

Title:

Assessing the need for power system flexibility on a global level: A multi-criteria assessment index

Abstract (339 words)

To effectively cope with the intermittency of VRE, power systems will need different flexibility options. The future portfolio of flexibility options will differ among countries, as it will be determined by the political, economic, social, technological, legal, and environmental factors of a country. Thus, some countries might have a greater need for flexibility options than others.

Generation and expansion planning for renewable power systems on a national level are complex and require large long-term investments. Therefore, it is crucial to estimate the "need for flexibility" in energy systems from a macro-level. By assessing relevant indicators (e.g., economic) and different boundary conditions (e.g., VRE capacity), power system planners, policymakers, operators, and regulators can evaluate the need for flexibility in power systems and prioritize the needed actions.

Published research and international reports do not refer to the countries with the highest need for flexibility options in respective power systems. In this regard, the aim of this paper is to answer the following question: "Which countries in the world have the highest need for flexibility options from a macro-energy systems point of view?"

To answer our question, first, we have identified relevant indicators from the literature that can help us to estimate the "need for flexibility" in national power systems. Second, we weighed the different indicators according to their importance by using the analytical hierarchy process (AHP) of the multi-criteria decision analysis (MCDA) process. Finally, this paper proposes a "global index for flexibility need" using these indicators. As for the results, countries were ranked in this index based on indicators and already show us the promising countries with the top 10 dominated by European countries.

This index works as a macro-level assessment framework that provides the comparative position of countries with regard to the need for flexibility. This index will help technology providers and increase investor confidence to choose countries with the highest "flexibility need" for technology implementation. This will help relevant stakeholders to focus on key countries first to accelerate the integration of VRE and thus help the global energy transition.