Latin American Countries Integration: Energy, Industries and Markets

Ruben Chaer,

Institute of Electrical Engeniering
University of the República Oriental del Uruguay

Administración Del Mercado Elèctrico
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Electricity exchanges between Brazil, Paraguay, Argentina and Uruguay

1) Current situation of the electricity energy regional integration
2) Principal barrier to increasing energy exchanges
3) Improvement proposal

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Current situation

- Strong interconnection infrastructure between Brazil – Paraguay – Argentina and Uruguay.
- Unconditional support in emergencies.
- The utilization of the available interconnection infrastructure is less than 20%.
- To think about long-term planning, we must first make progress in utilizing what we already have.
- Progress has been achieved driven by **Complementary Extreme Situations (CES)**.

Example of **Complementary Extreme Situations**
(2021) AR+UY -> BR

In 2021, low availability of hydroelectric resources was observed in Brazil and good availability in Argentina and Uruguay

Brazil imported 6000 GWh from Argentina and Uruguay(*)

(*)Fonte: pág.92 del **Plano Decenal de Expansão de Energia 2031**. Ministerio de Minas y Energía, Secretaria de Planejamento e Desenvolvimento Energético
(https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/plano-decenal-de-expansao-de-energia-2031)

Example of **Complementary Extreme Situations**

(2023) BR -> AR+UY

- In 2023, Brazil had high hydroelectric availability and Argentina and Uruguay had a prolonged drought.
- Brazil's authorization of the export of Hydro Energy from Turbinable Spillways was CRUCIAL.
- Argentina and Uruguay imported large volumes of energy to compensate for the lack of rain.

Prob.(CES) < 20%

- Hydroelectric resources are highly correlated in the region. Niño years are rainy and Niña years are dry.
- This means that **Complementary Extreme Situations have a relatively low probability (<20%).**
- It is true that these situations are the ones that benefit most from exchanges, but we need to make the other 80% of underutilized capacity viable.

Study: Impact of climate change on electricity generation in Southern Cone countries (World Bank 2023)

- Very detailed SimSEE model of Brazil, Argentina, Paraguay and Uruguay, does not include Chile

Final Final

Model details

SimSEE - Model

Conclusions

- One of the main results of the study is that: The uneven behavior, in the face of Climate Change, in the availability of hydroelectric resources, in Demand and power requirements are impacts that can be mitigated by all countries by making use of the existing interconnection infrastructure.

- **The history of exchanges over the last 10 years and the simulations carried out with the model show that, with the current exchange rules, the use of existing regional interconnections was and will remain less than 20% of the available capacity.**

Composition of the future generation matrix

- Non-conventional renewable energy (NCRE = Wind and Solar) has reached prices below US$40/MWh, which competes directly with the variable cost of combined cycles powered by Natural Gas. This has led to its rapid introduction into the generation matrices in the world and particularly in the region.
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- From an economic point of view, it is optimal to reach levels of incorporation such that NCRE surpluses are produced.
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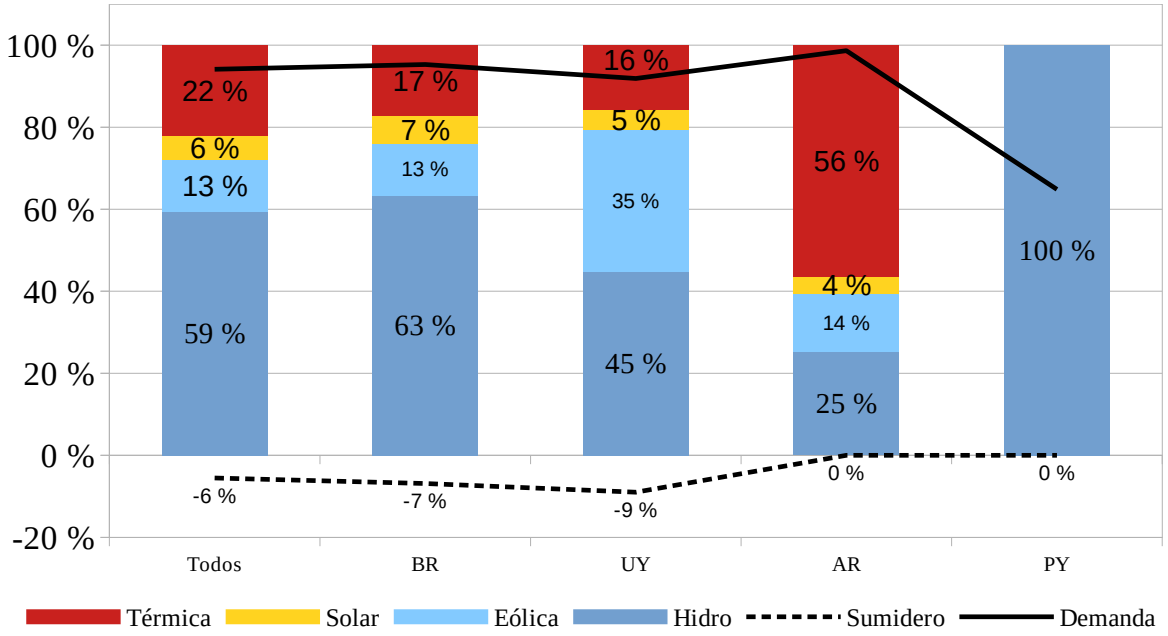
- Being able to valorise these surpluses would undoubtedly imply a reduction in energy costs and would also allow a greater substitution of fossil fuels with clean energies, contributing to the global decarbonisation objectives.



Identifying the main barrier

- In theory, energy should flow through interconnections from the lowest marginal cost market to the highest marginal cost market, increasing the level of exchange until marginal costs equalize (taking into account loss factors) or reach the limit of exchange capacity.
- The effects on the costs/remunerations of domestic agents in each country are often the basis for difficulties in exchange outside of Complementary Extreme Situations.

The main barrier: We are reluctant to exchange reservoir energy

Currently, exchanges are carried out based on offers that are formed with certain limitations regarding the use of energy stored in the reservoirs of each country.

Given the high hydraulic component of the region and that the energy stored in the reservoirs of each country is part of the energy security of supply, it is estimated that restrictions regarding the use of stored energy in exchanges will be a difficult aspect to modify in the short and medium term.

In the long term, if countries converge to common security of supply criteria, this restriction could be lifted. As long as the restriction of NOT Exporting Dammed Water remains in place, added in the case of Brazil to the non-importation of energy that replaces hydroelectric generation, exchanges will continue to be limited to situations in which one country has quasi-zero marginal costs and the other has thermal generation, which leads to the use of less than 20% of the available capacity.

How to increase the exchange between the countries of Cone SUL without altering the optimization of the reservoirs?

- We should aim to cover 80% of situations that are not CES.
- To achieve this, it is necessary to exchange in normal situations, which implies the use/replacement of stored water.

It emerges that it would be desirable to seek regional storage mechanisms for surplus renewable energy, mechanisms that should take into consideration the operating rules in current markets.

A proposal: "Regional Storage of Turbinable Surpluses of Renewable Energy"

A possible solution would be to enable what could be called the Regional Storage of Turbinable Surpluses of Renewable Energy.

This could be implemented without affecting the restrictions of "not exporting stored water" and also, if necessary, the "not importing by replacing hydraulic generation." The mechanism could be as follows:

Storing renewable surpluses that can be turbined

- When in the daily pre-dispatch, a country has surpluses of renewable turbine energy, and the other countries cannot accept the offers made in the current modalities, they can accept the energy to be stored in one of the hydroelectric plants that has reservoir capacity.
- For this, said hydroelectric plant would have to be dispatched by the National System Operator (NSO) of the country that receives the energy and the way to receive and store it, without affecting the market, is that the hydraulic generator reduces its generation (thus storing the energy received by the interconnection) and that for the purposes of market settlement, everything is accounted for as it would have been if said generator had delivered the energy. That is to say, for the purposes of the market that receives the energy, there is no changes in remunerations.
- For the purposes of the stored energy of the country receiving the energy, the lake level (of the generator that received the energy) will be considered as if it had generated what was programmed by the NSO.
- The Regional Turbinable Renewable Surplus Energy that remains stored would remain in what we could call the Regional Storage.

Spilling the stored renewable surpluses

- In the event of a spilling in a hydroelectric power plant, the Regional Stored Energy would be the first to be spilled.
- The same filtration and evaporation factors that apply to the rest of the energy in each reservoir would also be applied to said energy.

Using the stored renewable surpluses

- Whatever the form of commercial implementation, there will be a Marketers with rights over the Stored Regional Energy, said Marketers will be the ones that runs the risk of losing the energy if spilling occur and the risk of achieving monetization of said energy based on offers when the market rules allow it.

Regulatory feasibility

- It would seem that such an implementation could be a layer on top of existing markets, since it would not affect them and therefore it would seem possible to adapt the regulatory frameworks of the different countries to define the operation of the Regional Storage of Turbines of Renewable Energy.

An additional benefit: Risk reduction in extreme drought situations

Another important aspect is the complementarity that the proposal presents with respect to extreme situations. Note that the country that enters a period of low hydrologic capacity will automatically be the first to begin to have free storage capacity and therefore, although it has not reached the extreme of needing thermal generation, it will store regional turbine surpluses and therefore, if it is unlucky that the hydrological situation does not burst, it will have the good fortune to have, to replace thermal generation, in addition to what it can circumstantially import through the interconnections, the Regional Energy previously stored in its own reservoirs.

Muito obrigado pela sua atenção

- Não há nada impossível para uma boa equipe, apenas coisas um pouco mais difíceis