

Reliability with Interdependent Suppliers

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Abstract

We study reliability and the role of interdependent suppliers with reference to electricity systems. Individual availability of supply is uncertain and may exhibit dependencies with other suppliers as well as with the stochastic demand. Aiming at a comprehensive and consistent reliability assessment, we first investigate the system as a whole, and then derive a general solution for an individual supplier's contribution. Implicitly, we identify changing returns to scale, gains of diversification, and non-additivity. As these properties are often undesirable, e.g., for the purpose of accounting or in specific auction formats, we build on concepts from cooperative game theory to provide the Shapley value as the unique consistent reliability allocation rule. We then illustrate practical relevance and applicability of our approach for the case of wind power contributing to the reliability of Germany's electricity system, and discuss how today's reliability mechanisms may be improved by considering interdependencies between suppliers.

Keywords: OR in energy, Reliability of supply, Stochastic interdependency, Cooperative game theory, Electric power industry
