A bilevel model to improve residential electricity tariffs

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1 Abstracts

In this work we apply bilevel programming to model pricing incentives in order to optimise residential electricity consumption. In bilevel problems there are two agents, called a leader and a follower, interacting at two levels of a hierarchical structure. In our case the leader is an electricity provider producing energy to satisfy the demand of the residential consumers (the follower). The current hourly electricity consumption is unbalanced resulting in the peaks and, therefore, in involving the costly energy generation technologies. To this end, the leader has to regulate the hourly consumption by pricing strategies. It would like to force the consumers to react on a new tariff resulting in the rational usage of energy.

The leader problem is to define the new tariff maximizing the profit of the company which is the difference between the consumers electricity payments and the energy production costs. The consumers problem is to choose between the existing and the new tariffs to satisfy their demands with minimal payments and inconveniences caused by changing the time periods of electricity usage.

To solve the proposed model we apply a solution approach developed for the linear mathematical programs [2000, 2002]. It is based on a mixed integer single level reformulation applying duality theory and complementary slackness conditions. We demonstrate the sensitivity of the model to parameter changes on small-size instances, and we test the behavior of the model on the realistic data.

References

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