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Designing efficient distribution network charges in the context of active customers

I. Abdelmotteleb, T. Gómez, J.P. Chaves, J. Reneses

Abstract— The transformation of electricity network users from passive to active agents, as a result of decreasing costs of distributed energy resources, requires several adaptions, one of which is revising the distribution network charges. Often current network charge designs do not ensure network cost recovery and lack to incentivize efficient network investments and usage. New network charge methodologies are required to guide and incentivize customers in an efficient way while maximizing system economic efficiency. This paper proposes an efficient methodology that ensures network cost recovery while promoting efficient usage of the network as well as efficient network investments. The proposed network charge design consisting of two components: a peak coincidence network charge (PCNC) and fixed charge. The PCNC is a forward-looking charge as it considers the cost of future network reinforcements required and assigned to customers during peak hours of the network utilization. Fixed charges allocate the residual of the network costs following Ramsey-pricing principles. This paper compares the outcome from economic optimum customers' response to four different network charges: (i) volumetric charges (ii) fixed charges (iii) peak demand charge (iv) PCNC plus fixed charges. Two case studies for two different load profiles are simulated using linear programming to minimize their total costs within each charges design, considering the possibility of buying electricity from the grid and investing on onsite generation or curtail load. Finally, the paper highlights through the case studies how customer's response is highly influenced by different network charge designs, and compares the consequences of these responses in terms of network cost recovery and total system costs. The paper concludes with practical issues that need to be considered for the implementation of the proposed network charges design.

Index Terms— Customer response; Distributed Energy Resources; Distribution network charges; Peak Coincidence Network Charges

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