Trade Knowledge Network

Series on Trade and Energy Security – Policy Report 5

Regional Energy Security Dynamics in Southern Africa

Electricity Mixes in the Context of Global Climate Change Mitigation Pressures

Ivan Mbirimi

2010

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Abstract

Towards the end of the first decade of the 21st century, Southern Africa began to experience widespread power shortages. A number of factors contributed to these shortages, including poor planning, inadequate generating capacity and increased demand for power, with the latter in turn driven by high population and economic growth rates. Accordingly, energy security, particularly the need to ensure reliable, widespread and affordable power supplies, has become a major policy priority for governments in the region. With concerns about climate change looming large, there is an urgent need to diversify the region's energy sources away from the current high dependence on coal to hydro and non-hydro renewable sources of power. It would appear that the formation of the Southern African Power Pool (SAPP) offers a suitable framework for such diversification and coordinated expansion of generating capacity. This report looks at the main drivers of electricity generation in the region and evaluates the challenges that the region is likely to face as it seeks to expand its power generating capacity. It also assesses SAPP's suitability as a framework for expanding generating capacity in the region and speculates on what might happen if South Africa were to opt for an independent expansion of generating capacity.

Published by the International Institute for Sustainable Development

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This study is part of a larger, multi-region TKN project that seeks to understand better the impacts of trade policy on energy security. It includes country case studies and regional analyses from Latin America and Southern Africa. It was made possible through the generous support of the Norwegian Agency for Development Cooperation (NORAD). The project outputs are available on the TKN website.

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About the author

Ivan Mbirimi is an economist with nearly 30 years of experience specializing in trade policy analysis, research, capacity building and international trade negotiations. His areas of interest include climate change and the environment, with a particular focus on the concerns of developing countries; trade negotiations; and regional integration issues. Until 2007 he worked as an economic adviser at the Commonwealth Secretariat. Currently a research associate with the South African Institute of International Affairs, he has also consulted for Chatham House, ICTSD, IISD and a number of governments in Southern Africa.

Abbreviations and acronyms

AICD	Africa Infrastructure Country Diagnostics
DRC	Democratic Republic of the Congo
GDP	gross domestic product
Gw	gigawatt(s)
kW	kilowatt(s)
kWh	kilowatt hour(s)
MW	megawatt(s)
SADC	Southern African Development Community
SAPP	Southern African Power Pool
USD	U.S. dollar
Westcor	Western Corridor Project

Executive summary

Policies on energy security are essentially about minimizing the risks of supply disruptions. Not surprisingly, there is no single definition of energy security. While geopolitical considerations weigh heavily in the definitions of energy security adopted by many developed countries, in Southern Africa energy security can be defined largely in terms of the need to develop new infrastructure such as new electricity generation capacity and the exploitation of any opportunities created by renewable technologies to get the poor in rural communities connected more quickly and at less cost than is currently the case.

Two options are available to the region for building new energy infrastructure and increasing regional generating capacity: the expansion of national generating capacities or the cooperative regional expansion of generating capacity. The formation of the Southern African Power Pool (SAPP) could be taken as a signal that the region is intent on pursuing the latter course. This view is broadly shared by energy experts in the region, who see the cooperative approach as offering opportunities for the exploitation of the vast hydropower potential that exists in certain countries in the region (notably the Democratic Republic of the Congo and Mozambique)—a potential that would otherwise remain unexploited without the assurance of an export market such as that provided by the regional power pool. Moreover, South Africa, which is by far the region's largest economy and the main market for future electricity exports, faces the urgent need to decarbonize its energy supply. Circumstances in the region would therefore appear to favour a cooperative approach to the expansion of generating capacity in the region.

However, while all countries in the region recognize the value of cooperating in the exploitation of regional energy resources, practical considerations may make this difficult. The long gestation periods associated with the development of hydropower plants reduce the attractiveness of this technology, not just because that makes it more expensive, but also because additional power is urgently required to address current power shortages. The abundance of cheap coal resources in the region makes it more likely that in the short term, more coal fired power stations will be built to meet the pressing energy needs of the region. The commencement of work on the new Medupi coal fired power station in South Africa at the beginning of 2009 should be seen in this light. Thus, the possibility exists that regional cooperative expansion efforts may be undermined by the pressing need to immediately find or develop new additional energy supplies. So, how the region, especially South Africa, responds to the short term requirement for increased generating capacity will be an important determinant of the success of the region in diversifying its energy supply sources. Looked at more broadly, the challenge for the region is to strike the right balance between urgent short term requirements for increased power and the long term provision of cheaper, reliable and cleaner electricity. This requires both a great deal of political will and a keen understanding of the regional energy security dynamics.

In order to get a handle on the key elements of regional security dynamics, the report analyzes the main drivers of energy and power generation in the region, and highlights the importance of three aspects of regional energy security dynamics. The first is South Africa's anchor role as the largest economy, as well as the main producer and potentially largest importer of hydropower in the region. This places it in a position of considerable influence in shaping energy developments in the region. At the same time, as one of the most energy intensive economies in the world, South Africa has a clear interest in alternative cleaner forms of energy. Secondly, widespread poverty, in part mirrored by low electrification rates across the region, mean that there is an urgent need for accessible and affordable sources of power to a wider cross section of the population. Thirdly, non-hydro renewable sources of energy, such as solar and wind

technology, may offer new opportunities for expanding access to electricity. However, their initial development may require government support to overcome the disadvantages created by incumbent producers of power and the costs of associated infrastructure.

Inevitably, South Africa's anchor role prompts the question of what future regional energy arrangements might look like if it opted for self-reliance in power generation and supply. The report considers the likelihood and implications of such a development. Current government policy suggests that there is a strong commitment to diversifying energy sources, no doubt reflecting concerns that in a world of increased carbon prices, fossil fuel based sources of energy would no longer be a source of international competitiveness, while the possibility that the country's exports may be at the receiving end of protectionist measures applied by industrialized countries is very real.

But a case can still be made for the construction of new coal fired power stations on the grounds of development needs. SAPP's current focus is on the development of a competitive market for electricity. This does not necessarily require cooperative development and joint exploitation of available energy resources. In theory, this suggests that if South Africa opts for self-reliance, some countries in the region may follow suit, with the result that additional generating capacity may be created, but with a less diversified energy mix. Inertia might be another factor that might stand in the way of the cooperative exploitation of regional energy resources, partly because energy development technologies are subject to 'lock-in' effects that make the switch from one source of energy to another more difficult.

Clearly, energy security dynamics in Southern Africa are much more than about South Africa's anchor role and the role of SAPP in facilitating the regional exploitation of energy resources. An important consideration is how the power sector in the region is organized. At the most basic level, clarity is required regarding rules, regulations and the decision making process, including the roles of different stakeholders. This is a particular challenge, because the power sector in the region at the moment can best be described as a 'hybrid' market, following the stalling of attempts at liberalization in the 1990s, leaving behind a mixture of commercialized but publicly owned utilities controlled in some cases directly by government departments and in other cases by an independent regulator, which in practice may or may not be independent of government. These 'hybrid' markets add to investor uncertainty and give rise to what investors would see as regulatory risk—a major deterrent to investment in the sector. Irrespective of how additional generating capacity is created, however, there is an urgent need for reform of the energy regulatory framework both at the national and regional levels. At a minimum, every effort should be made to adopt price setting mechanisms that are as fully cost reflective as they can possibly be, while aiming any subsidies provided at carefully targeted groups.

1. Framing the issues

Viewed against a backdrop of a failing energy infrastructure and widespread lack of access to affordable energy, energy security in Southern Africa can be defined largely in terms of the need to develop new infrastructure such as new electricity generation capacity and fuel storage facilities, and of exploiting any opportunities created by renewable technologies to get the poor in rural communities connected more quickly and at lower cost than is currently the case. In contrast to the situation in most developed countries, where the power grid and total capacity are, on the whole, adequate, total capacity in Southern Africa falls well below what is required for economic and social development. In consequence, the main focus of policy is to find the best ways to add generation, transmission and distribution capacity to the electricity grid in order to meet the emergent needs of commerce and industry, as well as of communities currently without access to power. Most of the underserved communities are poor and reside in rural areas, although a significant number are found in urban areas. Poverty and development concerns are therefore at the core of energy security dynamics in the region.

Another important element of regional energy dynamics relates to the central position that South Africa occupies in the regional energy system. South Africa is a massive producer and consumer of electricity, most of it produced from coal, and this heavy consumption reflects the fact that the economy is structured around large scale, energy intensive mining and primary minerals industries, giving it one of the highest energy intensities in the world. South Africa accounts for about 80 percent of the region's total electricity demand, while it exports about 5 percent of its electricity production to six neighbouring countries in the Southern African Power Pool (SAPP). Botswana, Namibia and Swaziland import at least half of their electricity from South Africa, while Lesotho, Mozambique and Zimbabwe also import some electricity from South Africa (Foster *et al.*, 2008). Yet South Africa (and its neighbours) is in desperate need of additional capacity in the short term, while in the long term there is a pressing need for the country to move away from its heavy reliance on coal generated power in response to the looming climate change problem.

From a sustainable development perspective, the most logical way for South Africa to diversify its energy supply mix away from its heavy reliance on coal is to tap into the significant hydropower potential that exists in the region. However, the long gestation period for hydropower development means that in the near term South Africa will have to find the additional capacity required from new investments in coal fired power stations.[1] A key challenge for the region then concerns how the region might manage the transition from an energy system largely dominated by fossil fuels to one dependent on renewable energy.

The important point to note is that climate change concerns have introduced a new element to the debate, which South Africa's position amply demonstrates. In order to make significant reductions to its greenhouse gas emissions, South Africa has effectively adopted a two pronged approach. On the supply side, this entails diversifying the energy supply mix to include, for example, alternative sources of energy, notably renewable energy sources such as hydro, wind and solar power. On the demand side, the focus is on better energy demand management, for example, by implementing energy efficiency programs. Policies on energy demand management also contribute to the attainment of sustainable development, which is another important policy objective of government.

1 This is already happening. Construction of the first of the country's new coal fired stations began in April 2008. The Medupi Power Station, scheduled for completion in 2012, will be the first greenfield coal fired station to be built in 20 years. Construction of a second coal fired power station, scheduled for completion in 2017, also began in 2008. Also under construction is a new generation of nuclear reactors (EIA, 2008).

In sum, regional energy security dynamics in Southern Africa have two key attributes. One is related to the pressing need for vastly increased generation capacity to satisfy both economic growth and development demands. The other, which is brought to the fore by South Africa's particular position, is how the region addresses environmental issues linked to current concerns about climate change. What constitutes energy security clearly varies depending on circumstances. In the case of Southern Africa, the formation of the SAPP suggests that countries of the region share the view that future energy security lies in regional cooperation. Answering the question of whether the region has hit on the best policy is the broad objective of this report. The report starts with an outline of the key drivers of energy policy in the region, partly to situate the discussion in the broader context of the evolution of thinking on global energy security, followed by an assessment of the current state of play in terms of generation technologies (the role of mature non-renewable versus renewable technologies) and cost effectiveness. It then evaluates the potential for the expansion of regional trade in electricity and policies that can support cross border trading and addresses the anchor role of South Africa by asking what might happen if the country followed a strategy that placed greater emphasis on policies of self-sufficiency as opposed to the regional pooling of power.

2. The five drivers of electricity and power generation in Southern Africa

There are broadly two types of drivers for electricity and power generation. On the one side are *demand drivers*, which include both income drivers such as gross domestic product (GDP) growth, growth in household incomes and population growth, and price drivers related to the price level for electricity and energy sources that could substitute for current sources of electricity. On the other are *supply drivers*, which include the availability and security of resources, the profitability of different options, the fuel price (including the cost of carbon based fuels), technological development, subsidies and policies on renewable energy. Some of these drivers impact on both demand and supply. How these drivers affect different countries will also vary depending on the unique circumstances of a particular country.

In addition, two factors that cut across both demand and supply drivers are worth highlighting. One is *climate change* and its consequences. As governments around the world adopt policies to mitigate climate change, the cost of electricity generated from fossil fuels will rise, thereby raising the attractiveness of renewable sources of energy. We can therefore expect climate change to exert a growing influence on choice of energy supply sources. And as the cost of fossil fuel generated electricity increases relative to that of renewable energy sources, some benefits of renewable energy sources, e.g. the distributed nature of solar power, will begin to pay off.

The second cross cutting factor is *technology*, which has always been a major factor in determining the choice of sources of energy. In large part, this is because the cost of exploiting alternative sources of energy is determined by the available technologies, while the adoption of new technologies, e.g. in the area of renewable energy, is directly linked to the capacity of economies to innovate, learn, change and adopt the new technologies.

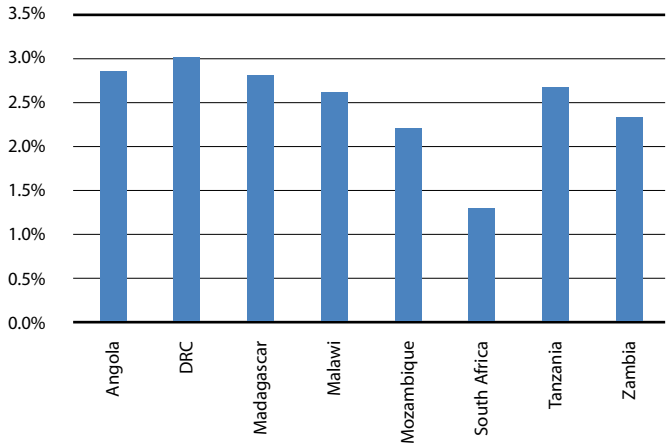
Finally, *government policies* will affect the way these drivers interact with one another and in some cases determine the choices to be made. For example, in the non-hydropower renewable energy sector, the technological choices to be made will be heavily influenced by whether or not government support (including subsidies) is available in the early stages of development and on the overall clarity of policies in regard to the non-hydropower renewable energy sector.

2.1 Demand drivers

On the demand side, economic growth, population growth and urbanization, which have all been rising across the region (except in Zimbabwe, where political instability and a shrinking economy have undermined the power sector; see Figure 2) will remain the key factors driving demand for energy services. The problem is that the demand for energy services created by these 'growth factors' has not been matched by an increase in electricity generation capacity, with the result that the gap between demand and supply has widened over time, with the most dramatic illustration of this being the frequent power outages experienced across the region. Even South Africa, which maintained a good reserve capacity for many years, experienced serious power outages in 2008—a direct result of stagnation in supply capacity.

In thinking about demand for power in the region, it is best to see it as comprising three components: (1) market demand associated with economic growth, population increases and urbanization; (2) suppressed demand, manifested in frequent blackouts and power rationing; and (3) the social demand associated with the goal of widening access to electricity. Figure 2 shows that economic growth during the period 1995–2005 was generally over 5 percent for most of the economies in the region. Population growth is also high (see Figure 1), and when this is combined with rapid growth in urbanization, it produces high growth in demand for energy services.

Figure 1: Average annual growth in population for selected SADC[a] countries, 2000–08 (%)



[a] Southern African Development Community

DRC = Democratic Republic of the Congo

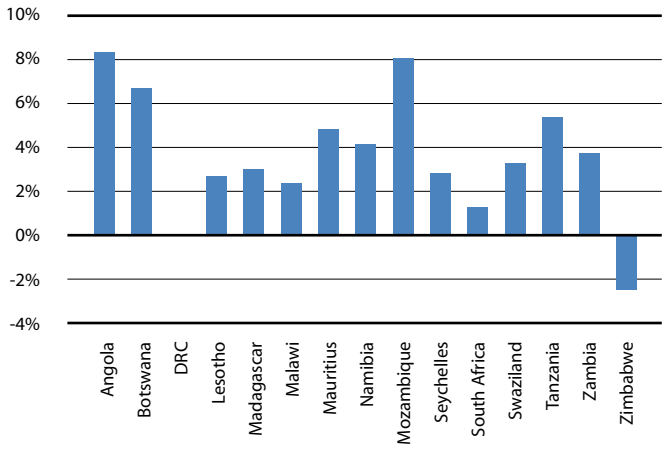
Source: World Bank (2010b)

The existence of suppressed demand reflects the fact that even where electricity is available, it does not necessarily mean that it is available on demand. In part, this is the result of the poor maintenance of existing power infrastructure, which has generally meant that not all the installed capacity is available to consumers. However, affordability may also be the main barrier to access.[2] In Southern Africa, where there is more reliance on fossil fuel electricity generation and hydropower, electricity has generally been cheaper, but there are costly implications for investment and maintenance of infrastructure. However,

2 This is particularly the case in countries that are heavily reliant on diesel generated electricity.

the practical reality is that poor households, including in some cases middle income households in urban areas, cannot afford electricity. This general lack of access has recently been worsened by power shortages caused by deficiencies in the current installed capacity of the region. Power outages have become more frequent, especially in urban areas, leading to losses in jobs, sales and productivity.

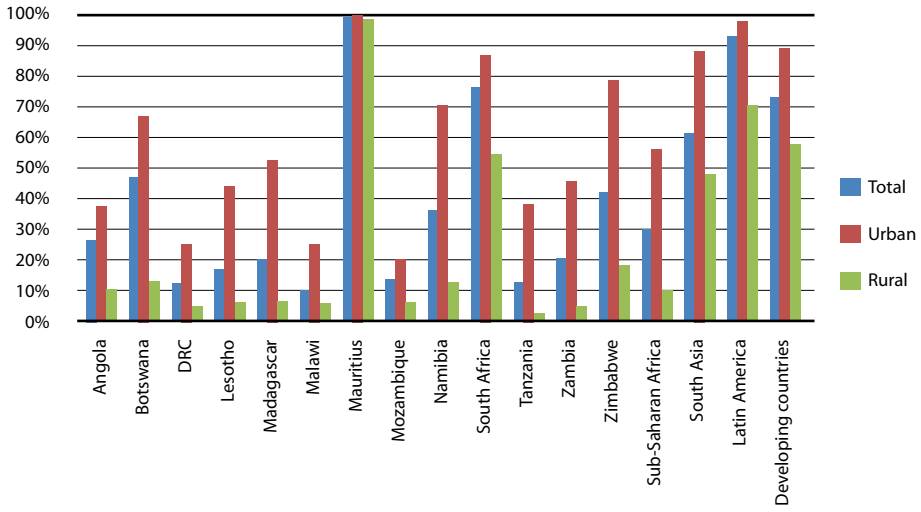
Figure 2: SADC countries' annual GDP growth, 1995–2005 (%)



Source: World Bank (2010a)

With respect to 'social demand' (widening access), Appendix 1 shows the extent of the challenge. Only four out of 13 countries in the region have an electrification rate above 30 percent. When one looks at the pattern of electricity coverage, it becomes clear that electricity access is even lower in rural areas. Apart from Mauritius, which has near total access for both the urban and rural sectors, only South Africa has a rural access rate above 50 percent. These figures are staggering when compared to other geographic regions that are broadly similar in economics and population terms, such as South Asia and Latin America. About 50 percent of the population in South Asia and 80 percent in Latin America have access to electricity.

Figure 3: Selected comparative electricity access and coverage, 2008 (% of population)



Source: IEA (2009)

At the core of this access problem is a shortage of financial resources to build new generation capacity, and repair and maintain existing infrastructure. One aspect of the problem is the underpricing of electricity by several utilities in the region. According to Africa Infrastructure Country Diagnostics (AICD),[3] nowhere in sub-Saharan Africa do residential or commercial and industrial customers pay full cost recovery prices, a situation that can be attributed to a mixed legacy of subsidies based on concern for the poor and outdated industrial policies (Foster *et al.*, 2008). For example, Zambia has historically priced power at highly discounted rates of just a few cents per kWh to the large scale mining sector. Angola, Malawi, South Africa and Zimbabwe have also maintained low prices (below economic costs). A direct consequence of this 'cheap' electricity policy has been the losses accumulated by power utilities in the region, a situation that has resulted in the failure to generate financial resources for maintenance and new generation capacity. To the extent that the level at which electricity prices are pegged determines the ability of power utilities to generate profits, prices will remain a key driver of power generation and development in the region.

A different aspect of the pricing problem is the link between prices and poverty. The subsidization of electricity has traditionally been justified on poverty grounds. But in most cases the subsidies have been so poorly targeted that they have only benefitted the relatively well off. Unable to afford electricity, the poor have opted for firewood and charcoal for their heating and cooking needs, which has not only increased deforestation, but also poses serious health problems (see Figure 4). Connecting poor households to the grid will continue to be a major challenge for the region's governments.

Another important demand driver is industry structure. There is a very close connection between industry structure and energy intensity—a connection that is particularly strong in the case of South Africa's 'mineral–energy complex'.[4] There is also a strong connection between new technologies and energy conservation. These links mean that changing the structure of this complex will require not only that electricity prices be increased to a level that takes account of externalities, but, even more importantly, it will entail the adoption of new technologies that help conserve energy. Such new technologies will be crucial especially in upgrading production towards the higher end of the value chain.

2.2 Supply drivers

Power can be generated from a variety of sources using a variety of technologies, which is why natural endowments play an important role in determining the energy supply mix. This is illustrated in Figure 4, which shows the composition of electricity generation among Southern African countries. Coal is currently the predominant energy source, especially in South Africa, which dominates the region's electricity market.[5] Zimbabwe and Botswana also have substantial reserves of coal, while the DRC (in particular), Mozambique and Zambia have considerable potential for hydropower. Mozambique also has reserves of natural gas, while Angola is a major African oil producer. The abundance of cheap coal resources and the high costs of developing hydropower have combined to create an environment with hardly any incentives for the development of alternative sources of power.

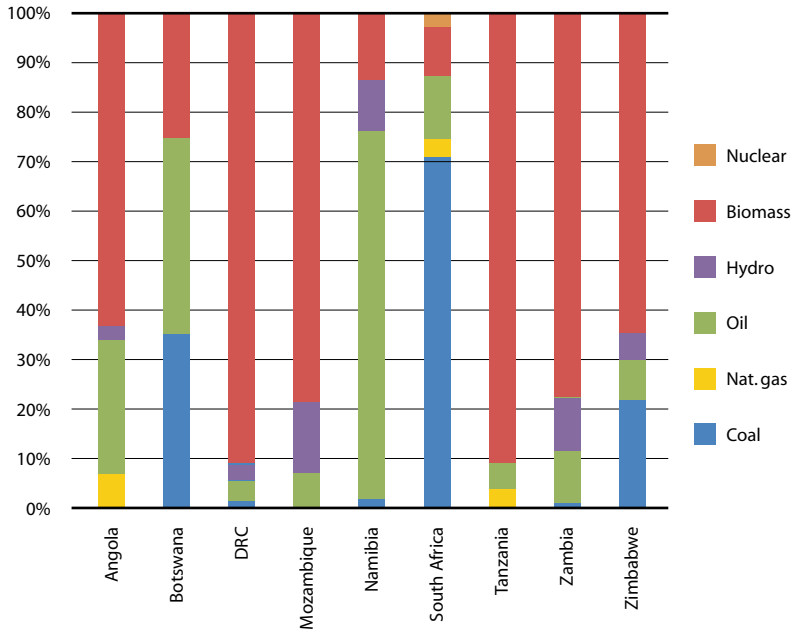
3 AICD is a program run by the World Bank and funded by several donors.

4 The concept of a mineral–energy complex was developed by Fine and Rustomjee (1997).

5 In 2005 it was estimated that coal fired power stations accounted for about 93 percent of the country's electricity production, thereby making coal the dominant fuel for generating electricity in the region (SourceWatch, 2010).

Biomass in the form of firewood, mostly used for heating and cooking, is the largest energy source in six out of nine SADC countries, with potentially adverse health impacts. In the DRC and Tanzania, more than 90 percent of the population depends on wood fuel. Such a high dependence on wood fuel in large part reflects the extreme disparities in the availability of electricity to the vast majority of people. The percentage of biomass in the energy supply mix is lower in the richer countries of the subregion (Botswana, Namibia and South Africa). South Africa derives 72 percent of its energy from coal and Namibia depends on oil for up to 70 percent of its energy, while Botswana has a supply mix that is more balanced.

Figure 4: Composition of power generation capacity in selected SADC countries, 2006 (%)



Source: World Bank (2010b)

What is apparent from Figure 4 is that the current energy supply structure does not fully reflect the domestic and regional endowments of energy resources (also refer to Table 1, below). This is partly because the type, size and time horizon of investments required for developing the different energy resource options vary. Accordingly, the risks and expected returns associated with developing the different options also vary, with some options, e.g. hydropower, requiring investments on a scale and over a time horizon that reduces their attractiveness to potential investors.

In the current circumstances, the type of investments we are likely to see in new electricity generation capacity will be influenced by at least three factors. The first is the expected deepening of regional integration, in particular, the further development of SAPP. Increased regional power trade should enhance the economic viability of large scale power plant development. One reason why the huge hydropower potential of the DRC has remained unexploited is that the market for the potential power that could be generated has not hitherto existed.[6] Now, a combination of electricity shortages in South

6 Plans to build the world's largest hydropower facility have been under consideration for the last several years. The Grand Inga Project, which in fact would be the final phase of a series of hydropower facilities located about 250 miles southwest of Kinshasa, will produce an estimated 40,000 MW of electricity, three times the amount generated by the Three Gorges project in China. Inga I and II were built in the 1970s, but currently operate well below capacity due to lack of maintenance, with some estimates

Africa and the whole region, pressures stemming from concerns about climate change, and the decision to formalize regional power trade means an electricity market of substantial potential will be available to the potential exports of hydropower from the DRC. This in turn should enhance the commercial viability of hydropower projects in the region and perhaps help further attract international (funding) support for them.

The second factor relates to what governments could do to further enhance the attractiveness of investment in refurbishment and new generation capacity. Clearly, money will be a key driver of investments in new generation capacity, especially if the focus is on developing hydropower projects. Money will thus dictate the technological choices to be made. This is an old problem: in fact, a key reason why most of the region's abundant hydropower remains unexploited is cost or lack of capital. High upfront costs are a feature of hydropower projects and the capital costs of such projects are significantly higher than those of alternatives such as coal and gas fired power plants. According to Frost and Sullivan (2009), it costs approximately USD 2 billion to build a 1,000 MW hydropower plant, compared to USD 1 billion for a thermal power plant of similar size. The cost element of hydropower development is unlikely to be affected by the formation of SAPP. What one hopes might change are investor perceptions about expected returns.

There are three potential sources of money: external donor funding, domestic and international capital markets, and internally generated resources (by power utilities). It seems reasonable to expect that donors and international capital markets would have taken notice of the potential created by the development of a regional power pool. However, prospects of turning this potential interest into investment flows are unlikely to improve until governments undertake reforms aimed at improving their own capacity, as well as that of national electricity utilities, to contribute to investment in power generation. Undertaking the necessary reforms would be seen by investors as a clear signal of political commitment to new energy projects and to running electricity services in a commercially viable manner.

Reform will be required in three main areas:

1. Given that electricity tariffs are among the most important determinants of investor interest and sector viability, they need to be set at a level that sends the correct market signals to investors. This means that tariffs must not be set at a level below the cost of generating electricity. When tariffs are set below cost, utilities have no incentive to connect new customers and no money to invest in new capacity and maintenance. Additionally, tariffs below cost imply that public funds will be used to subsidize the electricity provider, thereby diverting resources from potentially more productive uses.

2. Effective institutions for regulating the market are required. Weak institutions are one of the reasons why attracting private investors to Africa remains a challenge. Many institutions, including governments, do not have much experience of dealing with large infrastructure projects or with private–public partnerships, and the few institutions that have some experience usually have only a few individuals with the necessary expertise.

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of refurbishment costs being around USD 550 million. Progress on the implementation of the Inga projects has, however, been slow. The Western Corridor Project (Westcor), formed to develop Inga III, which is considered to be the stepping stone to Grand Inga, appears to have encountered problems, with the result that plans to link the electric grids of the DRC, Namibia, Angola, Botswana and South Africa are unlikely to be achieved; see Zvomuya (2007).

3. Government support policies are required, especially to promote the uptake of renewable energy technologies. This is necessary because experience shows that the switch to renewable energy is not going to be easy. Analysts have argued that energy systems exhibit strong path dependencies, which means that they experience powerful 'lock-in' effects that make it difficult to move to a different path in response to new imperatives such as the need for climate change mitigation. A key reason for this is the high capital intensity, longevity and fuel specificity of most energy systems (Scrase & MacKerron, 2009). The problem of lock-in is particularly acute for South Africa. For example, to meet its short term electricity requirements, the country is developing a new coal fired power station at Medupi. Some have questioned this development, seeing it as locking South Africa into future dependency on coal generated electricity. Others see few alternatives for the country, given in its current position (Davidson *et al.*, 2010).

2.3 Climate change

A related but different dynamic operates in the area of renewable sources of energy and more broadly is associated with efforts to mitigate the effects of climate change. Much has been written about the need for countries to move towards low carbon economies in which most energy services are derived either from clean or renewable sources, such as solar, wind, hydropower and biomass. As more countries adopt policies to mitigate the effects of climate change, the price of fossil fuel generated electricity is expected to increase. That is a strong incentive for countries like South Africa, currently highly dependent on coal generated electricity, to diversify their energy supply mix. But even for those countries in the region that may not be so dependent on fossil fuel generated electricity and have the alternative of hydropower, increased investment in non-hydropower renewable sources of energy may be opening a new frontier of competitiveness that cannot be ignored. Besides, with solar power, the possibility exists to build small electric grids that make it easier to provide electricity to rural populations, which tend to be widely dispersed rather than concentrated.

Table 1: Potential annual production of renewable energy in selected African countries relative to current annual domestic consumption

Country	Potential production	Country	PotentiNal production	Country	Potential production
Namibia	100.5	Burkina Faso	15.9	Kenya	6.5
Central African Republic	90.9	Madagascar	14.6	Malawi	6.4
Mauritania	86.2	Guinea-Bissau	14.2	Ghana	5.7
Chad	77.3	Tanzania	14.1	Uganda	3.1
Mali	58.4	Cameroon	12.7	Gambia	2.7
Niger	50.4	Senegal	12.5	Burundi	2.2
Republic of Congo	43.6	Benin	12.5	Nigeria	2.0
Angola	27.9	Sierra Leone	10.1	Swaziland	1.6
Sudan	27.6	Côte d'Ivoire	9.6	Lesotho	1.4
Zambia	25.2	Eritrea	9.5	South Africa	1.3
DRC	24.7	Guinea	9.0	Equatorial Guinea	0.9
Mozambique	23.4	Togo	8.9	Cape Verde	0.9
Botswana	22.4	Ethiopia	8.5	Rwanda	0.7
Gabon	20.3	Zimbabwe	8.0	Comoros	0.2

Note: SADC countries are indicated in red.

Source: Deichmann et al. (2010: Table 1)

These energy resources, in particular solar power, are abundantly available in Southern Africa and the technical feasibility of exploiting them has been proven in countries such as China, India and Germany. Evidence from research by the World Bank suggests that the renewable energy potential of many African countries is many times their current energy consumption (Deichmann *et al*., 2010). For example, under realistic assumptions of the technically feasible expansion potential, the estimated annual potential production from renewable sources (solar, wind, geothermal, hydro) for Namibia is about a hundred times the current energy consumption. The multiples for Zambia, DRC, Mozambique and Botswana are well into the 20s. Even South Africa, the most industrialized and carbon intensive economy in the region, has an estimated renewable energy potential that is about 1.3 times its current energy consumption (see Table 1).

What the region and Africa as a whole have suffered from for a long time is a lack of capacity to exploit the 'latecomer advantages' that other developing countries have been so adept at exploiting.[7] To do this successfully requires action on a number of fronts. One is to mobilize resources for an innovative renewable infrastructure. Another is to ensure that the pricing of electricity from established energy sources does not act as a barrier to the development of renewable energy sources. A third area where governments might act is in the creation of state owned investment vehicles that could be used to promote investments in renewable energy technologies. None of these actions is likely to succeed on its own: they are best pursued as part of an integrated strategy. This takes us, in the following section, to a consideration of the role of technology as a key driver of policies designed to increase both the supply and uptake of renewable energy in the region.

2.4 Technology as a driver[8]

The point was made earlier that energy investments tend to lock a country into technology trajectories that can make it expensive and difficult to change direction later if circumstances change. The main reason for this is that the existing energy systems are deeply entrenched in terms of the economic institutions associated with them; the regulatory rules and structures, including technical standards already in place; and even the skills and technical know how of the people who manage and run these systems. Changing the technology base of such systems or introducing new radically different elements such as solar and wind technology cannot be achieved without looking at all dimensions of a particular system.[9] This suggests that in considering the role of technology as a driver, the net should be cast wider, because in practice, whether or not a particular technology works is not just a technical question; rather, issues like how much it costs, the inputs used and the skills of the people implementing it matter a great deal.

This matters even more when implementing new technologies such as those involving non-hydropower renewable energy sources. Experience with other new technologies, e.g. information and communication technologies, shows that general support policies (e.g. those related to investment, education and skills) rather than the technologies themselves play a crucial role in the successful

7 'Latecomer advantage' has been defined by John Matthews (2007: 35) as a situation when 'a country arriving late on the industrial scene is able to access advanced technologies that have been developed elsewhere and put them to business use at lower cost than advanced firms themselves—sometimes at lower cost, and faster, than the very firms that developed the technologies in the first place'.

8 Technology will be used loosely to refer to the different ways in which electricity can be generated, e.g. hydropower technologies, fossil fuel technologies, renewable technologies, etc.

9 The decision to introduce renewable energy feed-in tariffs by the National Energy Regulator of South Africa suggests that the authorities recognize the need to act on issues such as the cost of new renewable technologies; see NERSA (2009).

adoption and implementation of the new technologies. So what might it take to change or transform an existing energy system? The answer obviously depends on the type of energy projects one is looking at, in particular the risks associated with their implementation. If the change envisaged involves a choice among established technologies, e.g. hydropower and coal-generated power, then considerations of cost and perceptions about risks and returns become crucial determinants of the technology that will be adopted. If the choice relates to new technologies, e.g. what might be required to significantly increase the share of non-hydropower renewables in the energy supply mix of a country, then general support policies would be expected to play a major role.

In the particular case of renewable energy technologies, it helps to look at countries that have made substantial headway on increasing the share of non-hydropower renewable energy in their energy mix. Although policies vary according to the circumstances of a particular country, a few shared elements are clearly discernible.

Firstly, the availability of technology does not appear to be a limiting factor, but rather the many regulatory barriers associated with electricity generation, transmission and distribution. These could take the form of 'preferences' given to fossil fuels, e.g. subsidies given to state owned utilities and a poor understanding of the potential gains that might be realized by investing in non-hydropower renewable sources of energy. Not surprisingly, countries that have made considerable progress in this area—which include Denmark, Germany, Sweden, China and, to some extent, India—began by introducing policies and incentives designed to overcome institutional and regulatory barriers and path dependencies. South Africa has made a start on such policies, having introduced a feed-in tariff in 2009 (NERSA, 2009). However, as experience from successful countries shows, a great deal of political will and strong and sustained policies are required.

Secondly, policies must be flexible in design and implementation, with an emphasis on creating institutions that can learn and change. A lot of the production processes involved are knowledge intensive, which means technology transfer increasingly entails learning by doing through use and interaction with experts, rather than just owning a particular technology (Lee et al., 2009).This point has relevance to the debate on whether intellectual property rights could be a significant potential barrier to the transfer of clean technology to developing countries or a prerequisite for the development and effective deployment of clean technologies. There is a school of thought that argues that this is not as big an issue as is sometimes feared (Bollyky, 2009). Enforcement of intellectual property rights does not seem to have induced significant amounts of private investment in clean technology. Instead, governments have had to subsidize clean technology research and development. On the other hand, intellectual property rights do not appear to be barriers to innovation in or transfers of technology to developing countries. The constraints lie elsewhere, as they do in other high technology sectors such as pharmaceuticals—in low economic growth and poor infrastructure and education. This is why large emerging economies with the capacity to learn, manufacture and adapt new technologies have made considerable headway (Bollyky, 2009).

A final comment is necessary on how technology developments affecting the energy supply chain might influence the adoption of renewable technologies. One important new development relates to how power systems are evolving from centralized to distributed systems, and from 'dumb' to 'smart'. Smart grids are a new kind of network that has been compared to the Internet. They provide two way communication and real time demand and pricing signals between interconnected elements of the power system, enabling electricity customers to act as micro generators. This then opens the possibility that the poor might have access to electricity at a cost they can control and afford. Besides, a less decentralized system might make it easier to add renewable energy sources to the system.

2.5 Government policies

Energy policies in the foreseeable future will be made in a dynamic environment in which established approaches and assumptions may be losing ground to new realities such as climate change; the increasing decentralization of electricity supply, partly in response to technology developments; and a changing role for established electricity utilities. While the circumstances of different countries vary, there are a few factors all governments need to focus on.

- In a dynamic environment such as the one that obtains in the energy sector, clarity of objectives and roles will be essential. In Southern Africa, the 'hybrid' market that has emerged following previous attempts at the privatization and liberalization of the state utilities sector has created many grey areas in terms of regulations and the roles of different players and institutions, creating uncertainty and standing in the way of meaningful cooperation among key actors.

- Many of the decisions that governments have to make, whether in regard to massive investments in hydropower or non-hydropower renewable energies, entail a radical change in direction. Such changes require both political will and sustained commitment to stated objectives. Flexibility in the design and implementation of changes is also important, especially as many of the investments required will be costly and some of them new, including the successful operation of a regional power pool, which we turn to below.

3. SAPP and regional trade in electricity: The future is clear?

3.1 Overview of the potential for regional trade in electricity

A key characteristic of the regional energy matrix, which has been partly captured by the data in Table 1, is that geography has endowed the region with significant renewable energy potential. This potential covers a spectrum of renewable energy sources that include mature technologies such as small and large hydropower facilities, and emerging technologies, principally solar and wind energy. This means that the scope and potential for regional power trade is quite substantial. According to Frost and Sullivan (2009), the Congo River in the DRC has the potential to produce over 100,000 MW of hydropower, which is sufficient to meet the energy needs of the whole of Southern Africa. The Zambezi can produce another 10,000 MW.

Table 2: Hydropower potential of selected SADC countries

Country	Hydropower potential (MW)	Current installed (MW)	%	Electricity access rate
Angola	18,000	527	3	15
DRC	100,000	2,446	2	6
Madagascar	7,800	150	2	15
Mozambique	13,000	2,199	17	6
South Africa	10,000	2,000	20	>70
Zambia	6,000	1,760	29	19

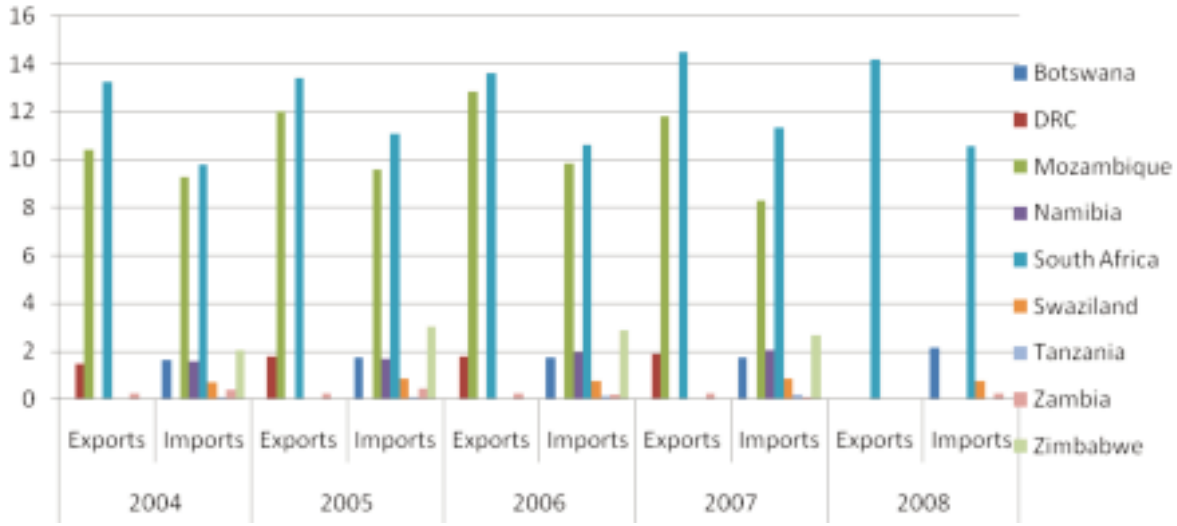
Source: Frost & Sullivan (2009)

South Africa will be pivotal to the development of this hydroelectric potential, both as a market and also a potential source of some of the financing required, as well as technical expertise. It will also be central

in managing the transition from a regional economy largely reliant on coal generated electricity to one based on renewable energy sources. As previously indicated, South Africa already exports electricity to six neighbouring countries (Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe).

Existing electricity trade flows are depicted in Figure 5. South Africa and Mozambique dominate current regional trade, both as exporters and importers. Botswana, Zimbabwe and Namibia emerge as major importers. Swaziland's imports are small in relative terms, but these are absolute amounts that do not reflect the importance of these imports to Swaziland.

Figure 5: SADC regional trade in electricity, 2004–08 (billion kW)



Source: EIA (n.d.)

Given the undoubted potential for regional power trade, this section takes a comprehensive look at the opportunities for such regional trade and the challenges likely to be encountered in formulating a regional energy policy and framework that enhances regional economic development.

But first we look at the economics of regional power trade.

3.2 The economics of a regional power pool

Regional power pools involving the interconnection and operation, on a coordinated basis, of two or more electricity generating systems have been gaining ground across Africa. Already, four are in operation on the continent: SAPP, the West African Power Pool, the Central African Power Pool and the East African Power Pool. SAPP, formed in 1998, was the first power pool to be formally created outside North America and Western Europe. Expected benefits from the regional pooling of electricity services include a reduction in capital and operating costs; improved reliability (of the system) in supplying the power pool's combined load; and enhanced security of supply. In the Southern African context, where generating capacity is inadequate, the creation of a regional power pool means that the expansion of generation and transmission capacity can be coordinated, which makes the development of a regional electricity market more feasible.

In terms of the economics of regional power pools, the circumstances under which they are likely to be beneficial to their members include the following:

- They work when resource endowments differ across countries. The most obvious example is the coexistence (within the power pool) of two different electricity generating systems/sources, e.g. thermal and hydropower. Interconnecting the two systems creates opportunities for energy banking, which occurs when one system (e.g. thermal) is able to transmit energy to the other (hydro) during its off peak periods, allowing the latter system to conserve power, which can then be supplied to the former to meet peak demand in that system. This sort of exchange—also referred to as economy or non-firm trade—seeks to exploit differences in short run marginal costs between participating utilities at a given time. It is thus an opportunity to save costs by the participating utilities.[10]

- Prospects for cross border trade also increase if there is reserve capacity in one or both generating systems. The advantage of trading electricity in such circumstances is that reserve capacity exchanges enable participating national utilities to achieve acceptable levels of reliability with lower reserve margins than they would as independent operating systems (World Bank, 2003).

- Another set of circumstances favouring cross border trade in electricity is when there is potential to benefit from economies of scale. This is mainly because an interconnected system makes it possible for larger generating units to be established than would be feasible if the networks operated independently.

- Just as differences in short run marginal costs create scope for cost savings, so too do differences in long run marginal costs. More importantly, such differences in long run marginal costs create opportunities for building new electricity generating capacity destined for export markets, especially when the type and mix of energy resources in the power pool are varied. This, of course, is among the reasons why SAPP was formed.

- In a power pool involving small developing country utilities, capacity additions can be planned in a way that allows them to function as one large interconnected system, thereby taking advantage of economies of scale. A good example of this kind of coordinated planning is the Kariba power plant: specifically, Kariba North in Zambia was constructed in large part to supply power to industry in Zimbabwe.

3.3 The implications for SAPP

When it comes to applying the economics of trading electricity to SAPP, it would seem that Southern Africa has several factors in its favour. One is the availability of complementary power sources noted earlier. As of now, the complementarities between the region's major energy sources (coal and hydropower) are theoretical (due to the relative underdevelopment of hydropower). The formation of SAPP creates a platform for the region to undertake coordinated and shared development of its enormous hydropower potential in the DRC, Mozambique and Zambia, thereby making a reality of these complementarities. The case for constructing hydropower plants dedicated to exports appears

10 The amount of power available in these situations is not guaranteed, because it varies according to the season and weather conditions, which is why it is referred to as economy (saving) or non-firm trade.

much stronger with the formation of the regional power pool than before its formation. Further down the line, the expansion of hydropower generating capacity in the context of an interconnected system offers the region—and South Africa in particular—the best way to reduce dependence on fossil fuel generated electricity and thus make a contribution to the worldwide effort to reduce greenhouse gas emissions. The additional hydropower would thus displace coal generation in the region.

The second factor in SAPP's favour is South Africa's active involvement in the regional power pool. As the largest economy in the region, it offers not only the largest potential market for the proposed new hydropower capacity to be constructed in other countries, but it is also the country under the greatest pressure to diversify its energy supply mix in response to climate change concerns. These are strong reasons that should drive South Africa to push for the success of the regional power pool.

The third factor is the existence of a political framework for cooperation. This is important for two reasons. One is that the success of the power pool will largely depend on political will and a sustained commitment to increased regional energy trade. In this regard, the fact that SAPP is one of the umbrella organizations under SADC is important. Another reason is that some tough political decisions will need to be made, especially in the area of regulations and institutions, if the organization is to realize its full potential.

Despite all this, SAPP faces a number of formidable challenges. One is the old problem of raising enough capital to finance the required investment in new generating capacity. While the expectation is that most of the funding can be raised from international capital markets, international financial institutions and the private sector, undeveloped capital markets and the fact that power utilities have traditionally operated at a loss mean that any local contribution would have to come from the national treasury. AICD has calculated that the amounts involved for countries like the DRC, Zimbabwe, etc. might be up to 6 percent of GDP. Although South Africa has better developed financial markets, it is difficult to know whether it will be in a position to mobilize some of the resources required.

The second challenge is linked to the sheer physical distance between the main potential source of hydropower (Inga on the Congo) and the main load centre (South Africa). The main challenge this poses relates to whether power can reliably and securely be transported for distances of about 3,000–6,000 kilometres. The costs associated with constructing and extending the transmission network may be minor compared to that of increasing generating capacity, but this is still a major challenge.

3.4 Do we have a sense of what the actual benefits to SAPP members might be?

Research undertaken by AICD provides some pointers to answer this question (Rosnes *et al.*, 2009). The researchers begin by quantifying the magnitude of refurbishment needs and the additional generating capacity required to meet electricity demand in 2015. Starting with a generating capacity of 48,000 MW in 2005, they estimate that this would be reduced to 17,000 MW (due to the ageing of the existing power installations), so that 28,000 MW of generating capacity will have to be refurbished. They then estimate that more than 33,000 MW of new generating capacity will have to be built, implying a 70 percent increase over the 2005 level.

AICD also provides estimates of the spending required to bring the region's supply and demand roughly into balance by 2015. Total spending is expected to be in the region of 4.2–4.4 percent of GDP, which is broadly in line with the estimate for the whole of sub-Saharan Africa. This is divided almost equally

between capital expenditure (about 2 percent of GDP) and operating costs (just under 2 percent of GDP). To bring electricity to consumption centres, further additional costs will be incurred building regional transmission lines. AICD has estimated that some 12 Gw of needed interconnections are lacking in the SAPP region. Building these lines would cost around USD 380 million (Rosnes *et al.*, 2009).

While AICD concludes that the costs of refurbishment and adding new generating capacity are significant, it does not consider the task unattainable. However, it acknowledges that spending requirements at the national level may be too onerous relative to the size of the national economies concerned. They estimate that in countries like the DRC, Mozambique and Zimbabwe, spending could amount to 6 percent of GDP. Obviously, countries with the largest hydropower potential (the DRC and Mozambique) face high spending requirements. One of the challenges that SAPP faces is whether it can find ways of sharing or reducing the financial burden on these countries consequent upon the development of their hydropower resources. In the case of Zimbabwe, one suspects that a major reason for expecting spending requirements to be relatively high is the degraded state of the country's electricity network brought about by recent economic decline and political instability.

The finding that within SAPP some countries may face more burdensome spending requirements takes us back to one of the main rationales of the regional power pool, i.e. that the main effect of SAPP would be to support the development of large scale hydropower schemes that would otherwise not be viable at the national level. Countries like the DRC and Mozambique have the potential to become major exporters of power, but only if they receive significant cross border injections of capital to develop their power infrastructures. Yet the necessary capital is only likely to materialize if trade actually expands or at least there are positive indications that the power pool is well placed to expand trade among its members.

In AICD's forecasts, the share of hydropower in SAPP is expected to rise from 25 to 34 percent of the region's generation capacity portfolio and the DRC will become the major exporter of hydropower, exporting three times as much as its domestic consumption, while Mozambique will remain a major exporter. Angola, Botswana, Lesotho, Malawi and Namibia will be the major importers, relying on imports for more than 50 percent of their electricity requirements. Although South Africa is expected to import large volumes of power, imports will still account for only 10 percent of domestic demand (Rosnes *et al.*, 2009).

The benefits of the power pool will not be restricted to those countries hosting expanded electricity generating capacity. Among the importers, countries with very high domestic power costs (e.g. Angola) should see the cost of electricity come down as they obtain cheaper electricity from neighbouring hydropower producing countries.

Other—indirect—benefits might be expected to flow to members of the regional power pool. Should SAPP succeed in triggering massive investments in hydropower, this would present the region with an opportunity to reconfigure its electricity network, almost as if the region were starting from the beginning. If such reconfiguration is combined with the introduction of the latest technology in transmission and distribution networks, then the region would, in the process, acquire a modern electricity network, with increased possibilities for widening access to electricity. Given that hydropower is a clean source of energy, the region might also expect considerable environmental benefits. For example, AICD estimates that increasing the hydropower component of regional generating capacity from 25 to 34 percent would result in a reduction of carbon dioxide emissions of about 40 million tons per year (Rosnes *et al.*, 2009).

3.5 SAPP and the five drivers

It may be worth summarizing this section by recasting it in terms of the five drivers suggested in Section 2: demand, supply, climate change, technology and government policies. This allows us to get a sense of how critical these drivers are likely to be in the future development of SAPP.

- *Demand* for electricity in Africa is forecast to grow by an average of 4–6 percent between 2008 and 2030, with growth in countries such as Angola and Mozambique even higher (Frost & Sullivan, 2008). There is both an opportunity and a risk for SAPP in this continued growth in demand for power. The opportunity lies in the impetus that this gives to a regional approach to expanding generating capacity and energy supply, but the opportunity has to be grasped early and firmly. The risk arises from domestic pressures to respond to this growth in electricity demand through domestic expansion of generating capacity, in large part because this may be the quickest and easiest way to meet the growing demand for energy (because negotiations to do this regionally take time), but also because constructing large scale hydropower plants is a time consuming process, in which feasibility work alone might take years and cost millions of dollars. One might argue then that the commencement of work on the Medupi and Kusile coal fired power plants suggests that this scenario is already unfolding in South Africa.[11] The dynamics of electricity demand in South Africa are, of course, heavily influenced by the needs of an industrial sector that is substantially larger than those in neighbouring countries. This difference in industrial capacity and structure is bound to have implications for the manner—particularly the speed and decisiveness—with which the different governments might respond to the electricity shortages. For, whereas in the countries with a small industrial sector the bulk of the cost of inadequate electricity supply registers more as lost or missed opportunities to develop and industrialize, in South Africa the costs are immediate and can be measured in terms of lost jobs and productivity. One might therefore expect this lack of a coordinated response to impact on the progress of the regional power pool.

- *Supply drivers:* The opportunities for power exports that a larger market would offer the countries with hydropower potential are among the most favoured justifications for a regional power pool. The general proposition that many observers have been expressing is that the formation of SAPP, combined with the sheer strength of growth in demand for electricity, will finally unlock the huge hydropower potential of the region. Recent developments suggest that this proposition will be severely tested, for although some change in investor sentiment towards Africa is clearly discernible, this is unlikely to make a noticeable impact on the two factors—politics and money—that have previously held back the exploitation of the hydropower potential of the region. Thus, politics, upfront high costs and the long gestation period characteristic of hydropower projects continue to plague the Inga Dam project. A foretaste of some of the challenges ahead is the recent collapse of the planned development of a 5,000 MW hydropower project by Western Power Corridor (Westcor), a venture comprising five African countries. Among the reasons given for the collapse is political 'indecisiveness' on the part of the government of the DRC.[12] However, it has also been alleged that the DRC government is more

11 This is perhaps inevitable, given the urgent need for South Africa to deal with the power shortages confronting the country.

12 According to one of the people behind the venture, 'There were five governments behind this project and the DRC part always kept falling off the pedestal'; see Kavanagh (2010).

interested in a private power development project currently under construction in the country's western Bas Congo Province, but which is primarily aimed at supplying power to an aluminium smelter being developed by BHP Billiton.[13] Meanwhile, due to the urgent need for additional power in South Africa, the authorities there have had to commission new coal fired power stations. Given the risks of lock-in discussed earlier, this may mean that the export market SAPP is supposed to have created is already being eroded.

- *Climate change:* It is not difficult to envision some of the ways in which climate change, its impacts and implications stemming from the adoption of mitigation policies might shape energy policy in Southern Africa. For instance, with respect to impacts, the projected increases in the frequency of droughts points to the possibility that water shortages might potentially develop into a major constraint on hydropower generation in the region, particularly if it succeeds in harnessing its enormous hydroelectric potential. During the 1992 drought, water levels in the Kariba Dam reportedly dropped by 8 percent, causing interruptions in the power supply (Mukheibir, 2007). However, some analysts have pointed out that the region's water storage capacity is underexploited, which means that there is considerable potential for hydropower even if the rainfall pattern were to become very variable (Ramachandran, 2009). Water is also a major input in the operations of coal fired power plants, which is why this has been a matter of some concern in the debates leading to the commissioning of the Medupi and Kusile power plants in South Africa. On the other hand, some of the implications stemming from the adoption of mitigation policies, notably the expected rise in the price of fossil fuel generated electricity consequent on the adoption of mitigation policies, would place the region in a strong position in terms of international competitiveness by virtue of its reliance on clean hydropower. At a minimum, the region's international competitiveness would not be hamstrung by the energy intensity of its energy supply mix.

- *Technology* as a driver is clearly a complex issue. For example, the main drawback of hydropower technologies in Southern Africa has always been the high financial and political risks associated with their development, in particular the large capital outlays required for projects of the scale of the Inga Dam in the DRC and the uncertainty that is inherent in long payback horizons. So, despite the formation of the regional power pool, investment decision makers still seem to be holding back, perhaps preferring to keep their options open until further development of the power pool. Thus, the adoption of hydropower technologies in the region will continue to be plagued by uncertainties until the differences in perceptions of risk between private investors and governments are narrowed. In other words, the formation of the regional power pool on its own is not sufficient to change private sector perceptions to a point where the investments required will start to flow. Climate change might begin to alter this, but until this happens, the weight of external considerations such as regulatory uncertainty and the tortuous decision making process involved in hydropower projects effectively raises the cost of capital, which in turn affects prospects for the implementation of such projects. Obviously, investors are averse to risks, i.e. they will weigh all factors before settling on the most cost effective project. Given this, governments ought to think beyond the short term, while they also need to look to what

13 Westcor's Inga 3 project was envisaged as the first step in harnessing the Congo River, with the ultimate goal being to build the world's largest power complex. The plan envisaged 2,000 MW of power each for the DRC and South Africa and a combined 1,000 MW for Angola, Namibia and Botswana. The DRC's desire to keep all the electricity rather than export some of it appears to be at the root of the collapse of the venture, which some of the participants in the venture see as dampening the spirit of utilities cooperation (Kavanagh, 2010).

investors are doing in other parts of the world. Another important consideration in favour of hydropower technologies is that in a carbon constrained future, this may be a source of competitive advantage. In short, the issues here link back to the role of cost, risk and return in determining technology choices in the energy sector and link forward to the opportunities created by some of the renewable energy technologies, including the opportunity to reform the entire energy supply chain in order to take advantage of new developments in distribution technologies.

- The interaction between each of the above drivers and *government policies* appears to hold the key to the future development of energy policy in the SAPP region. It is clear that government policies, mainly the regulatory framework for the electricity sector, will exert a profound influence on how the other drivers shape energy policy. Firstly, government policies on end user prices and subsidies to power utilities will determine the extent to which supply and demand drivers are allowed to influence energy policies in terms of further investments in new generation capacity. Secondly, the extent to which climate change hastens the adoption of renewable technologies will in large part depend on the support these technologies receive from governments (e.g. subsidies, feed-in tariffs, education and skills training). Thirdly, the success of hydropower in the region will depend on whether governments succeed in crafting national and regional regulatory environments that make it easier for the challenges of hydropower technology to be overcome. Finally, and most importantly, member countries should be prepared to subordinate their short term national interests in order to promote the long term interests of the power pool. The recent Westcor episode in the DRC illustrates the urgent need for such strong political commitment. In short, government policies will be the major driver.

3.6 The central role of hydropower in future regional energy security

The success of SAPP hinges on whether it can act as a spur for the development of the region's vast hydropower potential. It is not clear, however, that SAPP is in a position to play that role. In part, this reflects the limitations of its focus, which is to facilitate the development of a competitive electricity market in the region so as to offer end users some choice of electricity sources. In theory, the creation of a power market means that a regional price for electricity is established, which may allow investors to value new investments when considering investing in new generation capacity.

But there are a number of reasons why such a development (of market price) is unlikely to trigger the amount of investments required to exploit the region's hydropower potential. One is the long gestation period required to plan and undertake the development of large hydropower schemes. This implies that the development of the region's hydropower potential cannot be expected to address Southern Africa's current and short term shortages in power. In fact, in the short term, the largest share of new energy load in the region is projected to come from refurbished and new coal fired power stations in South Africa.

For the long term, the most attractive potential electricity generating projects from an economic and environmental perspective are the hydropower resources located in South Africa's neighbouring countries, such as Mozambique, where domestic demand is too small to justify the cost of large projects unless a significant portion of the power generated is exported. This means that the region has to deal with the difficult challenge of ensuring that it can meet its short term requirements for new generating capacity without foreclosing opportunities for developing its hydropower potential, which can only be realized in the long term.

It is abundantly clear that SAPP's competitive model needs to be supplemented by a more cooperative approach to the development of new generating capacity. Given that a major cause of the recent power shortages in South Africa, the regional economic powerhouse, is poor forward planning, one has to doubt whether the circumstances exist for the region to drive forward a cooperative effort to develop its abundant hydropower resources.

4. What if South Africa pursues self-reliance?

Underlying the preceding analysis is the pivotal role played by South Africa, which stands apart from the other countries in the region in three important respects crucial to understanding the dynamics of energy security in the region. Firstly, its highly energy intensive economy makes the case for transition to a low carbon economy urgent. This is partly because the country's future international competitiveness would suffer if the economy remained locked into the current energy intensive model of development. Furthermore, the country's energy intensive exports may potentially be the target of border adjustment measures (carbon tariffs) currently under consideration in developed countries.

Secondly, with an economy built on cheap energy, the task of reconciling the important goals of government such as achieving sustainable development, alleviating poverty, creating employment and improving access to power for the poor is likely to prove particularly difficult. The tension between development objectives and climate change mitigation objectives is much greater in South Africa than in other countries of the region.

Thirdly, without South Africa's large economy and energy market, it does not seem feasible to fully develop the substantial hydropower potential that exists in the region; i.e. without South Africa, the regional energy market is simply too small to justify the development of huge hydroelectric projects. Additionally, none of the countries in the region is in a position to mobilize the scale of resources required to develop such large scale hydropower projects. But the possibility that South Africa might pursue a less regionally focussed energy policy cannot be ruled out. This could happen for a number of reasons.

One possibility is that the current shortage of electricity in the country might force the government's hand when it comes to the choice of generating technologies. Faced with the immediate problem of securing electricity supply to meet current and future needs, the easiest and quickest option available to the country is to build new coal fired power stations and to do so at prices that are more reflective of costs. It could be argued that such a process has begun, with the government's announcement of electricity tariff rises in February 2010 (South Africa Online, 2010). While one cannot be certain where the current process of government sanctioned electricity price increases over the next few years might end, it is not unreasonable to speculate that with its finances replenished, Eskom, the South African power generating utility, might choose to follow a path that leads to self-sufficiency in electricity provision. This would necessitate the building of new coal fired power stations and perhaps one or two nuclear power stations.[14] Clearly, any development likely to result in South Africa being able to meet all its electricity requirements from domestic resources would weaken SAPP.

14 South Africa is reportedly a leader in efforts to develop a new class of safe and simple nuclear reactor, the Pebble Bed Modular Reactor (PBMR), according to *The Economist* (2008). However, South Africa's role in the future development of PBMR has been thrown into doubt following the decision by government at the beginning of 2010 to withdraw funding for the project; see Nording (2010).

The same outcome could come about through inertia. As has been argued earlier, powerful lock-in effects might make it difficult for the country to break away from its current high dependency on coal generated electricity. These lock-in effects are likely to be reinforced by the fact that the cost of developing the main alternative energy source that regional cooperation offers (hydropower) is very high compared to the costs of developing a coal fired power station. Then there is the additional cost of building transmission lines from the hydropower stations to the main centres of demand.

Concerns about political instability might also encourage South Africa to go it alone, particularly since the major source of hydropower is the DRC, which has been plagued by political instability for most of its post-independence life. Closer to home, Zimbabwe's political instability is another major concern, and there is evidence that Zimbabwe's neighbours have recently been less than enthusiastic about supporting the building of new transmission lines through the country, because one consequence of its recent political instability has been the neglect of and failure to maintain existing power lines, thus exacerbating the power crisis experienced in the region. Yet the central position of the country means that the most cost effective way of building a new regional network ought to recognize the central physical location of Zimbabwe in the region.

South Africa's industrial policy also points to another possible reason for the country to go it alone. Industrial policy in South Africa has not sought to encourage regional linkages even within the South African Customs Union. This has a bearing on policies that might be developed in the area of solar and wind power technologies. On the surface, there is an opportunity for South Africa to develop capabilities in these new technologies that could be the basis for exports to the region.

On the positive side, South Africa's commitment to change its energy mix in response to concerns about climate change appears very strong, judging by policy pronouncements. But a policy of self-reliance by the country need not foreclose the option regional trade in electricity, particularly given the region's history of trading in electricity. As noted earlier, several neighbouring countries have been dependent on Eskom for a long time. While one suspects most of them consider SAPP the best framework for developing additional generating capacity, faced with reduced electricity supply from South Africa and rate increases sanctioned by the South African government, they have had to look to increased investments in their own electricity infrastructure. For countries like Botswana, with abundant coal reserves and whose contribution to greenhouse gas emissions is negligible, this may be a viable option. And, paradoxically, this might still increase security of supply for the region, while at the same time opening the door to enhanced trading in electricity.

In the end, the likelihood of South Africa pursuing a strategy of self-reliance largely depends on the willingness and political commitment of member governments to push forward with plans to increase regional trade in electricity. It does not help that so far cooperation has proceeded rather haltingly, and the risk that current shortages might reinforce rather than loosen path dependencies is a major challenge. Still, one cannot underestimate South Africa's desire to diversify its energy supply mix. Both Eskom and the government appear to understand that any future electricity expansion program needs to be based on a diverse range of power generation sources, as this is the only way that the country can best prepare itself for a future likely to be characterized by shifting patterns of demand for energy.

5. The regulatory minefield

It was noted at the outset of this report that by forming SAPP, Southern Africa had effectively decided that its future energy security would be best served by regional cooperation. It was then suggested that

the main question this choice raised was whether this constituted the right strategy for the region in terms of meeting two of the key objectives of energy policy that the region had set for itself, namely increasing electricity generating capacity and widening access to electricity. After surveying the likely key drivers of energy policy in the region and the dynamics of their interaction, there does not seem to be a good basis for disagreeing with the general proposition that SAPP offers the region the best opportunity to meet its objectives. However, success is not guaranteed and the chief problem lies in what has been a recurring theme in most discussions of Africa's power problems, even before the formation of regional power pools across the continent, i.e. the importance of having in place clear, transparent and supportive regulatory frameworks at the national and regional levels, coupled with sustained political commitment to regional cooperation. Thus, in conclusion, we turn to a consideration of how and in what areas the regulatory frameworks might be strengthened.

It needs to be recognized, however, that the regional route, represented by a coordinated expansion of regional generating capacity, is not the only way that increased regional trade in electricity can be achieved. By individually investing in their national generating capacities, member countries could also increase regional generating capacity and in the process increase the future scope for regional trade in electricity. As has been argued in Section 4, above, the likelihood of this happening should not be underestimated, particularly if the largest economy in the region opts for a policy of self-reliance. The fact that this approach could be forced on member countries by the current shortages in electricity or be the result of inertia or lack of political will highlights the urgent need to address the shortcomings in the regulatory frameworks. However, compared to the option of coordinated expansion of regional generating capacity, this would seem to be a less effective approach. One might also view this approach as representing missed opportunities, in that with an abundant supply of clean hydropower, the region's long term energy future would have been adequately secured, while at the same time diversifying its energy supply mix away from coal generated electricity.

The main reason why a clear, transparent and stable (in this case maybe long term) regulatory policy framework is needed is that this removes uncertainty for investors and other stakeholders. It is clear that uncertainty continues to plague the economics of hydropower development in the region. This is why, despite expectations of renewed interest in the region's hydropower resources, there is little evidence that investors are queuing up to exploit the potential export market created by SAPP. Doubts about the political and financial risks of investing in the development of the region's hydropower persist and the recent cancellation of the Westcor venture shows why these doubts persist (Kavanagh, 2010). Such doubts and the uncertainties they give rise to have to be addressed.

The characteristics of investments in the power and electricity sector—capital intensive and long lived—mean that even a 'little' uncertainty about such factors as the price of energy services heightens the risks attached to particular investments. Investors generally respond to such uncertainty by delaying their investments until they can make an informed choice. More important, however, is the fact that increased risks lead to higher costs of capital, which in turn entail higher returns on investment.[15] In fact, a poor regulatory framework gives rise to or strengthens a number of risks, as in the case of technology-specific risks associated with hydropower development (referred to above as capital intensity and long gestation periods). Thus, to a considerable degree, strengthening the regulatory framework is about managing these risks. The table in Appendix 2 lists some of the risks associated with electricity generation and power development.

15 Perhaps as a general proposition, policymakers need a better understanding of how the lack of a clear regulatory framework translates into increased investment risks.

Evidence from the extensive analysis of the power sector in Africa undertaken by AICD provides some pointers to particular areas of the regulatory framework requiring reform or strengthening. The first area is the pricing of energy services. AICD has documented the extent to which electricity tariffs in Africa fall far short of what is required to cover the costs of production. For this reason, electricity utilities in Africa have rarely made a profit, making it financially impossible for them to fund investment in new generation capacity, as well as in the maintenance and refurbishment of existing facilities. Low electricity tariffs are in fact the main cause for the current electricity crisis across the continent. They reflect inadequacies relating to the pricing of financial risk that confronts electricity investors in the region. An environment in which existing investors are unable to make profits, let alone cover their costs of production, is hardly a good basis for attracting new investments.[16] To attract investments into the power sector, these prices would have to be raised and the process by which they will be adjusted in future clarified and outlined as part of the regulatory framework.

At the most basic level, clarity is required regarding rules, regulations and the decision making process, including the roles of different stakeholders. This is a particular challenge for the region, because its power sector at the moment can best be described as a 'hybrid' market, since attempts at liberalization in the 1990s appear to have stalled, leaving behind a mixture of commercialized but publicly owned utilities controlled in some cases directly by government departments and in other cases by an independent regulator, which in practice may or may not be independent of government. This hybrid market adds to investor uncertainty and gives rise to what investors see as regulatory risk. Such risk manifests itself as direct and indirect costs affecting the decisions or actions of enterprises.

Another area on which attention should be focussed is the need to strengthen the capacity of public institutions and the skills of people involved with all aspects of energy investments. Capacity impediments give rise to a variety of risks usually classified under the broad heading of political risk; such impediments include in some cases multiple bodies dealing with the energy sector, weak legal systems, and a lack of skills in handling international competitive bids and negotiating contracts.

But overcoming these obstacles will not be easy. In practice, even if electricity tariffs were set at an appropriate level and the governance of utilities improved, the high costs of maintaining a power infrastructure combined with the inability of many households in the region (including the moderately wealthy) to pay the full cost of electricity means that the problem goes beyond simply ensuring transparency and accountability in the regulatory framework and that government support, including subsidies, will still be needed. Given the financial constraints faced by governments, the regulatory policy framework would have to clearly state the size of envisaged subsidies, the role that they would play, and the link between any subsidies provided and the tariff setting structure.

The need for government support, both financial and regulatory, is particularly urgent in the case of renewable energy technologies, particularly as these technologies are considered an optimal means of bringing electricity to rural areas that cannot otherwise be easily connected to the grid (IEA, 2010). The support will include finance to subsidize upfront costs that may be incurred; market incentives that may be needed to improve the competitiveness of the new technologies; and general government support, including involvement as a consumer, for some of the new technologies.

16 It does not help that the region, except for South Africa, has poorly developed financial markets.

Finally, the opportunities that SAPP offers for the region to redesign its power system so that it becomes ready to deal with expected changes in demand patterns should not be underestimated. In building SAPP, the region has the opportunity to take a fresh look at the entire energy supply chain—extraction, conversion, delivery and consumption—and determine which sections of it could be made more efficient either through improvements to organization and operational methods or through the application of new technologies. Given the small size of current national electricity networks, there is more scope for introducing new technologies such as those associated with the distributed generation of electricity. Distributed designs may be the least costly and quickest way to get power to rural areas in developing countries using readily available indigenous sources of energy, but to turn their promise into benefits, governments would need to consider the introduction of incentives to promote the uptake of these technologies. At the moment the costs of many of these technologies may be beyond what many countries in Southern Africa can afford, but the costs, e.g. of solar power, have been coming down.

6. Conclusion

It has been argued here that despite concerns about whether the political commitment exists to drive forward the program of the regional power pool, SAPP offers the region the best avenue to energy security. But the road is still long, which is why solid and sustained political commitment to and support for the objectives of the regional power pool will be required. Can the region's national leaders provide the required support? Will they be able to escape the dynamic dictated to them by short term national political considerations, which may lead them to undervalue the long term benefits of regional cooperation in energy development? The jury is still out on these questions.

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Appendix 1: Comparative SADC electricity access, 2008

	Electrification (%)			Population without electricity (million)
	Total	Urban	Rural	
Angola	26.2	38.0	10.7	12.9
Botswana	45.4	68.0	12.0	1.0
DRC	11.1	25.0	4.0	57.0
Lesotho	16.0	44.0	6.0	1.7
Madagascar	19.0	53.0	5.0	16.4
Malawi	9.0	25.0	5.3	13.0
Mauritius	99.4	100.0	99.0	0.0
Mozambique	11.7	21.0	6.3	19.3
Namibia	34.0	70.0	13.0	1.4
South Africa	75.0	88.0	55.0	12.0
Tanzania	11.5	39.0	2.0	36.8
Zambia	18.8	47.0	3.3	9.9
Zimbabwe	41.5	79.0	19.0	7.8
Sub-Saharan Africa	28.5	57.5	11.0	587
South Asia	60.2	88.4	48.0	614
Latin America	92.7	98.7	70.0	34
Developing countries	72.0	90.0	58.0	1,453

Appendix 2: Risks facing energy sector investments

Economic risk	Market risk	* Inadequate price and/or demand to cover investment and production costs * Increase in input costs
	Construction risk	* Cost overruns * Project completion delays
	Operational risk	* Insufficient reserves * Unsatisfactory plant performance * Lack of capacity of operating entities * Cost of environmental degradation
	Macroeconomic risk	* Abrupt depreciation/appreciation of exchange rates * Changes in inflation and interest rates
Political risk	Regulatory risk	* Changes in price controls and environmental obligations * Cumbersome administrative procedures
	Transfer of profits risk	* Foreign exchange convertibility * Restrictions on transferring funds
	Expropriation or nationalization risk	* Changing title of ownership of assets
Legal risk	Documentation or contract risk	* Terms and validity of contracts, such as purchase/supply, credit facilities, lending agreements and security/collateral agreements
	Jurisdictional risk	* Choice of jurisdiction * Enforcement risk * Lack of a dispute settlement mechanism
Force majeure risk		* Natural disasters * Civil unrest * Strikes

Source: Sullivan & Blyth (2006)