TradeRES
New Markets Design & Models for 100% Renewable Power Systems

TradeRES Research Bulletin

Aligning heat pump operation with market signals: A win-win scenario for the electricity market and its actors?

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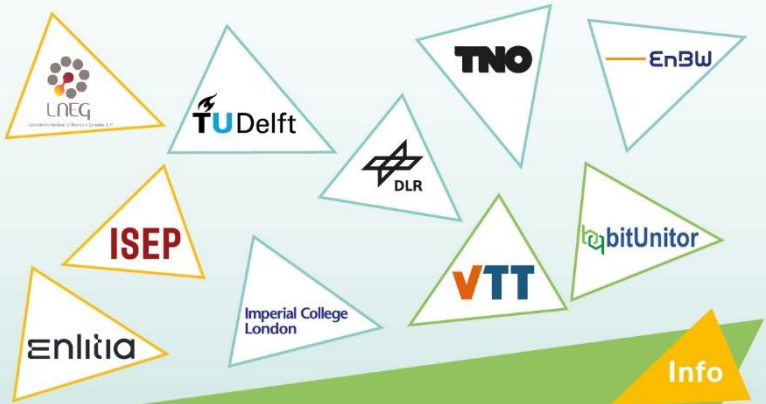
Summary

Residential heat pumps have significant potential for demand response, with real-time pricing (RTP) schemes emerging in many countries to unlock this potential. The effectiveness of incentivizing flexible heat pump usage through RTP is evaluated in this study, integrating the perspectives of the energy market and its actors. An agent-based model of the German electricity market has been coupled with a bottom-up optimization model for residential heat pump dispatch. Findings reveal potential win-win scenarios when users with local photovoltaic systems or energy-efficient buildings operate heat pumps under RTP and have moderate comfort tolerance for flexible heating setpoints. In these cases, savings of 10–30% in annual costs can be achieved by users, while market actors benefit from a modest reduction in maximum residual load and increased wind power market value. However, unintended consequences may arise in other scenarios. When users with high comfort tolerance respond strongly to price signals, overshoots in demand may occur, triggering an "avalanche effect" and new residual load peaks compared to inflexible heat pump operation. Additionally, users in certain building types may not benefit from RTP-driven flexible heat pump usage, as aggregator fees and other expenses associated with enabling flexible heat pump usage reduce the cost savings. Given these potential drawbacks, careful assessment is emphasized before the large-scale implementation of RTP for flexible heat pumps.

Highlights

- Residential heat pumps with real-time pricing can create win-win situations for both users and the market, depending on thermal comfort levels and building efficiency.
- Users with photovoltaics or energy-efficient homes can save 10-30% annually, while reducing residual load and boosting wind power market value.
- Strong price-driven responses from highly tolerant users may cause "avalanche effects," creating new load peaks and reducing savings for some households.



Info

The TradeRES project will develop and test innovative electricity market designs that can meet society's needs of a (near) 100% renewable power system. The market design will be tested in a sophisticated simulation environment in which real-world characteristics such as actors' limited foresight into the future and risk aversion are included.

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