

# **Impacts of operational variability and uncertainty on distributed generation investment planning: a comprehensive sensitivity analysis**

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**Abstract—** This paper presents a comprehensive sensitivity analysis to identify the uncertain parameters which significantly influence the decision-making process in distributed generation (DG) investments and quantify their degree of influence. To perform the analysis, a DG investment planning model is formulated as a novel multi-stage and multi-scenario optimization problem. Moreover, to ensure tractability and make use of exact solution methods, the entire problem is kept as a mixed-integer linear programming optimization. A real-world distribution network system is used to carry out the analysis. The results of the analysis generally show that uncertainty as well as operational variability of the considered parameters have meaningful impacts on investment decisions of DG. The degree of influence varies from one parameter to another. But, in general, ignoring or inadequately considering uncertainty and variability in model parameters has a quantifiable cost. Hence, the analysis made in this paper can be very useful to identify the most relevant model parameters that need special attention in planning practices.

**Index Terms—** distributed generation, investment planning, distribution network systems, uncertainty.

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