated by the rollout of decentralised solar-based systems, constitute an opportunity for the region.

Southern Africa is a rich region with a vast array of energy resources. Unfortunately, these remain largely untapped, mainly due to a lack of regional integration. The deepening of regional energy integration in the SADC region indeed offers a platform to fast-track progress towards electricity sustainability. Existing initiatives, structured around the SAPP and the RERA, notably provide the necessary building blocks for regional integration to help countries meet their energy challenges. However, this task cannot be left to utilities and regulatory bodies alone. Many avenues are available for regional institutions to play a driving and supporting role to achieve the inclusive governance of the sector and leverage the countries' vast experience. Indeed, regional integration is not an end in itself but a means to achieving a sustainable development pathway in the region.

Ultimately, regional integration remains conditioned on the willingness and engagement of member countries and national institutions, as well as robust, inclusive and transparent governance systems. The task at hand is evidently complex and ambitious, but the long-term benefits associated with inclusive regional integration are at the core of southern Africa's prosperity.

Or in the words of Tanzania's Haya proverb: 'Many hands make light work.'

NOTES

1 This chapter is extracted from a Trade and Industrial Policy Strategies (TIPS) Working Paper, initially supported and funded by the United Nations Conference on Trade and Development (UNCTAD) and the Department of Trade and Industry (the dti) of the Republic of South Africa.

2 The list of SAPP members is as follows: Botswana Power Corporation (BPC), Botswana (OP); Electricidade de Moçambique (EDM), Mozambique (OP); Hidroeléctrica de Cahora Bassa (HCB), Mozambique (IPP); Mozambique Transmission Company (MOTRACO), Mozambique (ITC); Electricity Supply Corporation of Malawi (ESCOM), Malawi (NP); Empresa Nacional de Electricidade de Angola (ENE), Angola (NP); Rede Nacional de Electricidade de Angola (RNT), Angola (NP); Eskom, South Africa (OP); Lesotho Electricity Corporation (LEC), Lesotho (OP); NamPower, Namibia (OP); Société Nationale d'Electricité (SNEL), DRC (OP); Swaziland Electricity Company (SEC), Swaziland (OP); Tanzania Electricity Supply Company (TANESCO), Tanzania (NP); ZESCO, Zambia (OP); Copperbelt Energy Corporation (CEC), Zambia (ITC); Lunsemfwa Hydro Power Company (LHPC), Zambia (IPP); Zimbabwe Electricity Supply Authority (ZESA), Zimbabwe (OP). Note that OP stands for operating member, NP stands for non-operating member, ITC stands for independent transmission company, and IPP stands for independent power producer.

3 In the energy space, a prosumer is an entity that both consumes and produces energy (generally electricity).

4 To achieve modern access to energy services, three incremental levels must be met: (1) basic human needs (electricity for lighting, health, education, communication and community services, modern fuels and technologies for cooking and heating); (2) productive uses (electricity, modern fuels and other energy services to improve productivity through notably mechanisation, irrigation and transport); and (3) modern society needs (modern energy services for many more domestic appliances, increased requirements for cooling and heating [space and water] and private transportation) (AGECC, 2010).

5 Energy intensity is a measure of the energy efficiency of a nation's economy. It is the ratio between the consumption of energy and the gross domestic

product of a country. Carbon intensity applies the same reasoning to CO2 emissions (or greenhouse gas emissions in some cases). The two are highly correlated in countries where energy is generated through carbon-intensive processes, such as coal-fired electricity. The use of low-carbon power generation technologies (such as hydropower) helps reduce the carbon intensity but does not have an impact on the energy intensity. A low energy intensity indicates a high degree of efficiency in using energy to produce goods and services, irrespective of the source. By contrast, a low carbon intensity results from both a high degree of efficiency in using energy to produce goods and services and the use of low-carbon production processes.

6 Transmission losses technically range from 4 to 8 per cent. However, they can be higher due to a multitude of reasons, such as the rollout and maintenance of transmission and distribution lines (quality, distance, size and operating hours) and associated systems (conductors and transformers).

7 The members of the RERA are as follows: Instituto Regulador do Sector Eléctrico (IRSE), Angola; Lesotho Electricity and Water Authority (LEWA), Lesotho; Malawi Energy Regulatory Authority (MERA), Malawi; Conselho Nacional de Electricidade (CNELEC), Mozambique; Electricity Control Board (ECB), Namibia; National Energy Regulator of South Africa (NERSA), South Africa; Swaziland Energy Regulatory Authority (SERA), Swaziland; Energy and Water Utilities Regulatory Authority (EWURA), Tanzania; Energy Regulation Board (ERB), Zambia; Zimbabwe Energy Regulatory Authority (ZERA), Zimbabwe. The DRC does not have a fully-fledged regulator yet. The Botswana Energy Regulatory Authority, created in 2016, is not yet a member of RERA.

8 The RERA has the following objectives:

- capacity building and information sharing, ie, facilitate electricity regulatory capacity-building among members at both a national and regional level through information sharing and skills training;
- facilitation of electricity policy, legislation and regulations, ie, facilitate harmonised policy, legislation and regulations for cross-border trading, focusing on terms and conditions for access to transmission capacity and cross-border tariffs; and
- regional regulation cooperation, ie, deliberate and make recommen-

dations on issues that affect the economy (Sichone, 2015).

9 A VPP is not a physical power station and makes extensive and sophisticated use of information technology, advanced metering, automated control capabilities and electricity storage to match short-interval load fluctuations. It aims to integrate the operation of supply- and demand-side assets to meet customer demand for energy services in both the short and long term. It also makes use of long-term load reduction achieved through energy efficiency investments, distributed generation and verified demand response on an equal footing with supply expansion (SADC and SARDC, 2016).

10 Cumulation generally refers to rules of origin, the restrictions in trade agreements that define how much value a country must add to a product for that product to be said to have originated in that country. Cumulation of rules of origin allows for the value added by certain third countries to count as local value added. For example, a product that is made in South Africa, using components from Botswana, and exported to the European Union could count a portion of those Botswanan components as 'locally-made', because all three are party to an Economic Partnership Agreement that allows for some cumulation of origin (Wood, 2017).

11 Trading is facilitated by SAPP pricing arrangement, set out in 13 detailed schedules in the operating agreement. The schedules cover four broad types of transaction: (1) firm power contracts of varying duration; (2) non-firm power contracts of varying duration; (3) mutual support contracts, such as operating reserve, emergency energy and control area services; and (4) scheduled outage energy, energy banking and wheeling. With support from Sweden, SAPP developed the Ancillary Services and Transmission Pricing System, the implementation of which was phased in over a three-year period starting in 2011. Ancillary services are essential for the reliability and security of power system operation in any competitive electricity market environment.

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