

Abstract

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Energy System Integration in the Course of the Energy Transition

Kazuhiko OGIMOTO
Project Professor, Institute of Industrial Science, The University of Tokyo
Tokyo, Japan

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Abstract

In the transition to carbon neutrality, a power system has a critical role in zero-emission energy supply, energy efficiency, electrification, and support of new demands. The penetration of variable renewables has been impacting an operation of power systems of the world.

In Japan, the revision of the 7th Basic Energy Plan has begun targeting the energy mix in 2040. In the 10 interconnected areas of Japan, according to a government committee, the generation curtailment will increase due to penetration of variable renewable, shortage of energy storage in various time-frames, emerging issues of system stabilities. In government committees, many aspects of integration of variable renewable are discussed to establish and improve rules of generation and demand connection to a power system and an operation of a power system including new enabling technologies such as batteries, demand responses of distributed energy resources, GFM inverters, reinforcement of power grids, and improved operations such as congestion management including distributed generation, inertia management, and compensation of generation forecast error.

It is extremely important to analyze the issues and benefits of the penetration of renewable energy generation and other countermeasures using a demand and supply analysis tool. In the presentation, some examples of demand and supply analysis will be presented. The method used is a production cost simulation tool “MR” with network constraints using real demand and supply condition of the future power system of Japan. MR has a capability to set the requirement for the various flexibilities and to define supply capability of various sources including traditional generation and distributed resources to optimize the generation dispatch, flexibility dispatch and demand shift to minimize the operational cost. MR also has a capability to optimize the operation of m-days to take n-days results, to optimize the operation under the transmission capacity constraints, and to analyze short circuit capacity of the nodes in the transmission system.

Main results obtained

The pathways of a transition of a power system is discussed and evaluated assuming further integration of variable renewable under several possible changes of enabling technologies. Under uncertainties of technology, economy and society, it is important to proceed with technology development and dissemination and institutional improvement in parallel in each of sectors of generations, demands, network with keeping alternatives.

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