When doing nothing may be the best investment action: Pessimistic anticipative power transmission planning

Pozo, D., Sauma, E., Contreras, J. (2017). When doing nothing may be the best investment action: Pessimistic anticipative power transmission planning. *Applied energy, 200*, 338-398. https://doi.org/10.1016/j.apenergy.2017.05.030

Abstract

A fundamental challenge in power system planning is how to handle the interactions of participants' behaviors in deregulated markets. This is important due to the high cost involved in their decisions. Proactive or anticipative transmission expansion planning models have been proposed by some authors to jointly model the interactions among deregulated electricity market participants making market-driven investment decisions. Several works have shown that a Transmission Network Planner can increase social welfare by anticipating line expansion planning to generation expansion equilibrium and market outcomes. However, proactive transmission expansion decisions may lead to suboptimal solutions when the generation expansion equilibrium problem have multiple solutions (i.e., leading to higher total costs and lower social welfare). We propose a methodology to study the potential impacts of proactive expansion planning on generation expansion decisions. The resulting formulation is stated as a mathematical program subject to an equilibrium problem with equilibrium constraints (EPEC). To deal with this problem, we also propose an approach to derive tractable EPEC solutions with global optimality guaranteed based on a column-and-row generation algorithm. Our numerical results shows that a proactive investment plan can lead to higher total cost than not investing at all because of the existence of multiple market-driven generation expansion equilibria.

We show that the proposed algorithm significantly reduce the time of computation up to two orders of magnitude with respect to existing methodologies.