

electricity_market_competitive

We present the extension to the monopolistic model as proposed in [1] by introducing a second supplier who is a competitor to the original. Appliances can now be supplied by either the original supplier, its competitor, or both. We model from the perspective of the original supplier, i.e. the competitor's prices \bar{p}^h , $h \in H$ are fixed and the upper-level variable remains as the prices of the original supplier p^h , $h \in H$. We introduce a second set of lower-level variables, $\bar{x}_{n,a}^h$ as the power purchased from the competitor. The bilevel program of the competitive electricity market is then given as

$$\begin{aligned}
& \underset{p, \Gamma}{\text{maximise}} && \sum_{n \in N} \sum_{a \in A_n} \sum_{h \in H} p^h x_{n,a}^h - \kappa \Gamma \\
& \text{subject to} && \Gamma \geq \sum_{n \in N, a \in A_n} x_{n,a}^h \quad \forall h \in H \\
& && 0 \leq p^h \leq p_{\max}^h \quad \forall h \in H \\
& && x \in \arg \min_y \begin{cases} \sum_{n \in N} \sum_{a \in A_n} \sum_{h \in H} (p^h + C_{n,a}(h)) x_{n,a}^h + \\ \sum_{n \in N} \sum_{a \in A_n} \sum_{h \in H} (\bar{p}^h + C_{n,a}(h)) \bar{x}_{n,a}^h \\ \text{s.t. } x_{n,a}^h + \bar{x}_{n,a}^h \leq \beta_{n,a}^{\max}, \quad \forall n \in N, a \in A_n, h \in H \\ \sum_{h \in H} x_{n,a}^h + \bar{x}_{n,a}^h \geq E_{n,a}, \quad \forall n \in N, a \in A_n \end{cases}
\end{aligned}$$

References

- [1] Sezin Afşar, Luce Brotcorne, Patrice Marcotte, and Gilles Savard. Achieving an optimal trade-off between revenue and energy peak within a smart grid environment. *Renewable Energy*, 91:293–301, 2016.