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Synthesising Residential Electricity Load Profiles at the City Level

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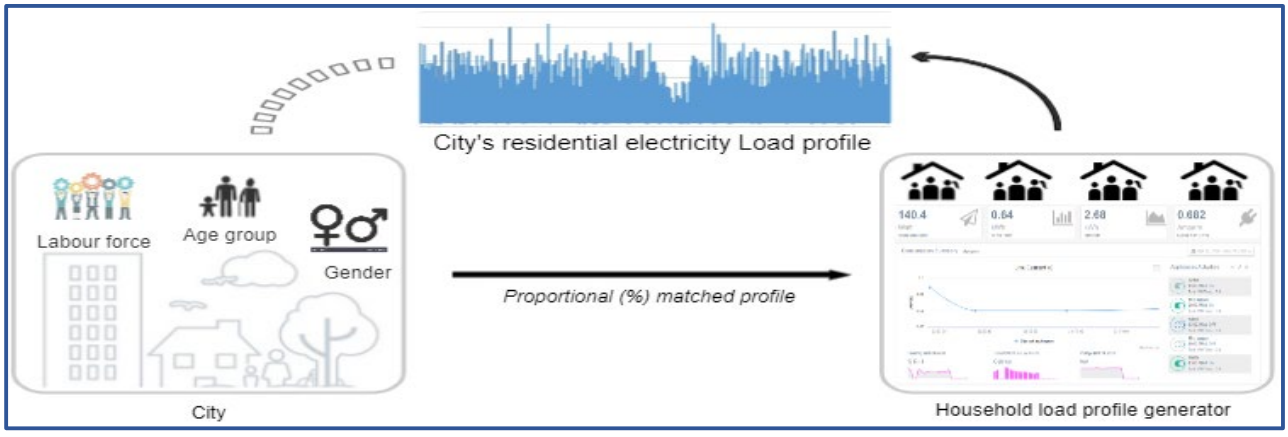
Introduction

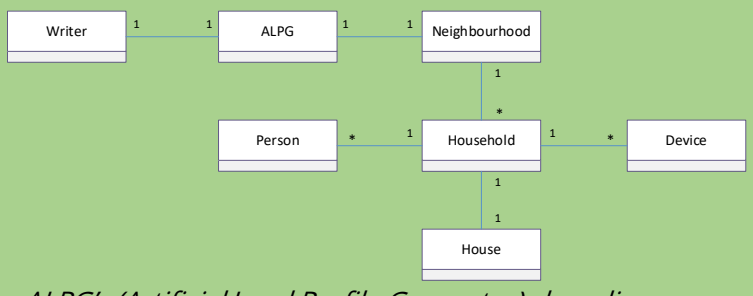
A large energy-saving potential and emission reduction potential can be achieved by understanding energy consumption patterns in more detail. However, existing studies show that it requires many input parameters or disaggregated individual end-uses input data to generate the load profiles. Therefore, we have developed an approach, called weighted proportion (Wepro) model, to synthesise the residential electricity load profile by proportionally matching the city's main characteristics with the representative households profiles provided in the load profile generator.



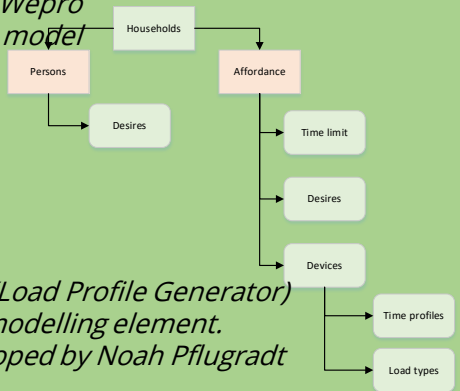
City's weighted proportion (Wepro) model

The Wepro model is emphasised on the behavioural aspect and city's statistical profile that should represent the local characteristics. Therefore, for the profile generators, LPG and ALPG (below) are selected in this study to apply the result of the proposed model and generate the city's load profiles.

The behavioural models of the household profile generators used in the Wepro model



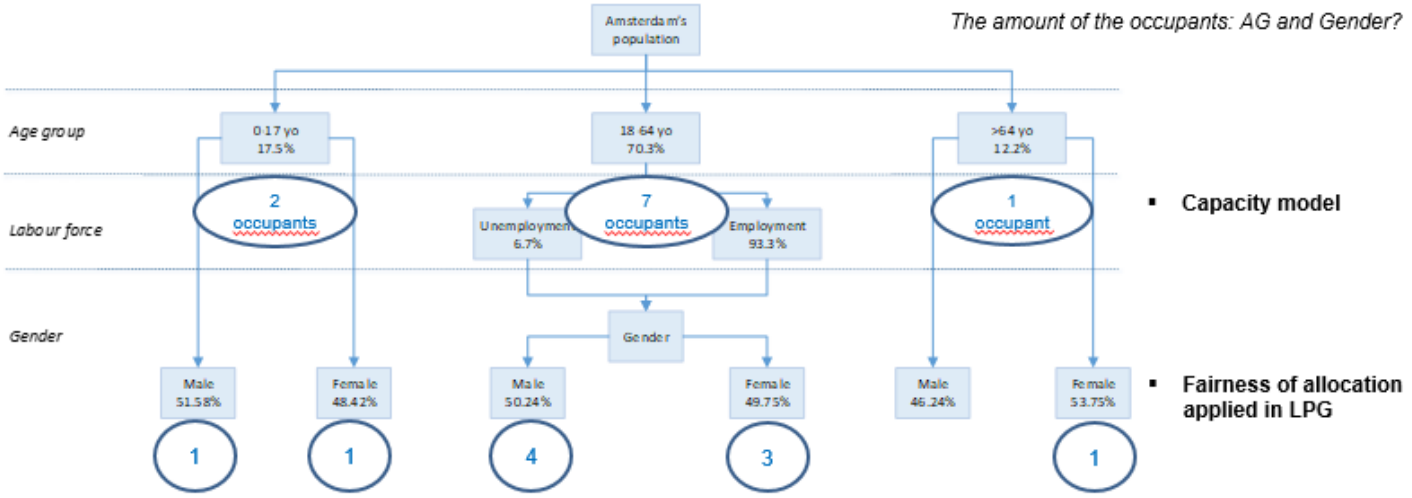
ALPG's (Artificial Load Profile Generator) class diagram. Developed by TU Twente



LPG's (Load Profile Generator) modelling element. Developed by Noah Pflugradt

Weighted proportion (Wepro) model

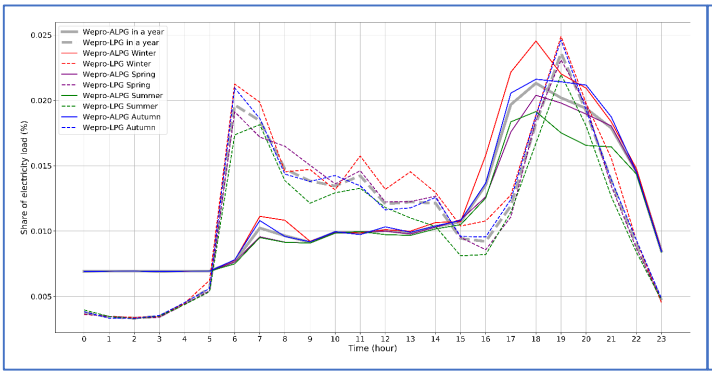
The city's main characteristics: citizens' age groups (AG), gender (GD) and labour force (LF) will be proportionately matched with the representative household profile using the capacity model and fairness of allocation model. The proposed approach is applied into the case city: Amsterdam, The Netherlands. The generated load profiles are provided in hourly resolution based on time-division analyses and evaluated by The Netherlands' standard residential load profile.



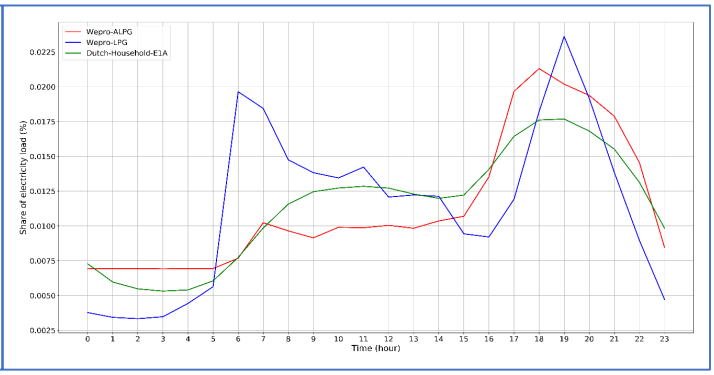
The application of the Wepro model's structure to Amsterdam, The Netherlands.

Key findings

- The results indicate that the synthetic load profiles can represent the local electricity consumption characteristics in the case city of Amsterdam based on time variation analyses.
- The approach is in particular advantageous to tackle the drawbacks of the existing studies and the standard load model used by the utilities.
- The model is found to be more efficient in the computational process of the residential sector's load profiles, given the number of households in the city that is represented in the local profile.



The hourly average load share in a year and the hourly average load share in each season based on the results of Wepro-LPG and Wepro-ALPG models.



The comparison of hourly average standard residential load profile in The Netherlands: NEDU E1A 2016, E1A and the generated Wepro-LPG and Wepro-ALPG.

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