

# **A methodological approach for assessing flexibility and capacity value in renewable-dominated power systems: a Spanish case study in 2030**

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## **Abstract-**

**Maintaining the security of supply is one of the challenges that system operators face. Variability and uncertainty increase due to the penetration of variable renewable energy sources such as solar and wind, while flexible technologies such as traditional thermal units are phased out to reduce emissions. The current methods for assessing power system adequacy are based on historical operations and are generally intended to be applied to thermal-dominated electricity systems. Therefore, it is necessary to improve current adequacy assessment methods since they usually neglect the flexibility of power systems. This paper presents a methodological approach for jointly assessing the adequacy and flexibility of power systems. The methodology's usefulness is demonstrated through its application to the Spanish power system. For the case study, results show that new closed-looped pumped storage hydro technology provides 25% flexibility while contributing to adequacy due to higher installed capacity and round-trip efficiency. Due to shorter storage duration, batteries only contribute to flexibility, supplying 16% of the total operating reserves. Therefore, this study shows that metrics of flexibility and individual contribution to the power system adequacy complement each other and simultaneously enable the scarcities of power systems to be observed.**

**Index Terms-** Electricity; Security of supply; Variability; Critical periods; Storage

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