Estimation of Potentially Flexible Demand



Konstantinos Kouzelis, Iker Diaz de Cerio Mendaza, Birgitte Bak-Jensen, Jayakrishnan R. Pillai, Aalborg University, Denmark

Scope and Motivation

Due to communication, data storage issues, bad measurements, malicious attacks etc., flexible consumption data should frequently be estimated rather than recorded.

Available data:

Aggregated consumption of residences <u>Data to be estimated:</u> HP consumption of a house

Methodology

- Compare consumers having a HP with similar consumers who dont have a HP.
- Similarity is defined by clustering the available data.



In February it is clear the that HP **1**S dominating the power consumption of the flexible all user at Hardly times. any demand can be shifted time horizon the on concluding that hardly flexibility is any available on this day.

Fig. 2. February 6th, 2012. (a) 3D PDF. (b) Top-down view of 3D PDF. (c) Non-flexible APs compared to HP user. (d) Potentially flexible demand.



Fig. 3 depicts a day in May. The household's thermal demand is not that high but is still adequate to make the HP operate several times within the day. In such scenario, a flexibility could be offered valley by filling.



Fig. 1. Clustering. (a) DBI test. (b) Clustering with industrial consumers. (c) Power-clustering of residential consumers. (d) Pattern-clustering of residential consumers.

- Erase the influence of the flexible consumption from the HP user.
- Classify the HP user into one of the formulated clusters.
- Compare the original load curve of the HP user with the load curves of non-HP users based on APs.
- The chosen AP characterises the risk to be undertaken by the utility when estimating flexible consumption.
 Application and Results

Fig. 3. May 9th, 2012. (a) 3D PDF. (b) Top-down view of 3D PDF. (c) Non-flexible APs compared to HP user. (d) Potentially flexible demand.



In Fig. 4, a hot summer day (**July**) is presented. Owing to the limited thermal need, the HP barely operates. The lack of potentially flexible consumption is obvious, even for low AP.

Fig. 4. July 25th, 2012. (a) 3D PDF. (b) Top-down view of 3D PDF. (c) Non-flexible APs compared to HP user. (d) Potentially flexible demand.

- The outcome is the potentially flexible demand.
- Depending on its pattern, the HP consumption might be flexible or not.
 Performing the analysis for 3 days of different seasons:



Validation

Depending on the AP, different HP estimations are obtained. Lower APs result in more HP consumption but with higher uncertainty of actually having this consumption and vice versa.

