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Energy Security in South America and Southern Africa: Synthesis Report

Sheila Kiratu

iisd International Institute for Sustainable Development / Institut international du développement durable

Abstract

This cross-regional report stems from a TKN project that focussed on electricity supply and the extent to which it is traded within Southern Africa and South America, and the resulting state of electricity supply security in these two regions. Within this context, the current and projected regional energy production mixes were established and, since concerns over climate change are finding their way into many aspects of economic growth and development, the project also explored the role that the regional "anchor states" (South Africa and Brazil, respectively) are likely to play in securing the future balance in light of climate change and related mitigation imperatives.

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Series on Trade and the Food Security

Energy Security in South America and Southern Africa: Synthesis Report

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This study is part of a larger TKN project that seeks to better environmental impacts of trade and investment policy in ASEAN, and specifically the Mekong subregion. It was made possible through the generous support of the Swedish Environment Secretariat for Asia (SENSA) which is part of the Swedish International Development Cooperation Agency (SIDA). The project outputs are available on the TKN website.

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Sheila Kiratu is the assistant coordinator for TKN Southern Africa and a researcher for the Development Through Trade program of the South African Institute of International Affairs. In this capacity, she has worked in a variety of areas of trade and investment law and policy for clients from government, intergovernmental organizations, donor intermediaries, business and civil society. Her areas of expertise are investment agreements in Southern Africa, regional integration, trade policy and negotiation in Southern Africa, climate change and sustainable development. Prior to this, she practised law as an advocate of the High Court of Kenya and at Gadhia and Mucheru Advocates.

Abbreviations and acronyms

DRC	Democratic Republic of the Congo
GHG	greenhouse gas
SADC	Southern African Development Community
SAPP	Southern African Power Pool
USD	U.S. dollar
ZAR	South African rand

Executive summary

This cross-regional report stems from a TKN project that focused on electricity supply and the extent to which it is traded within Southern Africa and South America, and the resulting state of electricity supply security in these two regions.

Electricity security is central to empowering and sustaining economic development in any country or region. In fact, the ability to provide adequate and reliable electricity supplies in order to meet the emergent needs of both commerce and industry, as well as those communities – both rural and urban – without access to electricity, is an essential driver of any developing state or region.

But the challenge to ensure electricity security is further compounded by important policy concerns that link electricity security to climate change. The scientific understanding of climate change has confirmed that current and future changes in the atmosphere not only form the greatest economic, social and environmental challenge humanity has ever faced, but, more importantly, has crystallized the fact that the drivers of climate change must be dealt with urgently and effectively. In order to avoid dangerous climate effects, signatories to the 1992 United Nations Framework Convention on Climate Change and its Kyoto Protocol have committed themselves to fighting runaway climate change by taking measures to reduce green house gas (GHG) emissions.[1]

Under Kyoto, the biggest emitters of GHGs are encouraged to implement mitigation measures that catalyze energy efficiency and motivate energy sustainability policies. The reason for this is simple: the economic, social and environmental costs of failing to act on a deteriorating climate are extremely high. South Africa and Brazil are not part of the group of industrialized countries that have emissions ceilings, but as rapidly developing countries it is crucial that they enhance their participation in the emissions reduction effort.

However, as their energy needs are predicted to increase substantially due to rising demand, not only internally, but also in neighbouring countries that rely on them for their electricity supplies, they need to find options that limit the threat to the environment while ensuring that they provide their populations and growing industries, as well as those of their neighbours, with the energy that they need.

While exploring these dynamics, the authors involved in this cross-regional TKN project (for which the current publication is the synthesis report) found that there is great potential to enhance electricity security in both South America and Southern Africa by tapping into vast resources of hydro and non-hydro renewable sources of energy, such as solar and wind technology.

However, the prospects of turning the potential of renewable energy sources into reality are dim without the following:

- *Technology:* This has always been a major factor in determining the choice of sources of energy, in large part because the cost of exploiting alternative sources of energy is determined by the available technologies, while the adoption of new technologies, for example, in the area of renewable energy, is directly linked to the capacity of economies to innovate, learn, change and adopt new technologies.

1 In order to avoid dangerous climate effects, countries must at a minimum achieve a halving of GHG emissions to 20 gigatonnes (GT) by 2050 and continue to decrease emissions until we reach an annual rate of 10 GT by the end of the century.

- *Financing:* The renewable financial markets are still nascent, and private investors are risk averse in this regard. Indeed, in an underdeveloped market, private investor hesitancy can be expected, which has led the UN Industrial Development Organization to observe that public funds and government measures are needed to capitalize private funding.

Government policies: These will affect the way demand and supply drivers interact with one another and in some cases will determine the energy-efficient choices to be made. For example, in the non-hydropower renewable energy sector, the technological choices 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.

1. Introduction

This report synthesizes a Trade Knowledge Network project that explored energy security and trade policies in regional and country studies in South America and Southern Africa.

Electricity security involves many concerns linking energy, the environment, equity and economic development. One of its core aspects is the availability and reliability of electricity supply. In this respect, policies on security are largely geared to enabling access to energy sources for electricity generators so as to minimize the risks of supply disruptions,[2] the harmful effects of which have recently been felt in both Southern Africa and South America (Kiratu, 2010; De Oliveira, 2010). On the whole, both regions are unable to guarantee the adequate provision of electricity for their populations and industries, before even considering the need to factor climate change into the equation.

While it is undisputed that industrialized[3] countries carry overwhelming historical responsibility for the growth in greenhouse gas (GHG) emissions, it is clear that these countries cannot stabilize the climate system exclusively through their own emission reductions; rather, developing countries[4] will also need to reduce their emissions (IPCC, 2007). As signatories to the 1992 United Nations Framework Convention on Climate Change and its Kyoto Protocol, the countries in Southern Africa and South America have committed themselves to fighting runaway climate change by taking measures to reduce GHG emissions. As energy needs are predicted to increase substantially due to rising demand in developing countries and fossil fuels are predicted to be a major source of energy, a significant increase in GHG emissions is imminent under the business-as-usual scenario. This is a particular challenge for the largest economies in the two regions: South Africa and Brazil.

South Africa's carbon dioxide intensity is extremely high because it derives much of its energy from highly carbon-intensive coal. In fact, 90 per cent of the country's electricity is generated from coal, which is among the cheapest in the world (hence its attraction as a source of energy), while 40 per cent of the country's petrol and diesel is manufactured from coal and gas (Unmüβig & Cramer, 2008). South Africa differs from its neighbours in several respects, but mainly in that it has a large manufacturing and industrial base that is highly dependent on coal as a cheap source of electricity, has an obligation to provide electricity access to its rural communities and is also responsible for a sizeable portion of the electricity used in a number of surrounding states in the region, including Botswana, Mozambique, Namibia, Swaziland, Lesotho, Zambia and Zimbabwe (Eskom, 2008). South Africa is responsible for 39 per cent of the emissions on the continent (UNECA, 2002: 33).

Electricity generation-related emissions in Brazil are negligible because supply is largely based on hydroelectricity (a renewable source). Even though the region as a whole has gradually increased its use of natural gas and oil, the low percentage[5] of GHG emissions from the region reflects a cleaner energy mix than Southern Africa and, in fact, all other regions in the world. However, if one takes into account emissions from land-use change and forestry (from deforestation of the Amazon Forest), the region's global emissions contribution increases from 4.9 per cent to 10.3 per cent, and the CO2 emissions of Brazil become higher than those of India, Mexico or South Africa. Brazil's GHG emissions from

2 However, geopolitical considerations weigh heavily in the definitions of energy security adopted by many developing countries because dynamics such as capacity, accessibility, affordability, level of development, demand and supply vary across both regions.

3 The G8 is the group of industrialized countries considered in the IPCC (2007) report, i.e. Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.

4 China, India, Brazil, Mexico and South Africa are widely recognized as the "Plus 5" rapidly industrializing nations that, together with the G8, produce 75 per cent of the world's GHG emissions.

5 The region emits 4.9 per cent of global energy-related CO2 emissions.

agriculture and deforestation account for 59 per cent of Latin and South America's land-use change and forestry emissions (Figueres, 2008). Furthermore, since major oil fields have been discovered off the coast of Brazil, it is likely that in the medium term the country will also face carbon mitigation challenges as these fields are exploited.

The economic, social and environmental costs of failing to act on a deteriorating climate are potentially extremely high. For instance, South Africa's important agricultural sector would be affected by resulting increased temperatures, more frequent droughts, and diminishing water availability and quality. In Brazil, climate change could induce forest fires, resulting in soil erosion and increased water run-off, combined with potentially devastating droughts. The combination of the two could mean considerably decreased hydropower potential in the future. Attention must also be paid to the fact that we are now living in a more climate-conscious world, and these countries will have to address the high carbon intensity of their exports for their goods and services to remain competitive. Thus, despite being exempted from national GHG emission reduction targets at the moment, these dynamics put the two countries squarely within the mitigation frame, a fact that has implications for their regions.

The Kyoto Protocol especially encourages the implementation of mitigation measures that catalyze energy efficiency and motivate countries to adopt energy sustainability policies. This means that substantial changes to the electricity production mix may be coming, owing either to potential mitigation targets or the need to avoid the adverse effects of climate change itself. This poses major challenges to existing infrastructure and will to some extent require regional solutions. Therefore, future electricity security in these two anchor states and their regions is a pressing challenge.

Electricity security and climate change

Establishing sustainable electricity security in Southern Africa and South America in the face of climate change exposes two key challenges. One is related to the pressing need for vastly increased generation capacity to satisfy both economic growth and development demands. In Southern Africa, this is defined largely in terms of the need to develop 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 affordably (Mbirimi, 2010). A World Bank Study (2008) also argues that, compared to costly grid extensions, off-grid renewable electricity provides a more cost-effective way of providing power to the under-served population in Latin America, particularly in Bolivia, Nicaragua and Honduras, where electrification rates in rural areas are below 30 per cent.

The second test is how the regions address environmental issues linked to current concerns about climate change. This poses major challenges to existing infrastructure and will, to some extent, require regional solutions, which are discussed below.

Infrastructure

Energy investments tend to lock a country into technology pathways that become extremely expensive and difficult to change. Thus, making large-scale changes to the technology base of such systems, for example by introducing radically different elements such as solar and wind technology, cannot be achieved without looking at all the dimensions of a particular system. The expense is illustrated by the new expansion plan of South Africa's state power-generation utility, Eskom, estimated to cost USD$1.86 billion, which highlights the country's overdependence on coal and its traditional technological frameworks that continue to lock out other options. The extra expense of renewables is

disputed by some commentators: Schaffer (2008), for example, has observed that the country "can have wind and solar energy in place of coal fired power stations for the same amount of money," concluding that "the main constraints [to clean technology and renewable energy] are neither resource availability nor techno-economics but a limiting mindset."

In addition to rigid technological pathways, institutional and policy frameworks are a major obstacle in their own right. The main reason for this is that electricity systems are deeply entrenched in terms of the economic institutions associated with them, regulatory rules and structures, technical standards, and even the skills of the people who manage and run these systems. A good example is found in financial support measures that governments provide in the name of achieving energy security. For instance, in order to help avoid the social, political and economic effects of the energy rationing crisis experienced earlier in the decade, the Brazilian government offered subsidies for building new hydroelectric plants (Werneck, 2010) and has been studying a proposal on renewing hydroelectric plant concessions at prices much lower than their opportunity costs. This has been observed to cause distortions in electricity prices without solving the structural problem of electricity supply security (De Oliveira, 2010).

Similarly, until recently the South African government provided financial support to Eskom and only capped its support because of the strain to the national treasury. This has necessitated a search for private loans[6] – borrowed expensively in overseas markets – and capital increases through tariff hikes,[7] in addition to the over ZAR170 billion in guarantees extended to the company by the National Treasury to enable it to raise the necessary loans it requires in the capital markets. However, such government tools, if well designed and targeted, can influence the "right" technological and electricity supply choices, which are discussed below.

Regional electricity supply

An important aspect of the dynamics of electricity security relates to the central position of both Brazil and South Africa in their specific regional electricity 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. South Africa accounts for about 80 per cent of the region's total electricity demand and it exports about 5 per cent 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 are in desperate need of additional capacity in the short term.

In South America, there is a deep-seated perception that energy security is a matter to be fundamentally dealt with in the domestic environment, even though the economic cost of this approach may be high. But this was not always the case: for example, in the 1990s heavy investments were made in the material infrastructure to increase energy flows of electricity or natural gas from neighbouring countries to the Brazilian energy market. This approach was reversed when the political climate and financial situation changed in the late 1990s, which resulted in Brazil's decision to launch the Gas Anticipation Production Plan (Plangás) and build terminals for liquefied natural gas soon after Bolivia's decision to nationalize Petrobrás assets in that country. Furthermore, the political tensions in the region compelled the Argentinean government to give priority to the domestic supply of natural gas, putting the Chilean

6 Eskom recently sought and received loans from the African Development Bank and the World Bank to finance the Medupi Power Station, despite the raging controversy surrounding the loans; see further, Calland et al. (2010).

7 In 2010 the National Energy Regulator of South Africa allowed Eskom to increase electricity tariffs by 24.8 per cent for 2010, 25.8 per cent for 2011 and 25.9 per cent for 2012; see further, Mail & Guardian (2010).

energy supply at risk. In these cases, recognizably more expensive alternatives were selected to improve the security of domestic electricity supply. As a result, low-cost energy resources remain underutilized, which raises the cost of energy supply and, ultimately, reduces the competiveness of South America's economies. Subsidies have further exacerbated the problem, as they have been widely used to prop up inefficient domestic production and supply.

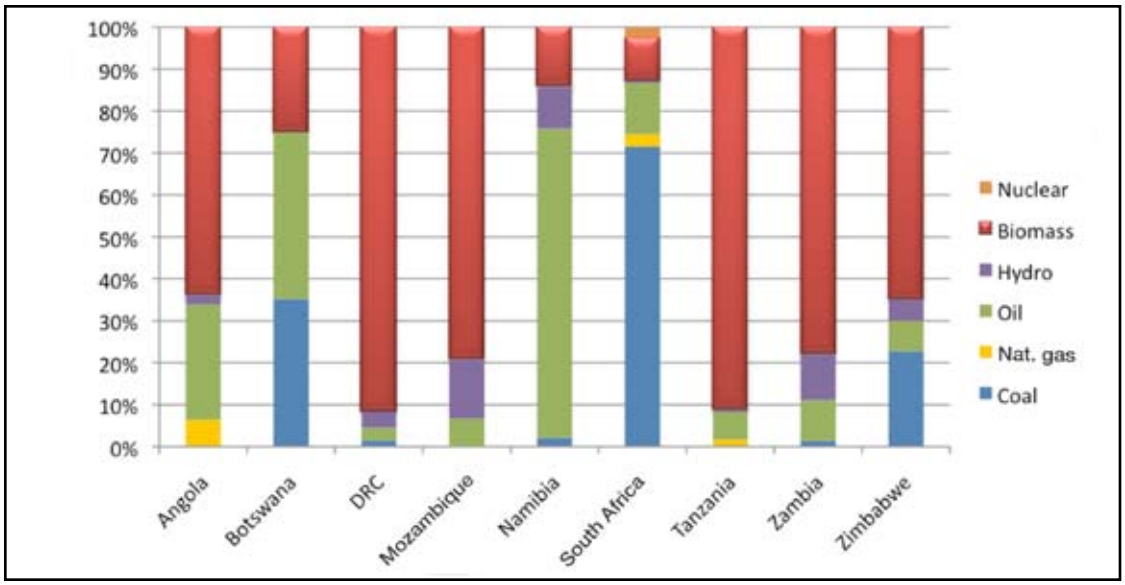
In sum, two central challenges emerge: one is related to the pressing need to develop the plants and infrastructure that would increase generation capacity to satisfy both economic growth and development demands, as well as provide power to the poor in rural communities; the other, which is brought to the fore by South Africa's particular position, is how the regions address environmental issues linked to current concerns about climate change. Thus, viewed against this backdrop, it is clear that options for diversifying electricity supply need to be prioritized.

Achieving energy security in the face of climate change

The role of renewable energy generation

Power can be generated from a variety of sources and technologies, which is why natural endowments play an important role in determining the energy supply mix. This is illustrated in Figure 1, which shows the composition of electricity generation among Southern African Development Community (SADC) countries. Coal is currently the predominant energy source, especially in South Africa, which dominates the region's electricity market. Zimbabwe and Botswana also have substantial reserves of coal, while the Democratic Republic of the Congo (DRC) in particular, as well as 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 in the region (Mbirimi, 2010).

Figure 1: Composition of power generation capacity in SADC, 2006 (%)



Source: World Bank (2010)

What is apparent from Figure 1 is that the current electricity generation structure does not fully reflect the domestic and regional endowments of renewable energy resources. This potential covers a spectrum of renewable energy sources that include small and large hydropower capacity and solar and wind energy.

South America is also characterized by a vast availability of energy resources, both renewable and non-renewable. But in contrast to Southern African countries, the region has relied on natural gas, nuclear plants and hydroelectricity, which emit much fewer GHG emissions than coal. The low percentage of emissions from electricity supply reflects a cleaner energy mix than other regions. Not only does 22 per cent of the region's electricity come from renewable sources, particularly hydropower, but the carbon intensity of the region's fossil fuels used for electricity generation is also lower than in other regions, i.e. 261 vs. an average of 500 grams of CO2 per kilowatt hour, respectively.

Taken as a whole, the region exhibits low GHG indicators compared both to Organization for Economic Cooperation and Development (OECD) countries and other developing countries. Even though the region's position regarding climate change is "favourable," Brazil and Mexico are two of five emergent countries[8] that could engage in enhanced mitigation efforts in the near future.

Therefore, in both regions, hydro and non-hydro renewable sources of energy (such as solar and wind technology) may offer new opportunities for expanding electricity security. But their initial development may require government support to overcome the disadvantages created by incumbent producers of power and the costs of associated infrastructure. However, the prospects of turning the potential of renewable energy sources into reality are dim without increased investment flows and government reforms aimed at improving generation capacity from renewable sources. The authors involved in this project have summarized the framework conditions that affect the viability of the renewable energy industry in South Africa and South America as follows:

Technology: This has always been a major factor in determining the choice of sources of energy, in large part because the cost of exploiting alternative sources of energy is determined by the available technologies, while the adoption of new technologies, for example, in the area of renewable energy, is directly linked to the capacity of economies to innovate, learn, change and adopt new technologies.

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Enabling increased renewable generation

It would seem that government support policies and reforms are required, especially to promote the uptake of renewable energy technologies. Indeed, experience shows that the switch to renewable energy is neither cheap nor easy. As argued in the previous section, electricity plant systems exhibit strong path

8 See note 4, above.

dependencies, which mean 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 electricity plants (Scrase & MacKerron, 2009). The problem of lock-in is particularly acute for South Africa.[9] While the circumstances of different countries vary, it is clear that any 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.

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. 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. When tariffs are set below the cost of generating electricity, utilities lack the incentive to connect new customers and 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 (Kiratu, 2010; Mbirimi, 2010), or the electricity supplier will be left short of essential resources. In this context, the possibility of financing works with public funds becomes more difficult (Kozulj, 2010).[10]

Effective institutions for regulating the market are also required. Weak institutions are one of the reasons why attracting private investors to developing countries remains a challenge. Moreover, many institutions, including governments, do not have much experience in dealing with large infrastructure projects or with private–public partnerships. In a dynamic environment like the energy sector, clear objectives and roles are essential. The detrimental effect of improperly delineated roles is evidenced 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.

In addition, applying regional solutions to electricity security problems is touted as a sound, convenient and effective approach to diversifying countries' electricity supply mixes. From a sustainable development and economic perspective, energy integration is a better alternative to national reliance because it offers access to energy resources from neighbouring countries at low opportunity costs. Thus, besides offering market access to the exporters of electricity, it enables the bloc's participant to acquire the competitive advantages that come from being in the same region as hegemonic countries such as Brazil and South Africa.

For example, the countries in South America would access the Brazilian market and utilize the infrastructure for the distribution of power that would otherwise remain idle. They would also get the opportunity to participate in the articulation of the productive chain of the energy system that is being produced in Brazil. In Southern Africa, in addition to improving and diversifying South Africa's energy mix, the implementation of an outward and regional policy on energy supply would promote a coordinated strategy for regional expansion and operation, thus reducing national costs of building expensive power plants and ensuring that electricity can be transferred from areas with low costs to areas

9 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 dependence on coal-generated electricity.

10 A good example is found in the burden of Argentina's energy subsidies on its treasury. Like many other countries, it went through a period of prosperity between 2003 and 2008, but saw a decline in its economy in 2009 and 2010. Interestingly, the growing fiscal surplus between 2003 and 2008 has been reduced mostly by the incidence of energy sector subsidies, which in 2008 amounted to almost all the tax resources coming from the energy sector itself; see further, Kozulj (2010).

with higher costs, which bodes well for economic development in SADC as a whole.

Lastly, regional energy integration potentially reduces volatility in energy prices. For exporting countries, energy is an important source of fiscal resources, which needs to be stabilized – both in terms of quantity and prices – to allow for the formulation of sustainable macroeconomic policies. Reduced volatility is also very much in the interest of consumer countries.

Conclusion

Electricity security 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, and a changing role for states and established electricity utilities. As such, policies must be flexible in design and implementation and adaptive to change. This includes, but is not limited to, the adoption of diverse energy sources, the "genuine" inclusion of the private sector in electricity provision and distribution, and a commitment to investing in and adopting newer and cleaner technologies. It also means that governments must find creative ways of dealing with the supply problem. One reasonably successful tool is the implementation of demand-side management programs that have been shown to reduce consumption of electricity.

It is also noted that the availability of technology does not appear to be a severely limiting factor; rather, bigger problems are posed by the fact that renewables cost more than conventional fuels in all but niche applications, as well as the many regulatory barriers associated with electricity generation, transmission and distribution. These barriers can 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 renewable sources of energy. For renewable and climate friendly technologies to take off, government support or incentives are needed.

In the case of the Southern African Development Community (SADC), the formation of the SAPP suggests that the countries of the region recognize regional opportunities and share the view that electricity security lies in regional cooperation. In South America, however, the key question is whether the region's leaders can muster the political commitment that will enable them to escape the dynamic dictated to them by short-term national political and economic considerations by looking to the region to meet their electricity needs.

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