

FIAS, Frankfurt 60438, Germany

The Editors  
Joule

## **Submission: Tracing prices: A flow-based cost allocation for optimized power systems**

Dear Editors,

Thank you very much for the opportunity to submit my manuscript to Joule. Hereby I submit the paper “Tracing prices: A flow-based cost allocation for optimized power systems”.

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

In the research community it is well-known that an optimization of a power system leads to a maximized social welfare of all participants. In such a system every part of the network (network asset) recovers its cost from the revenue and all consumers receive the lowest possible electricity price. It is less well-known that all costs of a network asset can be expressed using shadow prices which are a direct result of the optimization problem (Section 2.1). For a clear picture, I reformulate this relation with mathematical details for typical network assets (generators, transmission lines and storage units). Broadly speaking, the shadow prices indicate the price of a single network asset at a single point of time.

In a second step, I process this price and map it to consumers in the network (Section 2.2 + 2.3). Therefore, a prominent method, named “flow tracing” is used. It quantifies, under a defined set of assumptions, from which generators the consumers retrieve their electricity. By doing so, a measure for the benefit of single consumers/regions from specific investments is derived, which is in the literature known as cost allocation. Despite the straightforward conceptualization, the presented cost allocation 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, I 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.

**Fabian Hofmann**

PhD Student, Research Assistant  
*Department of Theoretical Physics*

F +49 69 798 47605

[hofmann@fias.uni-frankfurt.de](mailto:hofmann@fias.uni-frankfurt.de)

**FIAS – Frankfurt Institute for Advanced Studies**  
Ruth-Moufang-Straße 1, 60438 Frankfurt,  
Germany  
[www.fias.institute](http://www.fias.institute)

Page 2/2

For an audience of policy/economic analysts, I 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.

I am happy to be **available as a reviewer for Joule** in the future.

We look forward to your response.

Best regards

Fabian Hofmann