

FIAS, Frankfurt 60438, Germany

The Editors
Energy

Submission: Price Tracing: Linking Nodal Prices in Optimized Power Systems

Dear Editors,

Thank you very much for the opportunity to submit my manuscript to Energy. Hereby I submit the paper "Price Tracing: Linking Nodal Prices in Optimized Power Systems".

The paper combines relevant aspects of economic optimization and electrical engineering.

In the research community it is well-known that the optimization of a power system leads to a maximized social welfare of all participants. In such a system the operation of all power generators and transmission lines is perfectly aligned with the power demand of the consumers. It is less well-known that the optimization also returns shadow-prices for each network node and time step. These represent the optimal electricity prices that determine the revenues of generators, who sell power at that price, and the payments of consumers, who buy power at that price. Instead of being independent from each other, the prices reveal a strong interconnection at the cost-optimum. For now, no comprehensive method was developed to quantify that interdependence. We derive a variant of the Flow Tracing algorithm, an prominent algorithm that tracks power flows in complex networks, and use it to link the electricity prices in a optimized power system. This enables important insights into the composition of the prices, and therefore answers the question of how much an individual consumer has to pay to an individual power generator or to a transmission line operator. Despite the straightforward conceptualization, the presented method represents a novelty which has not been published before.

The paper is appealing to both a scientific and a popular

audience. For a scientific audience, we develop, apply, and discuss a novel cost allocation scheme for power system models. This connects to the academic discourse on optimized power system and links well-known concepts. For a clear presentation, mathematical relations are rigorously derived.

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For an audience of policy/economic analysts, we convey the possibility for more transparency in long-term system planning. Especially, against the backdrop of upcoming large investments, this approach facilitates a benefit analysis of a renewable infrastructure.

We think the paper is important because it, for the first time, develops quantitative peer-to-peer cost allocation for all system costs in an optimized network. Our methods and findings may contribute to managing the central short- and long-term role of the electricity network between supply and demand in a fast changing environment.

We look forward to your response.

Best regards

Fabian Hofmann and Markus Schlott