Estimating the benefits of transmission expansion projects: an Aumann-Shapley approach

F. Bañez, L. Olmos, A. Ramos, J.M. Latorre

Abstract— This paper proposes a novel methodology to estimate the benefits produced by transmission expansion projects that are part of an expansion plan. Any methodology applied should be coherent with the technical and economic principles that underlie an efficient planning of the network expansion, where expansion projects are selected to be part of the plan according to the benefit they produce when considered jointly with the rest of projects. The methodology developed is based on the idea that projects to be undertaken should be evaluated jointly, instead of individually, because the benefits produced by each of them depend on other projects in the plan. We formulate a cooperative game to allocate the benefits of the plan to individual projects using the Aumann-Shapley concept. Then, players in the game are expansion projects. The method proposed is able to capture interactions among projects. Moreover, it is highly computationally efficient and therefore can be applied to real –large– expansion plans. Two case studies are used to compare the performance of the methodology proposed to that of existing methods. The results show that the proposed methodology provides regulatory authorities with the most relevant information for the identification of high-priority expansion projects.

Index Terms— Aumann-Shapley; Cooperative game theory; Cost-benefit analysis; Investment; Transmission expansion planning