AN ANALYSIS OF THE OPERATIONAL FLEXIBILITY VALUE IN THE BRAZILIAN SYSTEM

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# Overview

The energy transition process taking place around the world has resulted in a significant adoption of variable renewable energy sources and this has brought a renewed perspective to system operators. Both in Brazil and in other markets, flexibility becomes a more necessary attribute as net load has increased variability that is mitigated by the dispatchable sources, which are more demanded. This work aims to verify whether there is value for a source in being flexible. For this purpose, a database was built of operational and price variables on an hourly basis from 2010 to 2023 for the entire Brazilian system, that includes years of greater and lesser scarcity of resources to meet the load. With this database, the Market Value and Value Factor metrics are calculated for dispatchable and non-dispatchable sources in the Brazilian system to verify the value captured by each one at different moments in the system. It demonstrates that there is value delivered by dispatchable technologies. Additionally, it is shown that the hydropower has higher value than non-dispatchable renewable sources, even in times of low availability of water resources.

**Methods**

A database of historical hourly data from 2010 to 2023 is constructed with operational variables and prices: the total generation by primary source (hydro, wind, solar and thermoelectric) for each of the four Brazilian regional subsystems and the power exchange between them. With this data two metrics are calculated in different time periods to characterize the value captured by each source, the Market Value and the Value Factor in different operational contexts. Historical contexts of high and low scarcity of energy resources and different levels of renewables penetration are compared and analyzed.

# Results

Overall, the dispatchable sources show a greater captured value than the non-dispatchable sources, even in situations of low availability of resources. It is also shown that the price formation is a key factor in differentiating the advantage of each source.

**Conclusions**

The results show that dispatchable sources capture more value overall indicating the demand for this attribute in the system. The supply for this attribute can be affected by how the price formation limits the value captured by the sources.