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Forward-looking dynamic network charges for real-world electricity systems: a Slovenian case study

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Abstract-

Electricity network charges are intended to recover network costs and adhere to economic efficiency and equity principles. Most network charges currently applied in real-world systems are merely focused on cost recovery, implicitly assuming inelastic customers. Although proposals for improved network tariff designs can be found in the literature, they are tested only for simplified small feeders. This paper reformulates a dynamic network tariff to implement it in a real-world electricity system. By adapting the proposed improved network tariff designs to manage large-scale layered networks and complex data sets, we address this gap in the literature. First, when considering the entire network, consumers and generators need to be clustered into subsystems by voltage levels, enabling to calculate the network utilization levels; this is the so-called cascade model. After, per voltage level, the network tariff needs to be computed. We focus on an advanced network tariff design that consists of forward-looking peak-coincident energy charges, which is symmetric for injections and withdrawals, a per-kWh component for energy losses, and fixed residual network charges. We illustrate that this network tariff incentivizes the shifting of flexible loads to off-peak hours and aligns individual customer incentives with expected system benefits, reducing future network investments. In addition, the symmetric nature of the proposed tariff enables a level playing field for distributed resources providing flexibility services. As demonstrated for Slovenia, the proposed formulation should be considered by regulators for implementation in real-world electricity systems.

Index Terms- Network tariffs, Forward-looking charges, Residual charges, Flexibility services, Decentralized energy resources

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