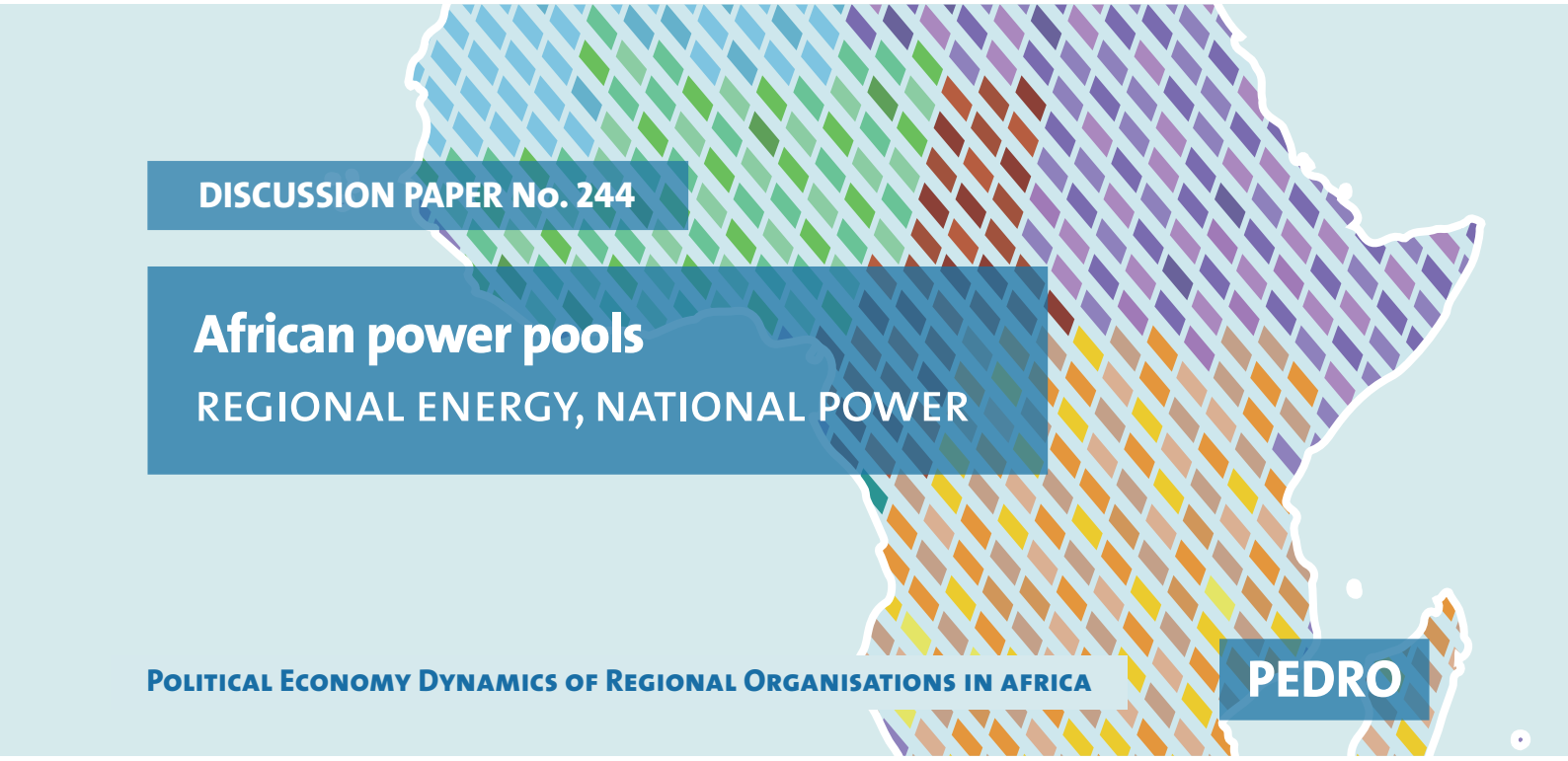
ecdpm Making policies work



DISCUSSION PAPER No. 244

African power pools

REGIONAL ENERGY, NATIONAL POWER

POLITICAL ECONOMY DYNAMICS OF REGIONAL ORGANISATIONS IN AFRICA PEDRO

By Alfonso Medinilla, Bruce Byiers and Karim Karaki

February 2019

Summary

Despite the continent's natural resource endowment of renewable and non-renewable energy sources, Sub-Saharan Africa (SSA) suffers from huge deficits in the supply and distribution of energy. While there is a need for improved electricity generation capacity and transmission infrastructure within African countries, greater cross-border trade in electric power is a potentially cost-effective way of connecting excess capacity in one country or region with (peak) demand in another. This is why power pools were established in Central, Southern and Eastern Africa.

Drawing on individual studies, this paper highlights the common objectives but quite different origins and challenges of these structures. Overall, the cases suggest that despite the initial, relative success of the Southern Africa Power Pool (SAPP), power pools across the continent are faced with:

- a deficit in investment in generating and transmitting power nationally;
- a lack of trust among states and willingness to liberalise markets;
- dominance by national power providers in national politics and
- the resulting preference for bilateral over regional agreements.

The SAPP case highlights the important role that South Africa originally played though this has waned, while a lack of a real energy champion in the West and Eastern power pools appears to limit their immediate potential. Even as Ethiopia becomes an energy giant, it is not clear that this will lead to improved regional energy supplies through a power pool given the political preference for bilateral deals and connections.

Effectively functioning power pools will require further investment in underlying infrastructures and a critical mass of distributed generation capacity, but also a shift in thinking from short-term oriented objectives towards long-term gains, and trust-building among states.

Table of Contents

Acronyms iii
1. Introduction 1
2. Objectives and origins 2
2.1. The power of pooling 2
2.2. The drive to pool resources 3
3. Pooling power in practice 6
3.1. Dynamics within and between countries 7
3.2. Regional market mechanisms 15
3.3. Decision-making, governance and institutions 18
4. Explaining performance differences 19
4.1. Infrastructure development and trade-offs between internal and external demand 19
4.2. Power pools and regional hegemons 21
4.3. Building a platform for regional energy trade 22
5. Conclusions 25
Bibliography 27

List of Boxes

Box 1: Regional markets without liberalisation? 15
Box 2: Main types of regional energy trade arrangements under the SAPP 17
Box 3: Added costs of transmission infrastructure and maintenance 21

List of Figures

Figure 1: African Power pools and their member states 3
Figure 2: Sub-Saharan Africa primary energy mix by subregion (2012) 4
Figure 3: Available capacity of total installed capacity 8
Figure 4: Population without access to electricity (2016) 9
Figure 5: Existing and planned interconnexions in the SAPP 12
Figure 6: Existing and planned interconnections in the EAPP 13
Figure 7: Projects for period 2018-2020 13
Figure 8: SAPP energy market evolution 16
Figure 9: The OMVS and OMVG in the WAPP implementation roadmap 24

List of Tables

Table 1: Overview of the three major African Power Pools 7
Table 2: Energy exporters and importers' interests in regional power pools 23

Acronyms

ABN	Autorité du Bassin du Niger
CAC	Control Area Center
CLSG	Côte d'Ivoire-Liberia-Sierra Leone-Guinea
COMESA	Common Market for Eastern and Southern Africa
DAM	Day Ahead Market
DRC	Democratic Republic of Congo
EAPP	East Africa Power Pool
ECDPM	European Centre for Development Policy Management
ECOWAS	Economic Community of West African States
EGL	Energy for the Great Lakes
ERERA	ECOWAS Regional Electricity Regulatory Authority
GDP	Gross domestic product
GERD	Grand Ethiopian Renaissance Dam
GTAI	Germany Trade and Invest
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAEA	International Atomic Energy Agency
ICA	Infrastructure Consortium for Africa
ICC	Information and Coordination Center
IDM	Intra Day Market
IPP	Independent power producer
IRB	Independent Regulatory Board
MOTRACO	Mozambique Transmission Company
NBI	Nile Basin Initiative
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
OMVG	Organisation pour la Mise en Valeur du fleuve Gambie
OMVS	Organisation pour la Mise en Valeur du fleuve Sénégal
PPA	Power Purchasing Agreement
REC	Regional Economic Community
REM	Regional Electricity Market
RERA	Regional Electricity Regulatory Association
RSMO	Regional System Market Operator
SADC	Southern African Development Community
SAP	Structural Adjustment Programme
SAPP	Southern Africa Power Pool
SSA	Sub-Saharan Africa
STEM	Short-Term Energy Market
SVP	Special Vehicle Projects
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNCTAD	United Nations Conference on Trade and Development
US	United States
USAID	United States Agency for International Development
WAPP	West African Power Pool

1. Introduction

Despite the continent's endowment of renewable and non-renewable energy sources, Sub-Saharan Africa (SSA) suffers from huge deficits in the supply and distribution of energy. Close to 600 million people (57% of the overall population) are currently without electricity access, 80 percent of whom live in rural areas (Grosse Puppendahl et al., 2017). This raises the cost of productive economic activities, thus hampering sustainable and inclusive development. At the same time, those with access to electricity typically face high prices for a supply that is both insufficient and unreliable (Woolfrey, 2016). This leads households and businesses to use expensive, non-renewable, fuel-consuming generators, a trend that renders many industries and manufacturing sectors "uncompetitive, hinders job creation, and slows annual GDP growth by between one and three percentage points" (Woolfrey 2016: 33). Low energy production and poor distribution networks are key underlying problems.

While there is a need for improved electricity generation and transmission across African countries at the national level (e.g. Barnett et al., 2016), greater cross-border trade in electric power is a potentially cost-effective way of connecting excess capacity in one country or region with demand peaks in another. By creating a regional power market, regional energy cooperation in theory allows countries to:

- better connect supply and demand for electricity by expanding the geographic scope of energy markets;
- optimise the use of regional generating resources and improve the reliability and affordability of electricity in Sub-Saharan Africa;
- increase the economic efficiency of the energy sector through competition effects from different suppliers;
- attract investors to the energy sector through opportunities to benefit from economies of scale[1]; and
- address social equity, through affordable energy from modern (renewable) energy infrastructure.

Pooling energy resources across countries is difficult to coordinate, requiring both institutional and technical systems to be in place. This is why since the mid 1990s African Regional Economic Communities (RECs) and their members in Southern, Eastern, West, Central and North Africa started rolling out regional power pools. These African regional power pools tend to struggle in fully achieving their objectives, leading to questions about how best they should be supported by policy-makers and international partners.

This discussion paper looks at the political economy of three power pools in Sub-Saharan Africa: the West African Power Pool (WAPP), the Southern African Power Pool (SAPP) and the East Africa Power Pool (EAPP). It also refers to the Nile Equatorial Lakes Subsidiary Action Program (NELSAP), an investment programme under the Nile Basin Initiative (NBI) that promotes investments in power development, power transmission interconnection and power trade as well as water resources management among NBI member states. The paper asks the following questions:

- Which factors led to the establishment of the power pools and what does this mean in terms of current cooperation among member states?
- What are the current challenges between and within between states that affect regional energy cooperation through power pools?
- What are the implications for policymakers and international partners in supporting such structures?

[1] Castellano et al. (2015) estimate that regional energy integration could save over USD 40 billion in overall capital spending to meet growing electricity demand.

2. Objectives and origins

2.1. The power of pooling

Much like the need for road and border infrastructures to create a regional market to trade goods, regional power pooling implies creating a regional network and market to trade and transfer electrical power between utilities in multiple neighbouring countries. The aim is to provide an integrated power transmission grid and energy market across countries that can create and exploit economies of scale in the generation, transmission and distribution of electric power (Woolfrey, 2016). This permits positive spillover effects across the different regions with benefits that are greater than those that could be generated by individual governments acting alone (Andrews-Speed, 2011).

Fully operationalising a regional power pool implies fulfilling at least three conditions (e.g. Vanheukelom & Bertelsmann-Scott, 2016):

1. cross-border interconnection *infrastructure* (interconnections) for the integration of national power grids;
2. a common *legal and regulatory framework* (involving inter-governmental and inter-utility memoranda of understanding) and;
3. a multi-country *organisational structure* to oversee planning, harmonise rules and develop a commercial framework for cross-border power trade.

With this in mind, four regional power pools have been established in Sub-Saharan Africa to develop the infrastructures and regulatory frameworks to facilitate electrical power trade in their respective sub-regions (see Figure 1 below).[2]

[2] The Central African Power Pool is not covered in this study, nor the COMELEC (Maghreb Electricity Committee).

Figure 1: African Power pools and their member states

Source: UNEP 2017: 61

2.2. The drive to pool resources

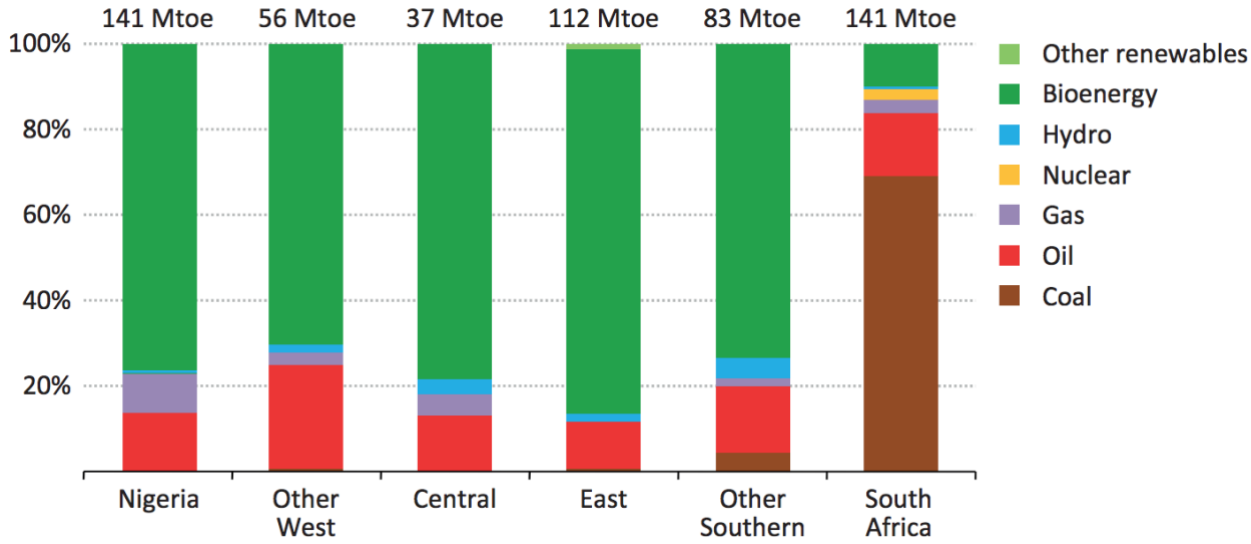
Cross-border energy cooperation in Africa is not new. African countries have signed bilateral power trading arrangements as far back as the 1950s and 1960s. This includes bilateral power agreements between Zaire (now the Democratic Republic of Congo, DRC) and Zambia in the late 1950s; between Zambia and Zimbabwe in the 1960s, and between Nigeria and Niger around the same time, with Nigeria becoming the main source of energy supply to Niamey (Vanheukelom et al., 2016; Karaki, 2017). Other early examples include agreements for Ghana to export energy from the Akosombo dam on the Volta river to Togo (1972) and Benin (1973), Mozambique selling hydropower from its Cahora Bassa dam to Zimbabwe and South Africa (1975); and Senegal, Mali, and Mauritania cooperating around hydropower produced from the Senegal river basin as part of the Organisation pour la Mise en Valeur du Senegal (OMVS) (Medinilla, 2018).

The ambition to go beyond these bi- and trilateral approaches came in the 1990s, driven by three broad dynamics:

1. the apparent successes of US and European experiences in power pooling (for example the Nordpool, the largest market for electrical energy in Europe operating in Norway, Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, Germany and the UK);
2. the limitations of bilateral power arrangements that provide fixed volumes of electricity trade but are unable to address peaks in demand, and have difficulty overcoming challenges such as power line disruptions; and
3. energy sector reforms and liberalisation of national grids that were put in place in many African countries in the 1990s as part of externally influenced structural adjustment programmes. External technical experts viewed power pooling as a way to balance the uneven distribution of energy production potential across regions with growing demand needs (Woolfrey, 2016).

While technical standardisation and market dynamics are critical enablers of regional energy trade, they are only part of the picture. Each power pool is also subject to a range of specific conditions and national interests that advance or constrain regional cooperation and trade.

Figure 2: Sub-Saharan Africa primary energy mix by subregion (2012)



Source: IEA 2014: 38

The Southern African Power Pool (SAPP) was the first power pool created in Africa in 1995, and is currently the most advanced regional power pool in Africa.[3] Two key events influenced the SAPP. First, in 1992, a severe drought hit Southern Africa, which severely impacted SADC's hydropower producers such as Zambia, Malawi and Zimbabwe (Benson & Clay, 1998). The resulting power shortages, signalled the need for energy cooperation between hydro-rich countries in the North and thermal-rich South Africa in the South, at that time an electricity surplus country due to its coal reserves[4]. The drive to create a regional pool was therefore driven by a convergence of interests between South Africa on one side, which sought to generate additional income from its energy surplus, and importing countries on the other, which looked to ensure a supply of reliable and affordable electricity to their citizens and industries when hydropower capacity was constrained.

[3] The SAPP was launched following the SADC summit in South Africa in 1995.
[4] To date, 77% of South Africa's electricity supply is based on coal, which is set to remain a leading source of energy due to lack of readily available alternatives (Department of Energy of South Africa).

Besides the economic rationale, there was also a broader drive in post-apartheid South Africa to demonstrate goodwill and solidarity towards its neighbours (Vanheukelom et al., 2016). South Africa thus played a critical role in initiating the SAPP, and remains one of the major political and economic forces behind the SAPP (ICA, 2017) even if the power generation dynamics in the region have switched, with South Africa now facing power deficits.

Creation of the SAPP was soon followed by establishment of the Western Africa Power Pool (WAPP) in 1999. First launched as an integral component of ECOWAS, the WAPP was later transformed into a specialised (and independent) ECOWAS agency covering 14 of the 15 members of the REC (all but Cape Verde). The WAPP could build on the experience of the SAPP just four years earlier, and benefited from significant technical assistance from the United States Agency for International Development (USAID) (Karaki, 2017). While the ambition of regional energy cooperation already featured in the 1975 ECOWAS Treaty, the ECOWAS Energy Policy (1982 and 1993), and conception of West African Gas Pipeline in 1982, the WAPP is widely regarded as a replica of the SAPP. This reflects strong donor influence in setting up the WAPP, while ownership by ECOWAS and its member states appears to have been limited (Karaki, 2017).

Similarly, to Southern Africa, energy exporters such as Nigeria, Côte d'Ivoire and Ghana were expected to benefit from short-term sales of power to neighbours through the WAPP, particularly given the pre-existing bilateral arrangements between Ghana and its neighbours Benin and Togo. Energy importers like Togo, Benin and the Sahelian countries would be able to better manage their energy deficit by accessing more than one supplier, and importing energy at a lower cost than producing it themselves[5]. The limited size of their domestic power markets indeed offered limited opportunities for economies of scale in energy production (World Bank, 2007; Castalia, 2009). However, unlike South Africa that became a 'champion' of early SAPP efforts in Southern Africa, the WAPP had no such energy champion that could lead regional cooperation, often a condition for regional cooperation to take off in practice (Vanheukelom & Bertelsmann-Scott, 2016, Brenton and Hoffman, 2013).

The EAPP was established in 2005 by seven eastern African countries: Burundi, Democratic Republic of Congo (DRC), Egypt, Ethiopia, Kenya, Rwanda and Sudan (Verhaeghe & Woolfrey 2017). In 2006 the EAPP was adopted as a specialised COMESA institution though in practice it remains completely autonomous. As such, COMESA is not significantly involved in the implementation of the EAPP agenda. Instead, COMESA's main role is to provide a level of oversight and 'political cover' and to provide the EAPP with more political clout and financing opportunities from donor agencies. The founding members were later joined by Tanzania (2010), Libya (2011), and Uganda (2012).

With nineteen member states, COMESA - like much of Sub-Saharan Africa - has abundant but underdeveloped and unevenly distributed energy resources, inadequate electricity transmission infrastructure and underdeveloped distribution networks and regulatory systems (Woolfrey, 2016). While the lack of reliable and affordable electricity supply across the region was a key issue for member states to support the EAPP, COMESA recognised that these factors were also key to the region's economic agenda, representing major supply side constraints on the productive sectors of its member states, and impediments to economic growth and competitiveness in international trade (COMESA, 2012). Though Ethiopia, Egypt, Kenya and Sudan played a key role in the establishment of the EAPP, and though hydro-rich Ethiopia seeks to become a significant energy exporter in the region, it is not clear that there is any lead country underpinning the further development of the EAPP.

[5] In absence of any major (renewable) sources of power, countries with an energy deficit often need to rely on expensive, often imported diesel fuel power plants to address peak demand. This drives up the cost of electricity and limits infrastructure investment capacity.

The SAPP, WAPP and EAPP all share similar objectives, generally modeled on existing and well-functioning power pools. The first is to promote and increase investments in electricity production, transmission and distribution infrastructure; the second to create a regional regulatory framework for pooling energy resources, including the establishment of common standards, rules and monitoring mechanism of systems performance, with a view to promote power exchanges between utilities; the third objective is to coordinate the long-term energy development in the region (though the WAPP is less explicit about this dimension). The SAPP, being the most advanced, also includes developing regional expertise, training courses and research and has an explicit objective to focus on rural electricity access, and renewable energy.

While there are significant similarities in why and how these power pools have been set up, the practice of pooling power is very different across the three regions. The following section looks at how dynamics within and between different countries define the political economy and eventually also the outcome of energy deals and cooperation within those regions.

3. Pooling power in practice

The theoretical business case for power pools is clear and powerful. Energy producers get access to larger markets, and can avoid excessive grid losses[6] by selling to customers close to where energy is produced. Countries and areas with energy deficits or limited generation potential can access reliable power from outside their borders. Grid development at scale allows countries to save resources by reducing their dependence on portable solutions and expensive and often outdated thermal power plants.

In practice, however, the pooling of power is not straightforward. Power pools must develop gradually as a collection of interconnections, bilateral arrangements and deals between members, where a regional regulator must be given authority to apply its rules. A power pool can only ever be as strong as its weakest link.

Although countries join power pools, the real participants are energy producers and utilities from those countries. In African regional power pools, those are often public enterprises that operate as monopoly providers under very specific market conditions. Their importance often makes them political ‘champions’ that are often part of a wider system of rent-capture and distribution (e.g. Barnett et al., 2016). The ongoing energy crisis in South Africa in 2019 due to past corruption and governance problems at energy provides Eskom is a case in point (e.g. Financial Times, 2019). Creating and operating power pools is therefore not only about finding the right mechanisms for cross-border cooperation, but also working around or within the incentive structures associated with the complex political economy of national energy production, transmission and distribution.

[6] Grid losses or transmission and distribution losses are energy losses due to dissipation of electricity in transmission, transformation and distribution infrastructure, over long distance, grid losses increase, and therefore increase the cost of transporting power from producer to consumer. High Voltage Direct Current (HVDC) transmission suffer lower losses than the more common High Voltage Alternating Current (HVAC) lines, yet they are more expensive to build and more difficult to operate. Losses need to be taken into account by utilities buying power, and compensated by a sufficient margin of supply.

Table 1: Overview of the three major African Power Pools

	SAPP	EAPP	WAPP
Regional Organisation	SADC	COMESA	ECOWAS
Participating Members States	12/15 SADC members: Botswana, DRC, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe [Angola, Malawi and Tanzania participate as non-operating members]	10/19 COMESA members: Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda and Sudan. Tanzania, Libya and Uganda joined between 2010, and 2012. Djibouti is the latest entrant. South Sudan is expected to become a member soon.	14/15 ECOWAS members: Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo [all ECOWAS member states except Cabo Verde).
Participating Utilities	Botswana - Botswana Power Corporation; Democratic Republic of Congo - Societe Nationale d'Electricite; Lesotho - Lesotho Electricity Corporation; Mozambique - Electricidade De Mozambique, Hydroelectrica De Cahora Bassa, Mozambique Transmission Company; Namibia - NamPower Centre; Swaziland Electricity Company - SEC; South Africa (Eskom); Zambia - Copperbelt Energy Corporation; ZESCO Limited; LUSEMFWA HYDRO; Zimbabwe - Zimbabwe Electricity Supply Authority	Burundi - REGIDESO/SINELAC; Democratic Republic of Congo (SNEL/SINELAC); Egypt (EEHC); Ethiopia (EEPCo); Kenya (KPLC, KENGEN, KETRACO); Rwanda (RECO/SINELAC); Sudan (MED); Tanzania (TANESCO); Libya (GECOL)	All except Cabo Verde and Mauritania) Benin (SBEE, CEB;) Burkina Faso (SONABEL); Côte d'Ivoire (CI-ENERGIES, CIE); The Gambia (NAWEC); Ghana (VRA, NEDC;, KARPOWERSHIP, GTS Engineering Services, GRIDCO, ECG, CENPOWER, CENIT Energy, GTG Energy); Liberia (LEC); Mali (SOGEM, EDM-SA); Morocco (ONE) Niger (NIGELEC) Nigeria (TCN, NBET, MAINSTREAM); Senegal (SENELEC); Sierra leone (EDSA); Togo (CONTOURGLOBAL, CEET);

Source: SAPP, 2018[7]

3.1. Dynamics within and between countries

Powering power pools: installed capacity constraints

Operationalising power pools requires producing excess capacity that can be traded, and transmission infrastructures to connect national grids. Even within the EU, to achieve optimal regional electricity trading an estimated additional 76% in capacity would be required (Oseni and Pollitt, 2014). Progress has been uneven across the power pools studied here. All three struggle to develop and maintain the necessary power

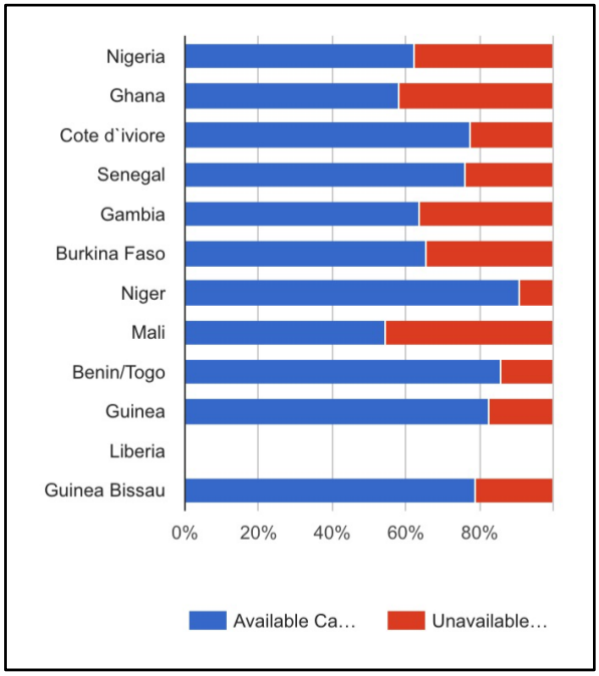
[7] http://www.sapp.co.zw/about-sapp#members

generation and transmission infrastructure to enable a functional regional market. Infrastructure projects are often financed through donor grants and concessionary loans, though all three power pools also have specific instruments to facilitate infrastructure financing, including Public Private Partnerships, or Special Vehicle Projects (SVP) (ICA, 2011).

The SAPP member states went from a combined installed capacity of 48,461 MW in 1995 (with around 38,000 MW in South Africa alone) to 61,894 MW in 2016, yet only 46,959 MW are routinely in operation, which is still less than the estimated demand of demand of 52,542 MW. The gap between the installed generation capacity and the actual operating capacity is mainly due to climate variability, and ageing or badly maintained power plants. The ongoing energy crisis in South Africa is again emblematic of this. For instance, in some cases, generators or the whole power stations are out of service (Kambanda, 2017);[8] or in times of drought, hydropower plant cannot function at full capacity. Besides generation capacity, transmission capacities are lacking, with 20 existing interconnectors in 2012 (Wright, 2014) - limiting energy trade and thus the development of the SAPP (Maviya, 2017; Stewart, 2016).

Unlike the SAPP, the WAPP countries had a combined installed capacity of just 9,705 MW capacity when the WAPP was launched in 1999, while each of the member states was struggling to meet domestic demand. Years later in most WAPP countries demand continues to outstrip supply. The current combined installed capacity is 10,640MW, of which a mere 60% is in operation (ca. 6,500MW). Overall demand, fuelled by rapid urbanisation and population increase is estimated at 22,000MW. The actual on-grid demand however tends to be lower in most countries, since electrification rates fall behind grid development and extension.

Figure 3: Available capacity of total installed capacity



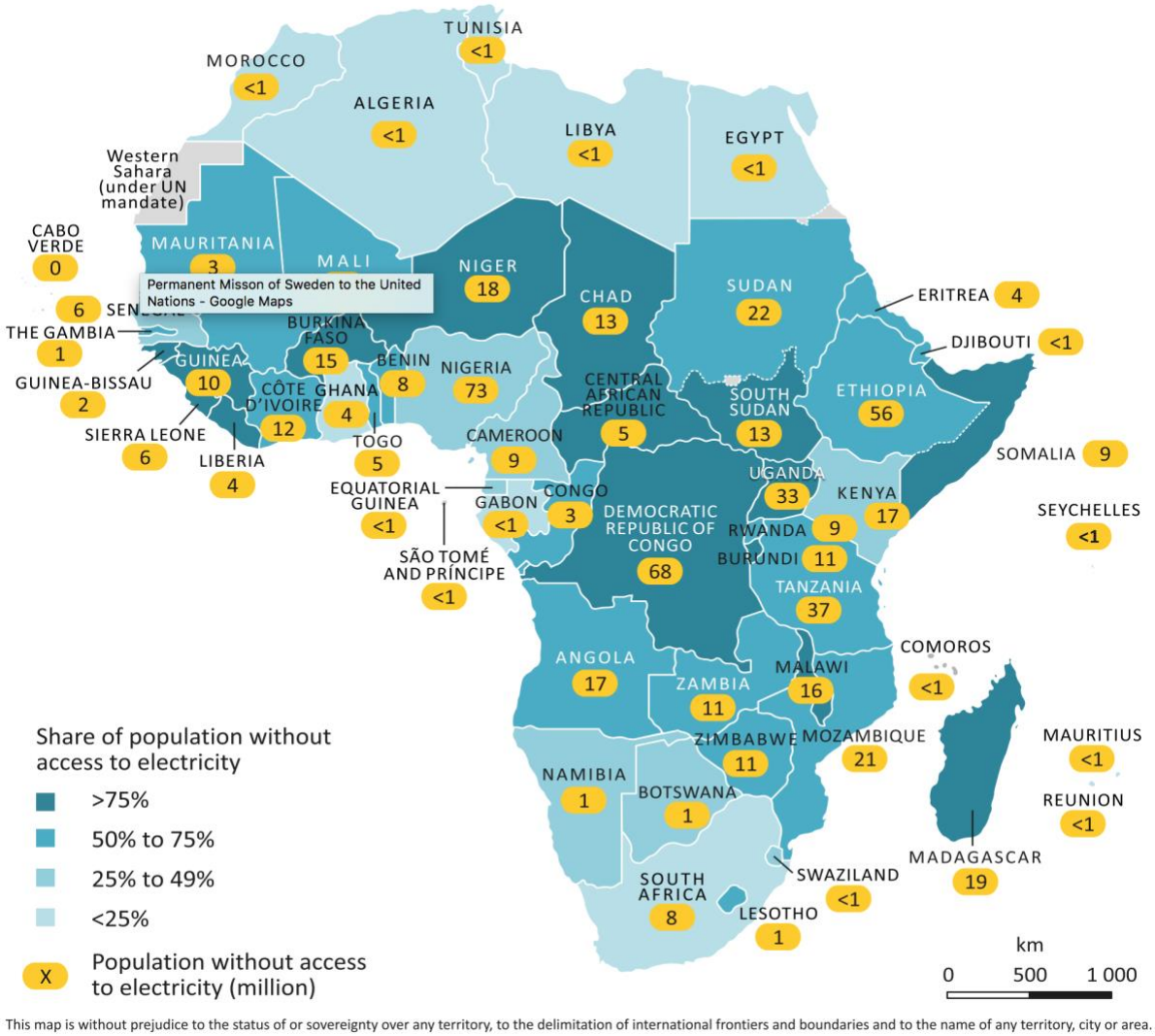
Source: WAPP, 2018

The EAPP had an initial installed capacity of 54,311 MW, and its power capacities have increased the last decade. This means the region theoretically has a surplus, based on current on-grid demand (Power Africa 2018), concentrated in Ethiopia, Kenya and Uganda, with Tanzania and Rwanda having a deficit. The regional surplus is set to increase with Ethiopia's prospects of becoming a major hydropower producer in the

[8] Due to degraded infrastructure, major hydroelectric projects face losses on their lines of up to 50% (Patat, 2015)

near future. Nevertheless, 200 million people or 80 percent of the population in Eastern Africa still lack access to electricity, the majority of which is located in the populous member states Ethiopia, Kenya and Uganda (IEA, 2014). Egypt resigned from the EAPP in 2016 due to its opposition to the construction by Ethiopia of the Grand Ethiopian Renaissance Dam (GERD) - an upstream dam and hydro plants along the Nile River. [9] Until then, Egypt accounted for 66% of the energy production and almost 75% of the total demand for electricity. In 2014, it still satisfied its domestic demand almost entirely (99,8%) (World Bank, 2017). The five smaller member countries (including Burundi and Rwanda) together account for less than 2% of the total demand (ICA, 2017). While several interconnections existed before the establishment of the EAPP,[10] the latter is developing a number of new interconnections, linking Ethiopia to Sudan and Djibouti; and Kenya to Democratic Republic of the Congo to Republic of the Congo (see Figure 4 below).

Figure 4: Population without access to electricity (2016)



Source: IAE 2017: 82.

[9] See ESI Africa. 8 February 2016.

[10] DRC, Burundi and Rwanda associated to Ruzizi II (45 MW); Cross-border electrification between Uganda and Rwanda, Tanzania and Uganda; Kenya – Uganda Interconnections; Egypt Interconnection to Maghreb and Eastern Europe countries through Libya and to Eastern Mediterranean trough Jordan; Ethiopia-Sudan 220 KV: Ethiopia-Djibouti 283 KM of 220KV

Overall, the installed capacity in most African regions is still well below what would allow for a full regionalisation of energy markets, even if this may change fairly rapidly in Eastern Africa. On top of that, large producers such as Nigeria often struggle to meet theoretical demand[11], given the low electrification rates in large parts of the country. Countries will prioritise investing in national demand for various reasons. Hence, large production capacity, such as that likely to come on stream with completion of Ethiopia's GERD is not always a guarantee for a reliable regional export capacity[12].

National grids and the politics of power production

The ultimate success of regional energy pooling depends on national grids and energy infrastructures. In most African regions, national power grids are not only outdated but also operate in a constant state of energy shortage, either structurally, or due to peak demand failures. National grid development is therefore often a critical blocker of power integration. In West Africa for example, the economic heavyweight Nigeria, which also houses enormous energy potential, remains inwardly focused for this precise reason. While it has the potential to produce more[13], it has long failed to meet the demand for electrification in large parts of the country (Karaki 2017: 10). Ghana and Cote d'Ivoire instead are the key drivers of regional energy integration because of their regional ambitions and their geographical location at the centre of the region.

In the SAPP, market conditions radically changed in the second half of the 2000s as South Africa's supply of cheap, coal-powered electricity dwindled. This altered the political and economic calculations behind the SAPP. While there was a rise in demand from local industry (mostly due to energy-intensive mining), and there was a substantial increase in the number of citizens with access to electricity, investments in new or more efficient electricity production capacity failed to keep up. This severely impacted the functioning of the SAPP which heavily relied on South African energy. Section 3.2. below illustrates how this energy crisis led to the collapse of the Short-Term Energy Market of the SAPP (Vanheukelom & Bertelsmann-Scott, 2016).

Evolving interests and energy mixes

A crucial element of what shapes, drives or constrains power pool progress is the energy mix: the combination of different primary energy sources that makes up the total supply of electricity produced in a given country or region. Since the SAPP was formed, the tables have turned in South Africa, and while it previously sought to sell its surplus capacity, today its main concern is to meet its future domestic demand. It seeks to do so, not by reviving its aging thermal infrastructure, but by importing low-cost hydropower from its northern neighbours (Vanheukelom & Bertelsmann-Scott, 2016). The SAPP's current energy mix is still mostly composed of coal (62%), followed by hydroelectric power (21%) and solar and wind energy at a mere 5%. This reflects the continued dominance of South Africa as a producer with 41,074 MW of production capacity in 2013 - close to 80% of the overall region production (IRENA, 2013), and consumer - 85% of the SAPP electrical energy demand in 2015. This is almost 30 times higher than the next biggest market in the SAPP - DRC with 3% (idem; Wright & van Coller, 2017). The biggest change behind these figures is that South Africa has evolved from a surplus producer to an importer of electricity as it can only satisfy 90% of its domestic demand (IOL, 2016).

[11] Theoretical demand includes energy demand regardless of the limits imposed by the existing infrastructure, and therefore includes households and energy users that are currently not connected to the national grid.

[12] The Grand Ethiopian Renaissance Dam has hit some delays but in 2018 it stood at over 60% completion. the dam is good for an installed capacity of no less than 6000 MW, and would more than double the output of existing national infrastructure.

[13] Nigeria owns about 98% of proved crude oil and natural gas reserves in West Africa, and produces more than 40% of the region's hydropower (Karaki 2017: 7).

The WAPP has a combined energy mix of 64% fossil fuel, 31% hydroelectric power and 5% solar wind and other. This reflects the dominance of Nigeria, Ghana and Côte d'Ivoire as leaders in energy production. Their combined installed and available capacities represent respectively over 82.5% and 90% of the region, with about two thirds of the electricity generated in thermal power plants. The other third is generated by hydroelectric power stations (IAEA, 2016). However, in contrast to South Africa's electrification rate, the main producers in West Africa have significantly lower electrification rates, and are therefore only meeting part of their own theoretical domestic demand. The electrification rate varies from 48% in Nigeria, to 59% in Cote d'Ivoire and 72% in Ghana (ECREEE, 2014). Combined, the three main producers house 56% of the ECOWAS population without access to electricity. 48% or 113 millions of those live in Nigeria This may incentivise key energy producers in West Africa to focus on national priorities (thus addressing their domestic demand), rather than fostering regional energy integration ambitions.

Further, in West Africa the discovery of offshore gas off the coast of Mauritania and Senegal (Banda Gas Fields) is also altering the regional energy distribution. The Banda Gas-to-Power project will turn Mauritania from a net consumer into a net producer. This may ultimately change Mauritanian incentives to cooperate and invest in the subregional Hydropower sharing mechanism of the OMVS which oversees a number of interconnections between Mali, Senegal and Mauritania, with significant planned investment in Guinea (Medinilla et al., 2019). Mali is already buying electricity from Mauritania, even though it also exports part of the production of the Manantali dam back to Mauritania, as part of an intergovernmental agreement under the OMVS.

New discoveries and technological advancement can alter the regional dynamics, if one member state suddenly sees its production capacity or demand increase. The examples cited above, however are relatively modest reconfigurations of the African energy map. Examples of more ambitious projects are the GERD in Ethiopia, which is redrawing the geopolitical power lines between Ethiopia, Egypt and Uganda (Knaepen and Byiers, 2017); and the planned Grand Inga Dam expansion, which would revolutionise energy dynamics in Central and Southern Africa (Medinilla, 2017).

Interconnecting networks

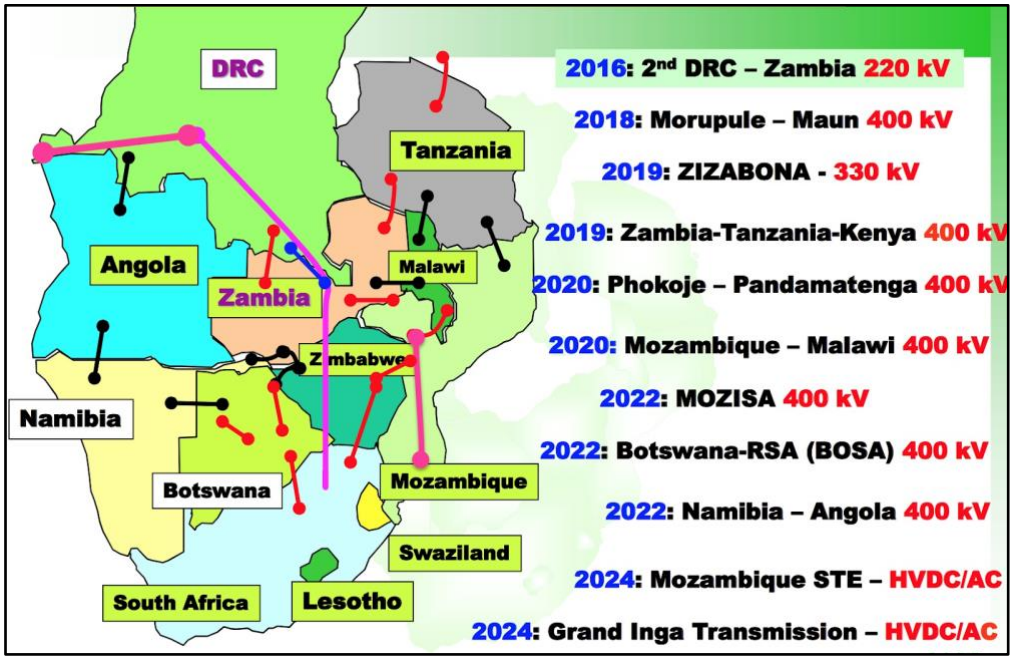
Many existing interconnections in Africa rely on ad-hoc, bilateral agreements between power producing countries and power consuming neighbours. This was the case with South Africa and its neighbours under the apartheid regime, but also with the historical interconnection between Nigeria and the highly dependent Niger, which transfers part of the Nigerian hydropower production to ensure the energy supply of Niamey.

New interconnections in power pools ideally take a longer-term perspective, yet at the same time physical distance is a key barrier due to grid losses. High Voltage Direct Current (HVDC) connections, such as those planned between DRC's Grand Inga project and South Africa suffer lower losses, but require additional expensive conversion infrastructure and can be more difficult to handle than conventional interconnections. As a result, the shorter the distance, the lower the costs and the higher the reliability. In West Africa, for example that means that connecting power generating infrastructure in Nigeria with consumers in Mali would be more expensive than to transfer power from Côte d'Ivoire, even if the cost of acquiring said power could be lower elsewhere.

SAPP energy generation and transmission capacity has improved in recent years. A total of 15,470 MW (or an annual average of 1,290 MW per year) of generating capacity was commissioned between 2004 and

2015, as part of the SAPP framework; with nine transmission interconnectors[14] commissioned (SAPP, 2016). Between 2016 and 2022, a total of 32,695 MW of additional generation capacity has been committed to by all countries, and an additional 8,047 MW is planned to be commissioned in Angola, Malawi and Tanzania (non-operating members[15]) emphasising the need to interconnect these countries (idem). In total, nine countries out of 12 are already interconnected. Recently, the World Bank financed a 667 km HVDC power line from Kenya through Tanzania to Zambia - linking the EAPP and SAPP (USAID, 2016).

Figure 5: Existing and planned interconnexions in the SAPP



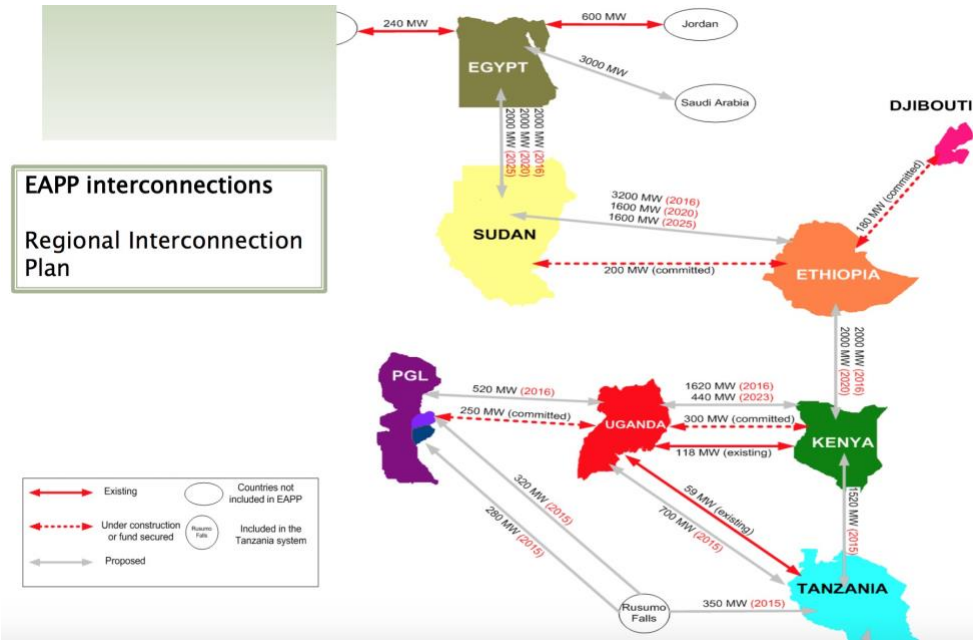
Source: Beta 2016

Several interconnections are underway in the EAPP. A 500KV HVDC line between Ethiopia and Kenya is set to go online in mid 2019 (Olingo, 2018), which will enable a 400MW power purchase agreement between the two countries. A further interconnection between Kenya and Tanzania is planned, which would enable it to purchase electricity from Ethiopia through a "wheeling agreement" with Kenya for transporting power over the Kenyan grid into Tanzania (Power Africa, 2018). The position of Tanzania is particularly interesting from a regional perspective since the country can provide a bridge between the EAPP and the SAPP. In 2018, Tanzania had an estimated deficit of around 485 MV (Power Africa, 2018), which is set to further increase in the coming years. The World Bank is currently financing an interconnection between Zambia and Tanzania, which is also set to come online in 2019, and will enable Tanzania to engage in short-term energy trade with its southern neighbours in the SAPP, while also purchasing power from its Northern neighbours in the EAPP.

[14] Linking e.g. Mozambique and Zimbabwe; Mozambique and SA; Swaziland and Mozambique; South Africa and Mozambique; South Africa and Namibia; Zambia and Namibia.

[15] Angola, Malawi and Tanzania are not yet connected to the regional grid and efforts are at an advanced stage to link the three countries to the power pool (SADC, 2016).

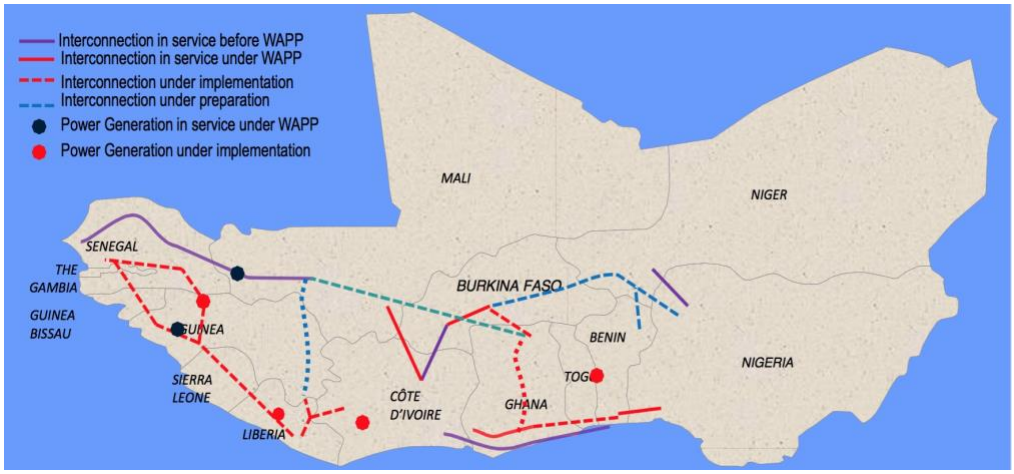
Figure 6: Existing and planned interconnections in the EAPP



Source: Kiilu, 2015

WAPP progress in infrastructure development has been limited. Only six out of the 25 planned priority projects have been completed, with three more under construction for the 2007-2017 period[16] (Ki, 2017). The current installed capacity amounts to 14,091 MW of which only around 60% (ca. 8,458 MW) is fully functional in a context where the demand is estimated to be around about 22,000 MW (ICA, 2011). This gap between the demand and the offer is exacerbated by high commercial and technical losses estimated at 21.5% in West Africa in 2010 (ECREEE, 2014). In addition, the poor state of national grids and markets, both in net producing and net consuming countries remains a major obstacle for further integration (Karaki, 2017), and explains the gap between installed generation capacity and operating capacity (Figure 3).

Figure 7: Projects for period 2018-2020



Source: Ki, 2017

[16] Lines linking Ghana Togo and Benin; Cote d'Ivoire and Mali, Nigeria and Benin, as well as power plants in Guinea, Mali and Cote d'Ivoire and Liberia.

State-business relations around energy

The nature of the energy sector within countries ultimately defines those countries' action within the region. First and foremost, it is the utility companies that participate in power pools. These can be national producers, fully independent or partially state-owned power producers (IPP) such as Hidroelectrica de Cahora Bassa but also independent transmission companies (such as Mozambique Transmission Company - MOTRACO). Though countries like South Africa have an increasing number of IPPs, they do not as yet participate in the SAPP. The role of South Africa's parastatal Eskom is in fact part of the origins of the SAPP and its importance illustrates the historical political economy dynamics of the regional power pool.

South Africa's apartheid regime long used its energy surplus and control over the sector as a way to exert its regional dominance, and played a vital role in that strategy. In 1994, South Africa operated twenty-two heavily subsidised power plants through Eskom that provided an excess of comparably cheap electricity (Vanheukelom 2017: 13). Energy independence from South Africa was a major priority for its neighbours Mozambique, Zimbabwe and Angola, yet long-term bilateral arrangements made this difficult. In the early 1990s a drought in Northern South Africa reduced hydropower production significantly; coupled with the launch of SADC in 1992, this meant that the cards for regional energy dominance were being reshuffled, and that ESKOM's dominance was no longer absolute. This paved the way for the launch of the SAPP in 1995.

State interests in the energy sector continue to shape the prospects for regional energy trade and cooperation until today. Many African national utility companies are in a monopoly position, which more often than not manage ageing infrastructure. This is rarely a good basis for competitive investments towards regional energy trade. Energie du Mali in West Africa, for example, is continuously on the brink of bankruptcy, but at the same time national elites and the government officials continue to treat the national energy sector as a self-service buffet for cheap electricity and/or lucrative but uncompetitive business opportunities (Medinilla et al., 2019). As referred to above, in spite of its crucial role in the SAPP, in recent years Eskom has similarly been poorly managed in a short-termist manner, accompanying the switch in South Africa from surplus to deficit country and the undermining of the SAPP (e.g. Financial Times, 2019 and Box 1). While regional cooperation and deals are being made in West Africa (e.g. between Nigeria and Niger, between Ghana, Côte d'Ivoire and their neighbours, between Mauritania, Senegal, Mali and Guinée) these are less subject to market dynamics than to intergovernmental horse trading. In that sense, the regional level reproduces the national dynamics.

Box 1: Regional markets without liberalisation?

Governments tend to perceive energy security within the narrow context of meeting national demand. Historically, energy security is also seen as a critical responsibility of the state. This - among many other factors - helps explain why national energy sectors remain largely state-controlled and are in many cases vertically integrated, meaning that the entire chain, from production to transmission and distribution is controlled by one entity. Hence any reforms, especially those related to the governance of the energy sector and energy supply, are not only economic in nature, but also political.

In West Africa, although most countries began to liberalise the energy sector in the 1990s as part of the World Bank and IMF's Structural Adjustment Programmes (SAPs), only Cote d'Ivoire and Cabo Verde have a power sector owned in majority by private companies, and only a few more countries[17] allow for independent power producers. In the EAPP, even though countries allow for the participation of independent power producers, vertically integrated state-owned enterprises remain the only buyer in most EAPP member states and dominate domestic energy sectors.

Monopolistic national utilities generally struggle to attract investments in energy generation, which may hinder the development of regional energy trade and the supply of a more reliable and cheaper electricity (Pineau, 2008). In post-apartheid South Africa for example, Eskom systematically underinvested in its production capacity, yet worked hard to extend the electricity grid and transmission infrastructure to reach all South Africans (Vanheukelom & Bertelsmann-Scott, 2016). Ultimately this approach reduced South Africa's capacity to engage in regional power trade and reversed the roles of producers and consumers within the region. In other cases, national energy markets underperform so badly that the return on investment is simply deemed too low or the risks too high.

On the other hand, the case of Cote d'Ivoire shows that power sector reform can result in timely power generation expansion - Côte d'Ivoire succeeded in attracting private investment for two IPP projects[18], which enabled it to develop excess capacity, and become a net exporter of energy in West Africa (UNECA, 2004). In South Africa, the expansion of IPPs into renewable energy production was partly driven by the deep energy crisis, but also by the weakened position of Eskom, which was no longer in a position of blocking the energy sector reforms that were driven by a new coalition, between the Treasury, the Department of Energy, the Department of Environmental Affairs, and foreign owned IPP companies and experts (Vanheukelom & Bertelsmann-Scott, 2016).

Overall, the progress of Africa's power pools is sobering. While generating capacity has improved slightly, more is needed for interconnections to start paying off, especially in the cases of the EAPP and WAPP. A lack of transmission capacity and the poor state of infrastructure further thwart the expansion of these power pools. Unlike in the WAPP, the regional hegemons South Africa (SAPP) and Egypt (EAPP) played a key role in supporting the initial development of their respective power pools, which can be partly explained by the fact that these countries had relatively mature grids and energy sectors that can cover almost fully their domestic needs.

3.2. Regional market mechanisms

Beyond the physical infrastructure, regional energy trade requires market management tools to be in place. To begin, regional power pools tend to build on existing and periodically updated bilateral contracts. After 14 years, the SAPP managed to move beyond these bilateral deals and formed a regional competitive market platform for energy trade. The latter represents a minor (5%) but growing share of the regional energy trade in Southern Africa (IRENA, 2013).

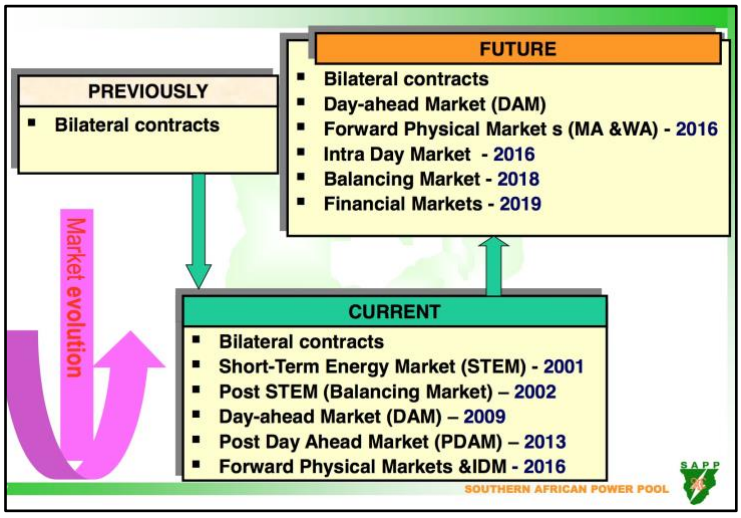
[17] Burkina Faso, Côte d'Ivoire, Ghana, Nigeria, and Senegal (Pineau, 2008)

[18] One critical factor underlined by one of the IPP operating in Côte d'Ivoire as that there was: "a defined set of rules for how CIE has to pay the independent power generators. This "waterfall" structure gives IPPs a relatively high place in the payments queue. "That allows transparency in the sector and all the operators know that we are going to get paid. It is the basis for everything that has made Côte d'Ivoire attractive for investment. There are very few countries that have such a clear organisation and structure." (Williams, 2015) http://www.smartcityafrica.com/en/media/blog/here-why-investors-benefit-electricity-sector-privatization-cote-divoire

A well-functioning crossborder market mechanism allows for a near real-time optimisation of supply and demand between countries. This means that peak demand (either foreseen or incidental) in one country can be met with increased supply in another country as it happens. At the very minimum, this requires an installed capacity that exceeds the national demand by a marketable share, but it also requires sufficiently advanced interconnections and switching infrastructure.

The SAPP regional market platform started in 2001 with the Short-Term Energy Market (STEM), a collaborative market structure within the SAPP, set up to facilitate short term electricity trading between SAPP members (Vanheukelom & Bertelsmann-Scott, 2016). Following the diminishing surplus capacity in South Africa and the aging infrastructure, this short-term market through STEM became dormant after 2006 and was eventually discontinued (Muntschick, 2013). The system was succeeded in 2009 by the Day Ahead Market (DAM), a competitive regional energy market that trades (via a double-sided auction process) hourly energy contracts for the following day inclusive of existing bilateral contracts (cleared first), transmission capacity constraints and wheeling fees (Wright, 2017). The DAM was complemented in 2016 with the Intra Day Market (IDM). The IDM enables trades up to one hour prior to delivery, which allows utilities to adapt their purchasing volume if they failed to cover their needs in the DAM (Rose et al., 2016: 3). The regional energy market therefore gradually introduced innovations to make the market mechanism more responsive. (see Box 1) This resulted in an expansion of regional market share from 0% of the total of total cross-border trade in 2009 to 6% in 2015 (Rose et al., 2016).

Figure 8: SAPP energy market evolution



Source: SAPP, 2016

These types of energy trade are hence driven at the regional level, in contrast to traditional bilateral energy trading. Flexible regional purchasing agreements (vs. bilateral agreements) can contribute significantly to energy security by providing a solution for peak demand situations, and can even go hand in hand with regional solidarity. South Africa for example was able to supply Zambia and Zimbabwe with emergency power in 2016, with voluntary and complementary action also taken by Swaziland and Lesotho to reduce consumption (UNCTAD, 2017). That said, bilateral arrangements continue to dominate cross-border power exchange (94%). The use of the regional energy trading platform is therefore limited, which suggests that it does not (yet) fully align with national interests.

Box 2: Main types of regional energy trade arrangements under the SAPP

- **Bilateral contracts**: To meet long-term energy supply-demand balance between market participants (can be firm and non-firm). This sub-market pre-dates the establishment of the SAPP and has been the legacy sub-market within which most electricity trading in the SAPP occurs.
- **Day Ahead Market (DAM)**: An open and competitive sub-market traded on a day-ahead basis (can forward bid up to 10 days if desired) to meet short-term supply-demand balances between SAPP market participants.
- **Intra Day Market (IDM)**: A sub-market where market participants can continuously trade up to one hour prior to delivery. The IDM matches market participants automatically on a first-come first-serve basis if a seller's offer price is less than a buyer's bid price and a seller's volume is lower (or equal to) a buyer's volume.

Source: Wright & van Coller, 2017

Rose et al. (2016: 4) explain that "bilateral contracts are favoured among power purchasers because they provide guaranteed electricity supply during scarcity events (...) and priority access to the transmission network to sell their power. By contrast, DAM and IDM trades face high levels of uncertainty as to whether their bids will be matched in the market and, if matched, whether the trades will be technically feasible as a result of transmission constraints [...]". Historically, less than 20 percent of buy and sell bids submitted to the SAPP were matched in the Day Ahead or Intra Day Market, with only a fraction actually transmitted due to infrastructure constraints. Another factor that explains the preference of member states for bilateral contracts is that small energy importers and exporters fear being exposed to short term international market prices through the IDM, and prefer most trades to occur under long term bilateral contracts which offer more long-term predictability (Oseni et al., 2014).

The WAPP currently relies exclusively on bilateral trading agreements, yet projects that a centralised regional trading mechanism can be set up in the coming years, subject to the completion of the regional interconnection projects (ICA, 2017). The WAPP is also setting up an Information and Coordination Center (ICC) that will be in charge of improving the access and the reliability of the electricity supply in the ECOWAS Region[19] (Ki, 2017). At the administrative level, numerous steps are being taken to pave the way for the WAPP to become a functional regional electricity market. Market governance rules are being developed jointly by the WAPP and the ECOWAS Regional Electricity Regulatory Authority (ERERA). An operations manual, market rules, and tariff methodology for transmissions costs and tariffs are already approved, the market participation agreement, market application form and other rules are still to be approved by ERERA. In this regard, the ERERA chairman recently revealed that a draft of ECOWAS rule on sanctions and enforcement rules to guide the operations of the Regional Electricity Market (REM) were being reviewed for approval. He reiterated the WAPP ambition to make all legal commitments binding[20] for all participating members (utilities) and member states (ERERA, 2015a), and emphasised that ERERA will not only concentrate on a single tariff system but would also engage in bilateral discussions to bring in bigger power producers to beef up the provision of bulk electricity that is needed for creating a regional market.[21] The implementation of the regional market rules was expected in 2018. The second phase, planned to be operationalised at the end of 2019 would be a formalised market allowing for the short- & medium-term

[19] This ICC will specifically aim to provide the means to manage the information necessary to stakeholders by constructing and equipping the ICC building; support the National Utilities and Control Area Centers (CACs) in the operation of the interconnected system; establish the regional electricity market (Ki, 2017).

[20] The powers conferred on ERERA are both statutory and quasi-judiciary. ERERA issues regulations and decisions that are binding, directly applicable in the ECOWAS zone and their application is guaranteed by Member States on their territory. (ERERA, 2008).

[21] See Modern Ghana 30 November 2017.

electricity exchanges through the day ahead market (DAM). Ultimately, the goal is to implement a long term vision of a liquid and competitive market (Adeyemo, 2014).

The EAPP, as the latest power pool created, plans to have a centralised regional trading regime between 2020 and 2025 (ICA, 2017). Currently the EEAP works with long-term bilateral agreements. The prospect of Ethiopia becoming a major hydropower exporter is already showing its effects. Ethiopia and Kenya signed a 20-year Power Purchasing Agreement (PPA) for 400MW of electricity, while Ethiopia and Tanzania are reportedly negotiating another PPA for the same amount. Today, East Africa already has a slight surplus, which will grow significantly with infrastructure coming online in the next few years (Power Africa, 2018). This calls for an acceleration, not only of transmission infrastructure projects, but also the short-term trading mechanisms. The EAPP initiated a short-term day-ahead market at some point, and market mechanisms are in the design phase, however none are currently in effect due to infrastructure constraints as well as institutional capacity issues (Woolfrey, 2016).

The SAPP is therefore the only power pool with an operational regional energy market, which represents about 5% of the total energy trade in Southern Africa. This contrasts with the 95% of bilaterally traded power in the region. Progress towards a regional energy market has been slow, partly due to the lack of sufficient electricity generation and transmission capacity in regions (no electricity means no trade), the preference of member states for bilateral trade agreements and the difficulties of harmonising the different national energy frameworks and standards.

3.3. Decision-making, governance and institutions

The SAPP, WAPP and EAPP, with headquarters in Harare, Cotonou and Addis Ababa, respectively, are all specialised institutions governed by their respective regional organisations, the SADC, ECOWAS and COMESA. Within the legal, administrative and financial framework of these regional organisations they operate as independent bodies based on Intergovernmental Memorandums of Understanding and inter-utilities MoUs, and in the case of the WAPP and SAPP also on a legally binding regional energy protocol.

Various actors consider the SAPP Coordination Centre to be a well-run and transparent organisation that effectively promotes the regional energy agenda and regional energy cooperation (Vanheukelom & Bertelsmann-Scott, 2016). In contrast, the EAPP has made limited progress towards an integrated regional electricity market. It lacks strategic direction, and its budgeting and financial management practices reportedly lack transparency (Woolfrey, 2016). The WAPP seems to be in-between the EAPP and the SAPP. It manages to organise regular meetings with donors (WAPP Donor Roundtable and Donor Coordination Meetings) and attract investments in the WAPP, but at the same time it lacks transparency in terms of budgeting practices.

Power pool operations are often overseen by a regional authority in charge of regulating regional energy trade and facilitating the harmonisation of regulatory policies, legislation, standards and practices. The WAPP has the ECOWAS Regional Electricity Regulatory Authority (ERERA) based in Accra and the EAPP has the Independent Regulatory Board (IRB) based in Addis Ababa. Paradoxically, the SAPP is the only power pool with a functional regional market dynamic yet it does not have a regional authority regulating the regional energy trade but a Regional Electricity Regulatory Association (RERA) which regroups national regulators of

10 of the 15 SADC members[22]. However there is an expressed intent to have the SADC transition into a regional regulatory authority (European Commission 2016)[23].

While the SAPP has a Coordination Centre based in Harare, in charge of coordinating activities of planning and expanding generation, transmission and distribution among member states, the WAPP is building its own Information and Coordination Centre, the "Regional System Market Operator" (RSMO) in Abomey-Calavi, Benin, which will promote operational coordination between Transmission Owning/Operating WAPP members and actual day-to-day information sharing/exchange between WAPP Operational Coordination Centers; and facilitate efficient trading of power between entities in the different countries that are interconnected in the region[24]. The EAPP's Coordination Centre is in the design phase.

The governance and organisation architecture of the three African power pools is similar. All three work under the auspices of a REC but follow a specific set of rules between their members. While they create some type of supranational governance, power pool structures have limited power over member states, as commitments and agreements are often non-binding and cannot be enforced.

Paradoxically, the most functional power pool (SAPP) may even have the least institutionalised governance system in place, especially when it comes to regulating its emerging regional market. This suggests that the formal institutional framework in the WAPP and EAPP somewhat precedes the function of regional energy trade.

4. Explaining performance differences

The idea of establishing and maintaining a power pool is not without consequence. Regional energy trade requires significant reforms, not only between but also within countries so as to be able to tap into a (future) regional market, either as a producer or as a consumer. It also requires a shift in thinking from short-term oriented objectives towards long-term gains through at times expensive investments. These changes can be difficult to implement. Sector reforms do not take place in a vacuum and are subject to a host of different national and regional considerations. Power pool performance therefore varies significantly between different countries and regions, and depends on more than simply excess capacity and infrastructure alone.

This section looks at the opportunities and challenges power pools face in their creation, development and maintenance, as well as the underlying interests that shape how the different power pools operate.

4.1. Infrastructure development and trade-offs between internal and external demand

The number one constraint for countries engaging in regional electricity trade is lack of generating capacity. If one country has a clear net surplus of electricity, it will be able to satisfy demand, but buyers will be in an insecure and dependent position. This was the case with South African energy dominance until the 1990s, It is also the case with Niger's reliance on Nigerian energy. For a regional power pool to perform well and for

[22] Only 12 of the 15 SADC members have electricity regulators. The Malagasy and Seychelles regulators are not members of the RERA.

[23] Contrary to the ERERA whose decisions are 'binding and enforceable on the parties' (ERERA, 2015b: 6), the IRB decisions are not binding (Deloitte, 2015).

[24] More information at http://icc.ecowapp.org/content/about-us

a regional market to be competitive, there need to be several surplus producers and different buyers within a pool. African power pools are still very much behind for the simple reason that with a few notable exceptions, hardly any country has reached a satisfactory level of generation capacity. Investments are being made everywhere and simultaneously, but the energy prospects of member states tend to be very uneven. That coupled with the highly volatile prices of fossil fuels in recent years and the rapid technological advancement in different segments of the renewable energy market leads to a situation where it is difficult to predict where the African regional energy maps in West, Southern and Eastern Africa will finally settle.

Electrification in most countries is also far from complete, which further complicates the incentives or disincentives for member states to go regional. National demand and pressure to provide electricity access tends to be a primary concern for most decision-makers, yet at the same time it may be more lucrative to prioritise exports to neighbouring countries. DRC is an excellent example, where the projected production capacity of the Grand Inga complex exceeds the wildest dreams of hydropower engineers, yet the electrification rate in the country is a mere 9% (USAID). While the national grid is far from able to absorb the planned capacity of the grand Inga project in the short-run, South Africa is in a position to take off a major portion of the future Inga production. While this could benefit both South Africa and DRC, it could also reduce the momentum for electrification in Central Africa, a region that is already running behind compared to the rest of the continent. Nigeria in West Africa is in a similarly conflicted situation. It has an electrification rate under 50%, and even less in the disenfranchised northern state of the country, but at the same time the country has been developing the West Africa Gas Pipeline project for decades, which will feed electricity generation in neighbouring countries, including Ghana.

African regional energy trade therefore is not only a moving target, its major producers are also often forced to choose between national energy objectives and regional commercial interests.

Financing plays an important role in the infrastructure development in African power pool regions. Energy infrastructure development is partly determined by development partners, member states and private sector interests, which explain in turn why some power pools are progressing faster than others. Beyond the ability of countries to invest in regional energy infrastructures, countries' interests in going regional tend to vary. Countries using debt (and assuming the risks) to finance energy infrastructure will most likely be interested in developing national rather than collaborative/regional initiatives, as this way, the perceived potential benefits are 'granted', i.e. they do not rely on the actions of third countries. Politics within countries also matter: how politically feasible is it to build a power plant in country x supposed to mainly providing power to country y? In a sector where 'the location of distribution and transmission lines were often decided by politicians wishing to win votes rather than according to where the greatest demand was or would be', politics matter greatly (Barnett, 2014: 6).

Box 3: Added costs of transmission infrastructure and maintenance

Energy transmission is not free. Interconnections come at a cost that is not invested in the generation of additional electricity. Building interconnections also brings additional costs for utilities and other energy producers as generators need to be adjusted to accommodate utilities elsewhere on the regional grid. Unless there is a mechanism to compensate countries that bear additional cost in adjusting their distribution capacity to include other utilities, there may be limited short-term motivation to incur such costs (Karaki, 2017).

In addition, in most power pools, the issue is not only about attracting finance to build new generation and transmission capacity, but also *to maintain* existing grids to avoid losses and power cuts. Countries often favour the construction of new infrastructure projects, over maintaining existing ones, which is explained by their different nature as regional public goods (Andrews-Speed, 2011). The construction of infrastructure is often referred to as a "club good", i.e. a public good that is fully excludable: countries need to provide financial resources to benefit from it, otherwise they are excluded. Infrastructure construction also follows a weighted sum aggregation technology, as countries' contribution usually differs, in proportion with the perceived potential benefits. In contrast, infrastructure maintenance is a pure public good (non-excludable and non-rival), but relies on weakest link aggregation technology, i.e. maintaining the integrity of the network relies on the action of the weakest or least competent party. Andrews-Speed (2011) therefore argues that infrastructure maintenance is more challenging than construction. Indeed, in the case of club goods, those parties who do not wish to participate can easily be excluded and the agreement can be concluded without excessive difficulty (idem).

Another argument can also be that building generation capacity is more politically attractive than 'simply' maintaining existing infrastructures, as evoked above.

4.2. Power pools and regional hegemons

In both Eastern and Southern Africa, regional hegemons played a key role in the creation and development of power pools, either by fostering or by blocking integration, depending on their national interests.

In the SAPP, South Africa was instrumental in the creation of the SAPP, which it used to sell surplus energy in more effective ways through the creation of a regional energy market and improved electricity infrastructure development. But historically, the country did not need the SAPP to trade within the region. In fact it engaged with Mozambique on a bilateral basis, with direct investment from South Africa to Mozambique's generation and transmission infrastructure. South Africa however used the SAPP to foster dialogues between stakeholders around the development of the Inga hydropower schemes in the DRC, given the impossibility of direct transmission from the DRC to South Africa.

Eskom plays a key role behind South Africa's choice to foster or block the development of the SAPP. While Eskom had an initial agreement with Botswana regarding the development and exploitation of the Mmababula coal mine, domestic pressures in South Africa eventually halted any further developments[25]. The project has since been suspended pending further interest from South Africa (Grynberg, 2012) and blocking further energy integration in the region.[26] In 2006, Eskom renegotiated a series of contracts with the rest of

[25] Trade unions with considerable influence within high-level politics in South Africa maintain that they want to protect employment opportunities provided within its domestic energy sector (production, mines, distribution, etc.) and don't want to see these opportunities spill-over into the rest of Southern Africa (Vanheukelom, 2017: 34).

[26] "Without South Africa's support and commitment to buying off significant quantities to be developed at the Mmamabula project, it is simply not feasible for other countries to invest the initial capital to establish coal generation plants, because they cannot take advantage of economies of scale due to lack of domestic energy demands or even through

Southern Africa, making them more flexible and strengthening Eskom's leverage (e.g. to block supply when its own grid came under pressure). This resulted in neighbouring countries like Botswana focusing more efforts on securing supply independently from South Africa by developing national energy capacities and by reaching out to IPPs to provide capacity in the short term mostly through bilateral agreements, hence reducing incentives to work with or through the SAPP (Vanheukelom & Bertelsmann-Scott, 2016).

Ethiopia in Eastern Africa is another "swing state". It dominates the EAPP and uses the power pool as an instrument and a means to pursue the country's broader national strategic interests and to further assert its dominance in the region (Woolfrey, 2016). The country invested heavily in exploiting its vast hydropower potential through the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile. This is part of the country's long-term strategy in the region, but also aims to tie the region to Ethiopia through energy trade, and, by fostering interdependence on Ethiopia's terms, to shift the regional balance of power away from Nairobi, Khartoum and Cairo towards Addis Ababa (Woolfrey, 2016).

In order to gain control over the transmission and prices of power traded in eastern Africa, Ethiopia convinced the EAPP to build a new Regional Head Office and Regional Market Operations and Control Centre in Addis Ababa. It thus blocked attempts to decentralise EAPP institutions to Egypt or Kenya (idem). While Ethiopia helped develop the EAPP and largely dominates its agenda, the country again mainly engages in bilateral energy trade agreements (with e.g. Kenya, Tanzania or Rwanda).

At the same time, Ethiopia's influence over the EAPP is not without challenges: Egypt is seen to block the EAPP agenda and the country resigned from the EAPP in 2016 over its concerns of other member states' strategies regarding the Nile[27] as it had an interest in protecting its downstream position on the Nile from any upstream hydropower development.

This situation also pushes some COMESA member states to look for alternatives, that could better foster their national interests: Tanzania and Uganda may prefer to have an EAC power pool, while Burundi, DRC and Rwanda all participate in the EAPP and also engage in energy cooperation through the Energie des Grands Lacs.

4.3. Building a platform for regional energy trade

Some countries have more to gain than others from power pooling and trading. There is an important distinction between energy importers and exporters, which, put in the context of regional energy integration and electricity trade, translates to different countries' needs, interests and constraints or even risks for engaging with their neighbours. Member state contributions to collective action will depend on the cost and benefit evaluation of the various available outcomes as well as on the expectations regarding the choices of other actors (Eyita, 2014). Table 2 below provides a stylised overview of different interest, constraints and risks for energy exporters and importers.

the SAPP. The case of Mmababula is illustrative of how SA has employed its position as regional hegemon to act as a blocker within the regional energy agenda due to domestic interests and pressures" (Grynberg, 2012).

[27] See ESI Africa 2016.

Table 2: Energy exporters and importers' interests[28] in regional power pools

	Energy exporters	Energy importers
Key benefits	Income	Energy access
Interests	• Ability to sell electricity surplus, thus generating additional income • Increase power leverage vis-a-vis energy importing countries • Create jobs at home	• Access electricity for a lower price, and ensuring energy security
Constraints	• Price of electricity may increase at home as a result of electricity trade • Large supply/demand shock in one country inducing a large price effect in the other country, which it could have avoided by not selling • Internal political instability • Limited means to finance interconnection infrastructures	• Limited means to finance interconnection infrastructures
Risks	• Dependence on export revenues from energy income	• Dependence on exporting country electricity provision, which may affect other economic sectors (e.g. industrialisation) • Loss of jobs

Source: Authors

These different national interests can lead to the 'collective action' required to achieve regional public goods a difficult endeavour. The slow progress in the development of regional energy trading platforms illustrates the effect of these issues. Small importing countries may be reluctant to accept exposure to short-term international market prices through the inter-day market and may prefer most trades to occur under long term bilateral contracts at fixed prices to benefit from more predictability. This may explain the lack of trading in the day-ahead market of SAPP and the overall preference for bilateral arrangements (Oseni, 2014).

Power pools are also about liberalising national energy market - making it competitive. This may not be in the interest of monopoly utilities and the decision-makers they are connected to. A regional market is also difficult to achieve in a context of energy subsidies, which in many African countries helps to guarantee an affordable price for consumers (Clements et al., 2013). There may be also a strong resistance from powerful and privileged consumers who stand to lose from a liberalisation of the sector.

Subregional energy frameworks and river basin organisations: does size matter?

The EAPP and the WAPP do not exist in a geographical or sectoral vacuum. In both regions, there are sometimes older initiatives aiming to promote energy integration at the sub regional level. This includes River Basin Organisations, (RBOs), which are key drivers of regional hydropower cooperation. Member states do not hesitate to use and develop these whenever they best fit their interests.

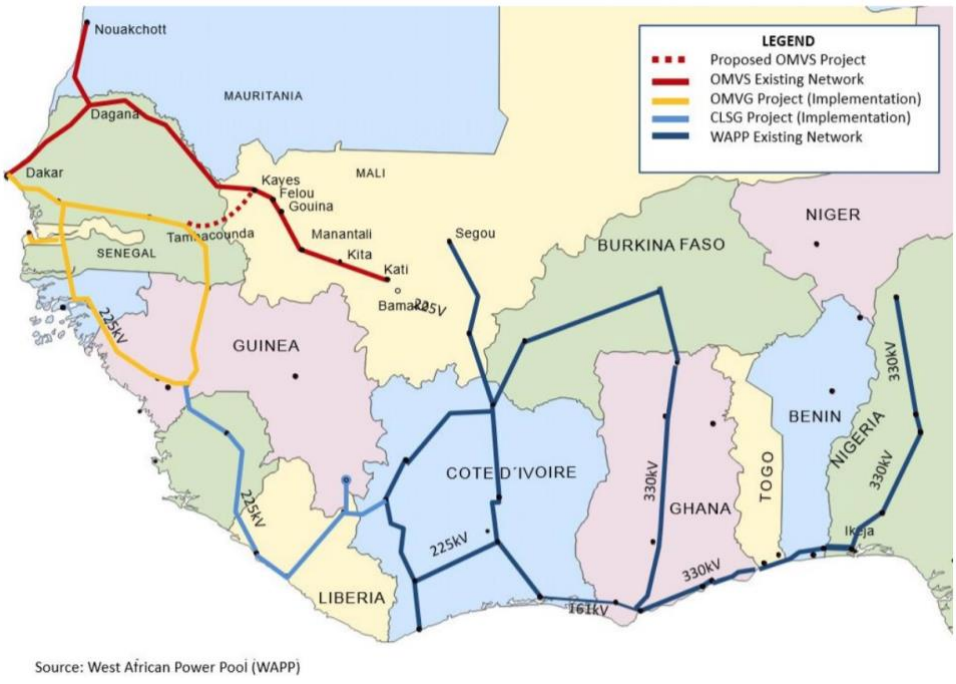
In this context, the EAPP's relations with other sub-regional energy initiatives such as the Nile Basin Initiative (NBI)/Nile Equatorial Lakes Subsidiary Action Program (NELSAP) or the Energy for the Great Lakes (EGL)

[28] Transit countries are not included in this particular study as there are no known cases of countries neither exporting or importing electricity.

are distant. This may be because these organisations perceive each other as competitors in the potentially lucrative field of asset creation, or because EAPP member states prefer to pursue different agendas through different regional organisations (Woolfrey, 2016). But fundamentally different ways of working may also make it difficult for them to work together. The NBI has no legal standing beyond a headquarters based in Entebbe, which allows it to take a more iterative, adaptive approach to building country interest in cooperation through the initiative (Knaepen & Byiers, 2017).

As in Eastern Africa, several sub-regional energy initiatives coexist in West Africa. Aside from the WAPP, these include the Organisation pour la Mise en Valeur du fleuve Gambie (OMVG), the Organisation pour la mise en valeur du fleuve Sénégal (OMVS) and the Autorité du Bassin du Niger (ABN). These River Basin Projects are included in the implementation "road map" of the WAPP Infrastructure Program, which is based on realising distinct but mutually reinforcing infrastructure sub-programs (World Bank, 2012). In practice, however the decision-making, commercial and investment agreements all take place in separate sub-regional structures made up of the same governments and utilities as the WAPP.

Figure 9: The OMVS and OMVG in the WAPP implementation roadmap



Source: GTAI 2017: 26

One objective in the medium term is to not only expand the electricity trade between the OMVS or OMVG countries, but to integrate these sub-regional organisations into the broader WAPP power system. This would then entail connecting them between themselves, or with the Côte d'Ivoire-Liberia-Sierra Leone-Guinea (CLSG) group, for example.

The WAPP and OMVS for example share relevant data, information and coordinate for the preparation of annual reports (GTAI, 2017). By their very nature, however, RBOs are an exclusive club. The OMVS is a particularly interesting case, as it manages interconnectivity between four countries (Senegal, Mali, Mauritania and Guinea), and centrally manages the exchange of electricity from a growing number of hydropower dams in the Senegal basin. It does so on the basis of a fixed, negotiated country allocations of regionally operated dams, and rates that are far below regional market value. In that sense, the RBO

approach could be seen to be incompatible with the regional power pool ambitions of the WAPP. At the same time, RBOs are rarely the only form of energy exchange between neighbouring countries, and Mali also engages in bilateral energy trade with both Senegal and Mauritania (Medinilla, 2018). The experience of the OMVS can therefore also benefit other regional mechanisms. Furthermore, with every addition to the total installed capacity of member states, the objective of a regional energy grid and market gets more within reach.

5. Conclusions

This paper seeks to draw out some of the similarities and differences in experience across the power pools currently being developed in Southern, Western and Eastern Africa. Though the power pools have been set up with similar objectives, progress has been incomplete and very uneven.

The challenges to achieving functioning power pools are technical, but also political. Power pooling requires trust and a strong alignment of interests between the region's member states, between the region (and/or member states) and the national private sector, and between external partners' and member states. The existence and political role of national power producers weighs heavily on the degree to which energy producing countries are willing and able to look outwards.

Hegemons are critical. The SAPP highlights the important role that South Africa originally played, while a lack of a historical champion in the WAPP and EAPP appears to have limited their progress significantly. Even if Ethiopia will soon become an energy giant, it is far from clear that the EAPP will be strengthened by this given that bilateral deals and connections dominate regional power trade.

While in theory, the case for power pools is strong, it may take time and incremental gains for countries to put their trust in an inherently flexible, yet less predictable model for regional energy trade. Part of the answer may lie in subregional cooperation, through existing organisations such as River Basin Organisations, and in new interconnections around major infrastructure projects. While working with the grain is somewhat built into African pools, it is equally important to keep the momentum around longer-term planning going.

Ultimately, power pools depend on a critical mass of surplus capacity, which on the African continent has long been in short supply. This leads to a tricky situation, where the immediate interest in regional electricity trade is often limited due to insufficient current surplus capacity. Structural deficit in many of the regions does not make a strong case for expensive interconnection investments or to make use of short-term market mechanisms. At the same time, when major infrastructure comes online as will be the case in Ethiopia, countries also run the risk of ending up with capacity they cannot use. African regions and countries therefore may have an interest in ensuring that grids and interconnections are in place and up to standard sufficiently ahead of time.

Major infrastructure projects can change regional energy dynamics relatively quickly. When Ethiopia's hydropower surplus will come online, energy trade will shift. At the same time, climate change variability (water levels) and oil prices are also likely to affect energy trade dynamics, regardless of installed capacity. This volatility can be mitigated by short-term market mechanisms that complement long-term PPAs, however this requires a sufficiently large and diverse amount of electricity that is available on the market.

Finally, while it appears quite clearly that generation infrastructures benefit from more traction both at the national and international level, power pools will not reach their objectives if member state power utilities do not invest in transmission capacities and maintenance. Although new generating capacity is due to come on line, the tradeoffs between domestic coverage and feeding a regional market will not go away, with rising electricity demand likely to continue to sway domestic politics away from power pooling, with the exception perhaps of a limited number of mega-projects.

Whatever form future cooperation takes place, the challenge of addressing electricity needs across countries is likely to remain, necessitating the continued need for regional cooperation in this domain.

Bibliography

Adeniyi, A., Adeniji, S. 2018. Integrated Power Market in West Africa: An Overview. Journal of Public Policy and Administration. Vol. 2, No. 3. pp. 20-27.

Adeyemo, B. 2014. West African Power Pool. Presentation at South Asia Regional Workshop on Competitive Electricity Markets. Colombo. 18 March 2014.

Andrews-Speed. 2011. Energy Market Integration in East Asia: a Regional Public Goods Approach. ERIA Discussion Paper Series. ERIA-DP-2011-06.

Barnett, A. 2014. Political considerations relevant to energy and economic growth. DFID Literature review.

Barnett, A., Stockbridge, M. & Kingsmill, W. 2016. Political Economy of Africa's Power Sector. Policy Practice Brief 10. The Policy Practice.

Benson, C. and Clay, E. 1998. The Impact of Drought on Sub−Saharan African Economies A Preliminary Examination. World Bank.

Beta, A. 2016. The Southern African Power Pool: SAPP Promoting a regional electricity market. Presentation at AFUR Workshop on Emerging Electricity Markets. 6-8 December 2016.

Brenton, P. & Hoffman, B. (eds.). 2013. Political Economy of Regional Integration in Sub-Saharan Africa. World Bank.

Byiers, B. 2017. Is the Nile Basin Initiative a 'regional sailboat' in choppy geopolitical waters? ECDPM Talking Points blog, 3 March 2017.

Castalia. 2009. International Experience with Cross-border Power Trading. (Report to the Regional Electricity Regulators' Association (RERA) and the World Bank). The Regional Electricity Regulators' Association/World Bank.

Castellano, A., Kendall, A., Nikomarov, M & Swemmer, T. 2015. Brighter Africa: The growth potential of the sub-Saharan electricity sector. Electric Power and Natural Gas. McKinsey & Company.

Clements, B., Coady, D., Fabrizio, S., Gupta, S., Alleyne, T. & Sdralevich, C. (Eds.) 2013. Energy Subsidy Reform: LEssons and implications. International Monetary Fund.

Deloitte. 2015. The roadmap to a fully integrated and operational East African Power Pool. 2015 edition.

Department of Energy of South Africa. Coal Resources overview. http://www.energy.gov.za/files/coal_frame.html

ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREE). 2014. ECOWAS Renewable Energy and Energy Efficiency: Status report 2014

ECOWAS Regional Electricity Regulatory Authority (ERERA). 2008. West African Power Sector Regional Regulation Project. Diagnostic Report on the institutional and regulatory interfaces of the ECOWAS Regional Electricity Regulatory Authority.

ECOWAS Regional Electricity Regulatory Authority (ERERA). 2015a. Resolution n.005/ERERA/15. Approval of the Regional Market Rules for the West African Power Pool.

ECOWAS Regional Electricity Regulatory Authority (ERERA). 2015b. (draft) Enforcement rules.

Eldridge, C. 2002. Why was there no famine following the 1992 Southern African drought? The contributions and consequences of household responses. Overseas Development Institute.

ESI Africa. 2016. Egypt resigns from EAPP until concerns over Nile are resolved. 8 February 2016.

European Commission. 2016. Action Document for Enhancement of a sustainable regional energy market in the Eastern Africa, Southern Africa and Indian Ocean region.

Eyita, E. K. 2014. Energy security through transboundary cooperation: Case studies of the Southern African power pool (SAPP) and the West African pool (WAPP). (Doctoral dissertation).

Financial Times. 2019. Cyril Ramaphosa pledges to save South Africa's ailing power utility, Joseph Cotterill in Cape Town, February 5 2019.

GTAI. 2017. OMVS Transmission Expansion Project.

Grosse-Puppendahl, S., Bilal, S., Karaki, K. 2017. The EU's financial instruments for access to energy in sub-Saharan Africa. (Discussion Paper 218). Maastricht: ECDPM.

Grynberg, R. 2012. SA Plays Power Games with Coal. Mail and Guardian. Available at: http://mg.co.za/article/2012-09-14-sa-plays-power-games-with-coal (last accessed: 23 March 2017).

IAE. 2014. Africa Energy Outlook: A focus on energy prospects in Sub-Saharan Africa. World Energy Outlook Special Report.

IAEA. 2016. Sustainable Electricity Supply Scenarios for West Africa. (IAEA TECDOC Series 1793). Vienna: International Atomic Energy Agency.

ICA. 2011. Regional power status in African Power Pools report. The Infrastructure Consortium for Africa Secretariat c/o African Development Bank.

ICA. 2017. Regional power status in African Power Pools - 2016 update. The Infrastructure Consortium for Africa Secretariat c/o African Development Bank.

International Renewable Energy Agency (IRENA). 2013. Current plans for regional transmission reinforcements in Southern Africa. Presentation at IRENA executive strategy workshop: Africa clean energy corridor initiative. Abu Dhabi. 22-23 June 2013.

IOL. 4 June 2016. Nearly 90% of SA has electricity - stats. https://www.iol.co.za/news/south-africa/nearly-90-of-sa-has-electricity-stats-2030406

Kambanda, C. 2017. The African Experience. In: Cottier, T. & Espa, I. (Eds.). 2017. International Trade in Sustainable Electricity: Regulatory Challenges in International Economic Law. Cambridge University Press.

Karaki, K. 2017. ECOWAS Energy: From national interests to regional markets and energy access? ECDPM policy brief, December 2017.

Ki, M.S.A. 2017. Introduction to the ECOWAS electrical interconnections and regional electricity market. Presentation by WAPP SG at the Africa energy forum in Copenhagen. 7-9 June 2019.

Kiilu, J. 2015. Building collaboration between East African Nations via transmission interconnectors. Presentation by Kenya Electricity Transmission Co. Ltd. at the East African Power Industry Convention (EAPIC). 28 August 2015. https://www.esi-africa.com/wp-content/uploads/2015/09/Joel-Killu.pdf

Knaepen, H., Byiers, B. 2017. The Nile Basin Initiative: Balancing historical rights, national needs and regional interests. ECDPM policy brief, December 2017.

Maviya, J. 2017. The Southern African Power Pool. Presentation at Southern African Power Pool SAREE/IRENA Workshop, Windhoek Namibia. 24-25 April 2017.

Medinilla, A. 2017. The International Congo Ubangui Sanga Commission (CICOS): Going with the flow - from navigation to climate finance in less than 20 years? ECDPM policy brief, December 2017.

Medinilla, A. 2018. African river basin organisations: From best practice to best fit. ECDPM discussion paper 236, December 2018.

Medinilla, A., Ronceray, M., Keita, A. & Fomba, B. 2019 [Forthcoming]. Entre coopération et contestation: Les intérêts maliens dans la gestion des fleuves transfrontaliers du Sahel. ECDPM Discussion Paper.

Modern Ghana. 2017. ECOWAS Electricity Market Set For June 2018. 30 November 2017.

Muntschick, J. 2013. Regional energy cooperation in SADC: is the southern African power pool currently powered by external funding? In: Monitoring Regional Integration in Southern Africa Yearbook 2012, tralac.

Olingo, A. 2018. Phase One of regional power pool project set for completion by mid-2019. The East African. 6 August 2018.

Oseni, M. O., and M. G. Pollitt. 2014. Institutional Arrangements for the Promotion of Regional Integration of Electricity Markets International Experience. (Policy Research Working Paper 6947). The World Bank.

Pineau, P. O. 2008. Electricity sector integration in West Africa. Energy Policy, 36(1): 210-223.

Power Africa. 2018. East African Countries Will Have Electricity They Cannot Use, Unless They Focus on Their Transmission Infrastructure Now.

Rose, A., Stoner, R., Pérez-Arriaga, I. 2016. Integrating market and bilateral power trading in the South African Power Pool. UNU-WIDER Working Paper 2016/133.

Southern African Development Community (SADC). 2016. SADC Energy Monitor 2016. Baseline Study of the SADC Energy Sector. SADC Energy Division.

Stewart, W. 2016. Overview of the Southern African Power Pool (SAPP) energy programme for the Southern African Development Community (SADC). SRK Consulting. Presentation at Fossil Fuel Foundation: IPP Conference. Johannesburg. 17 March 2016.

UNEP. 2017. Atlas of Africa Energy Resources. United Nations Environment Programme.

UNCTAD. 2017. The least developed countries report 2017: Transformational energy access.

UNECA. 2004. Assessment of Power Pooling Arrangement in Africa. UNECA Sustainable Development Division.

USAID. 2016. Power Africa. A US Government-led Partnership. The Roadmap: A Guide to Reaching 30,000 Megawatts and 60 Million Connections.

Vanheukelom, J. 2017. SADC: Living with a powerful neighbour. ECDPM policy brief, December 2017.

Vanheukelom, J., Bertelsmann-Scott, T., 2016. The political economy of regional integration in Africa: The Southern African Development Community (SADC) Report. ECDPM, Maastricht.

Verhaeghe, E., Woolfrey, S. 2017. The Common Market for Eastern and Southern Africa: Incentive-based institutional reform? ECDPM policy brief, December 2017

West Africa Power Pool. 2018. Key Indicators. http://icc.ecowapp.org/list-stat#?

Williams, D. 2015. Ivory Coast looks to more than double capacity by 2020. Power Engineering International. 28 September 2015.

Woolfrey, S. 2016. The political economy of regional integration in Africa - The Common Market for Eastern and Southern Africa (COMESA). Maastricht: ECDPM.

World Bank. 2007. Ghana: Energy Development and Access Project. (Project Information Document (PID) Appraisal Stage, report No. AB2898).

World Bank. 2012. West African Power Pool (WAPP) - Côte d'Ivoire, Sierra Leone, Liberia, and Guinea Power Interconnection Project WAPP. WAPP Integration and Technical Assistance Project.

World Bank. 2017. Sustainable Energy for All (SE4ALL) database. Access to electricity (% of population).

Wright, J.G. & van Coller, J. 2017. A review of SAPP markets and a proposal for a novel market structure to incentivise generation investment in southern Africa. Conference paper: 25th Southern African Universities Power Engineering Conference (SAUPEC). Stellenbosch, South Africa.

Wright, J.G. 2014. Over the Transmission Hurdle: Assessing electrical transmission constraints for the Southern African Power Pool (SAPP) in PLEXOS. Energy Exemplar.

About ECDPM

The European Centre for Development Policy Management (ECDPM) is an independent think tank working on international cooperation and development policy in Europe and Africa.

Since 1986 our staff members provide research and analysis, advice and practical support to policymakers and practitioners across Europe and Africa – to make policies work for sustainable and inclusive global development.

Our main areas of work include:

- European external affairs
- African institutions
- Regional integration
- Security and resilience
- Migration
- Sustainable food systems
- Finance, trade and investment
- Private sector engagement

For more information please visit www.ecdpm.org

In addition to structural support by ECDPM's institutional partners: The Netherlands, Belgium, Estonia, Finland, Ireland, Luxembourg, Sweden, Switzerland, Denmark and Austria, this publication mainly benefits from funding of the German Federal Ministry for Economic Cooperation and Development (BMZ).

ISSN1571-7577

ecdpm

Making policies work

HEAD OFFICE
SIÈGE
Onze Lieve Vrouweplein 21
6211 HE Maastricht
The Netherlands *Pays Bas*
Tel +31 (0)43 350 29 00
Fax +31 (0)43 350 29 02

BRUSSELS OFFICE
BUREAU DE BRUXELLES
Rue Archimède 5
1000 Brussels *Bruxelles*
Belgium *Belgique*
Tel +32 (0)2 237 43 10
Fax +32 (0)2 237 43 19

info@ecdpm.org
www.ecdpm.org
KvK 41077447