Integration of Long-Term Time Series Data into Energy System Optimization Models

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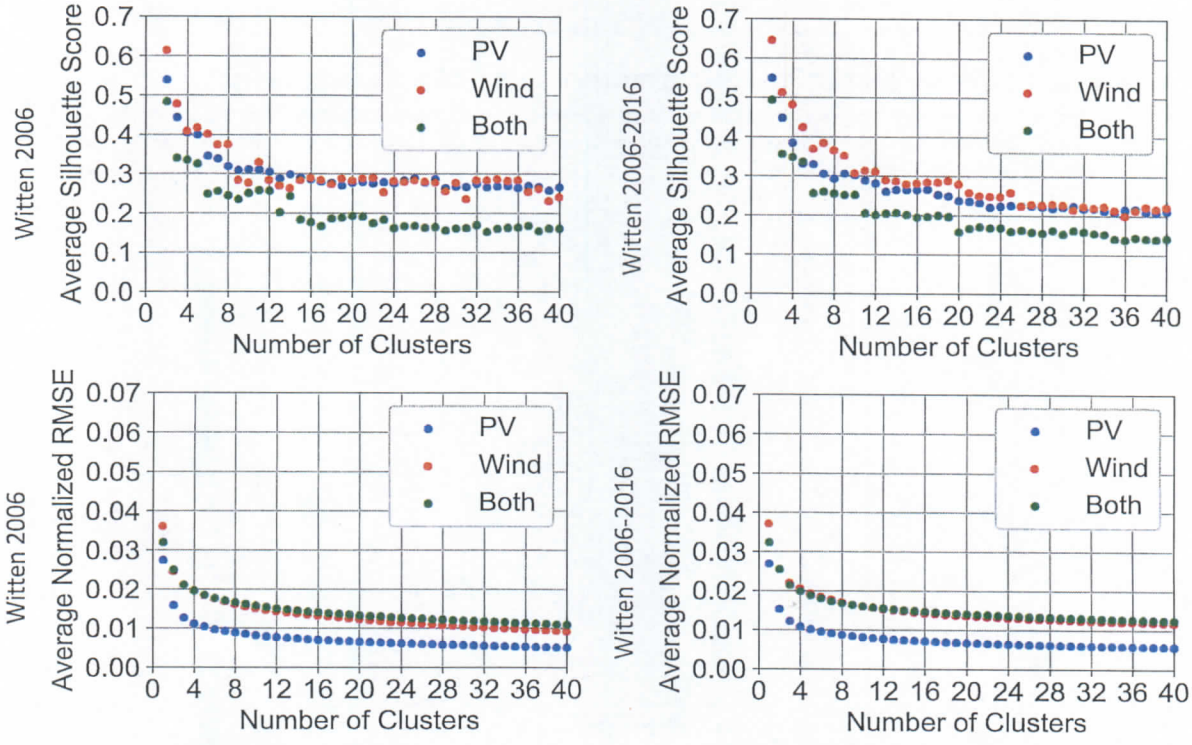

Figure 1: The Average Silhouette Score and the dimension-normed Root Mean Squared Error for photovoltaic and wind capacity factors depending on the length of clustered time series using k-means and a typical day formulation for the location of Witten, North Rhine-Westphalia

1. Objective

Facing the growing impact of global warming which is majorly caused by exhaustion of CO_2 from burning fossile fuels, energy systems with a great share of renewable energies are one answer. Due to the intermittency of these renewable ressources such as wind and photovoltaic, the impact of different wheather years play an important role for the reliability of the future energy grid. Since Energy System Optimization Models for numerous regions and long time horizons are normally not solvable within a reasonable amount of time and with normal computers, one approach for reducing the complexity consists of aggregating the input time series of energy system models. The objective of this study deals with the impact of different wheather years and time series of different lengths on the choice of typical days and the impact on the solution of the energy system optimization problem.

2. Method

First, the potential of renewable energy sources at different locations and for different time steps with respect to land eleigibility and given technology designs is determined by calculating location- and time-dependent capacity factors. In a second step, these input time series as well as those for e.g. e-demands are clustered to typical days. Then, different clustering indicators are used to estimate the exactness of the method depending on different time horizons, attributes and numbers of cluster centers as shown in Figure 1. In a last step, the impact and reliability of the indicators is compared to the impact of the clustering and wheather years on a Germany-wide dispatch model.

3. Results & Conclusions

The preliminary results show that the method performs worse for input attributed without strong daily patterns such as wind compared to those with daily pattern such as photovoltaic. Moreover, the data

cloud can be assumed to be rather homogenous with a dense center and rather sparse outer regions as the almost monotonous decrease of the Averaged Silhouette Score emphasizes. Moreover, clustering different attributes together result in higher errors due to the curse of dimensionality. In contrast to that, the number years used for clustering has a relatively small impact on the clustering procedure. The impact of these findings on the dispatch model will be closer examined as well.

(Max. word count 400)

Your topic suggestion(s) for breakout groups - beyond those on the list:

- **How safe is our future energy grid? Is there a trade-off between keeping backup-plants relying on fossile fuels and a major share of reneable energies or can we face future with more advanced storage technologies?**