INSIGHT

Challenges in modeling regional markets and the SAPP case study

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Regional integration of power systems brings a wide range of benefits in many regions of the globe, from improving economic efficiency to increasing system reliability. Modeling regional electricity markets is essential to better understand the current and future characteristics of electricity systems and to analyze the evolution of their key performance indicators in the face of major transformations in the generation matrix (strong development of renewable energy projects, for example).

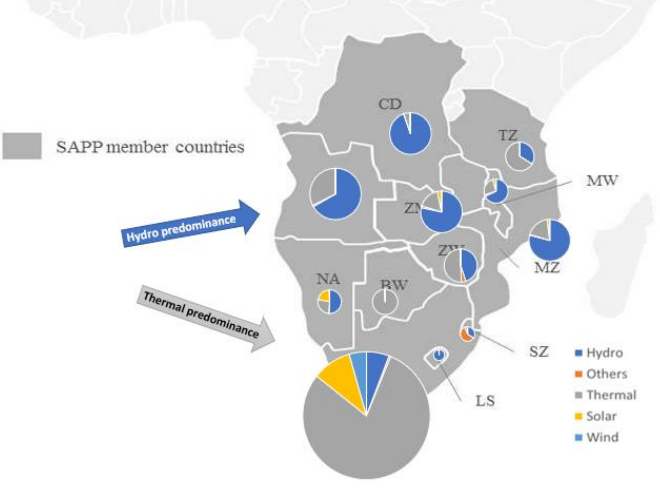
Main characteristics of the regional markets

Regional integration implies a wide range of benefits, from improved economic efficiency to increased reliability, better security of supply and reduced environmental impact (among other things). In that context, the SAPP was created in 1995, to facilitate the regional energy trade and optimize the use of the energy resources between countries (thermal/hydro complementarity, distribution of the power plants on the territory and between countries). Presently, SAPP is a competitive energy market in the form of a Day-Ahead Market and an Intra-Day market. Modeling the SAPP implies modeling the inner characteristics of its member countries (national demand and generation, binational projects) and the respective international interconnections.

About SAPP & member countries

The SAPP has twelve member countries represented by their respective electric utilities organized through SADC (Southern African Development Community). The SAPP coordinates the planning and operation of the power system among member utilities.

South Africa is the most dominant economy in SADC and this is also reflected in its installed generating capacity and electricity consumption compared to the rest of the countries.



The exhibit above presents the installed capacity per technology for each country member of the SAPP. The size of the pie charts for each country reflects the total installed capacity. It also illustrates geographically the hydro and thermal dominance in the generation mix.

Generation mixes change in each country but can be classified in those dominated by thermal generation and those dominated by hydro generation.

In the thermal-dominated group, the most important player by far is South Africa, which has very large coal reserves, and over 42.000 MW of steam turbines, almost entirely owned by Eskom. Other countries in this group are Botswana, Tanzania and Zimbabwe, but with much lesser size relative to the SAPP. The hydro dominated group encompasses Zambia, Angola, DRC, Eswatini, Lesotho, Malawi, Mozambique and Namibia.

Most of the SAPP member countries have power sectors dominated by a state-owned vertically integrated utility, which also acts as the single buyer of the power sold by IPPs. South Africa has been discussing the liberalization of its power sector for decades. Due to Eskom´s financial constraints, South Africa is now moving forward with some amendments to the Electricity Regulations Act on new generation capacity (originally enacted in 2011) in order to give the Municipalities the possibility to procure power directly from IPPs, which is an important step towards opening up the routes to market for private generation. Namibia has also taken some steps towards a more liberalized market by allowing "eligible" customers to enter into bilateral contracts with generators.

Within this regulated environment, the SAPP stablished the short-term energy market (2001) as a competitive trading platform with a set of options used by the member countries. SAPP currently operates a day-ahead market (DAM) (2009), intra-day market (IDM) and forward physical week-ahead (FPW) and month-ahead markets (FPM) (2015). The DAM is the most important market and accounts for 85% (2019) of the total traded volume within SAPP.

The modeling tool

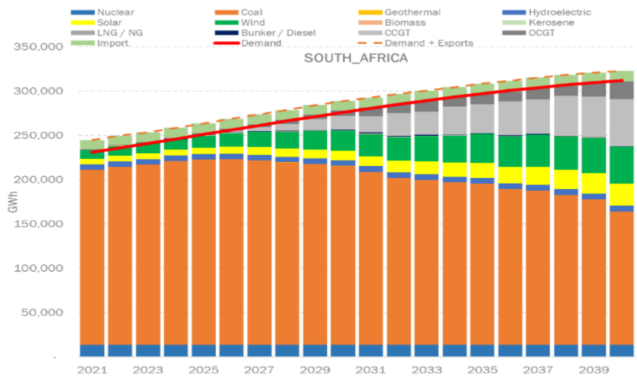
Future investments in power generation necessarily require a forward-looking approach and guidance on the economic feasibility and competitiveness of the target Project compared to many other candidates of diverse technologies with different attributes.

Either if the decision making process is guided by central planning or by market forces, the simulation of the future operation of the interconnected and regionally integrated power systems is of vital importance when appraising the feasibility of a given power Project and its impact on the interconnected regional systems.

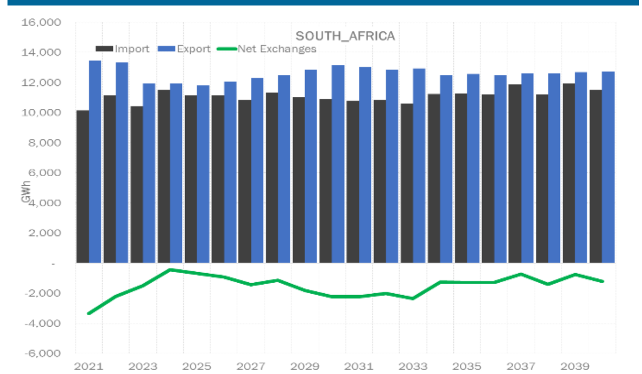
The tools used by GME are especially suited for analysing hydro-thermal systems and assessing the impact of different hydrological conditions on the electricity markets. Some of the results that can be obtained comprise: generation expansion, capacity and generation balance, energy exchanges, selling prices, among others.

Examples of results from the prospective market analysis in different countries of the region:

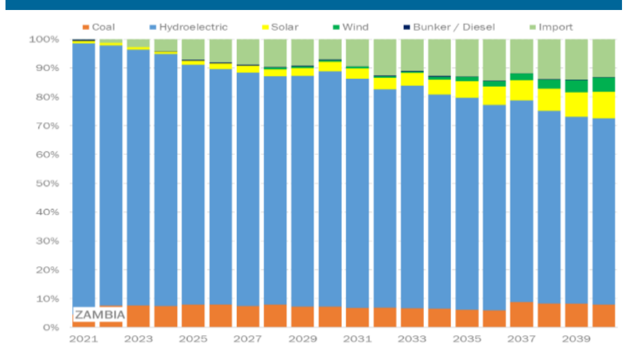
Energy balance – South Africa



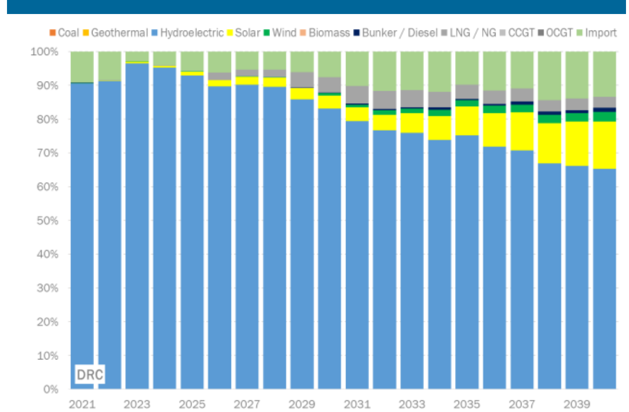
Energy exchanges – South Africa - SAPP



Generation mix– Zambia



Generation mix– DRC



Challenges within the energy transition environment

The energy transition opens opportunities to accelerate the universal access to electricity. At the same time, each country faces different challenges and advantages to fully embrace this opportunity.

The modeling of regional markets is a valuable tool to measure the impact of different energy transition´s scenarios, such as specific national expansion plans, official targets in terms of integration of renewable energy and gas resources or own-made independent scenarios.

The benefits of our modeling

Many challenges appears when modeling national or regional markets and different assumptions could be set up depending on the objectives of the study. In any case, model will support decision makers to determine the investment plan to expand the power system in the mid and long terms, by selecting the optimal expansion (least supply cost) amongst several candidate technologies, for different future scenarios of demand growth, share of renewables and fuel prices.

By simulating the future behavior of the power systems for different scenarios, providing valuable information, supported not only by the modeling tools but also by a thorough contextual analysis of the results obtained with such tools, and a focus on the specific regulatory context of each country under analysis.

The modeling process will go through data search and analysis, elaboration of sets of assumptions for different scenarios, modeling of the different components of the electricity system (demand, generation, transmission grid, interconnections, fuel prices, hydrological scenarios, etc.) giving our clients a clear point of view and strong basis for future decisions.

In the case of analyzing hydro-thermal systems the model is key to identify the impact of different hydrological conditions (dry and wet seasons) on the electricity markets.

Finally, the modeling process integrates the regulatory and commercial aspects, in order to analyze the opportunity of a new generation projects, the conditions for participating to an auction, the existing and future opportunities for large consumers, the interest in acquiring existing assets and all aspects related to energy policies that could affect the dynamics in the electricity sector (focus on generation and transmission) expansion plans.

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