sweet swiss energy research for the energy transition

PATHFNDR

Electromobility + buildings

Heating demand modeling for residential buildings

Work package 2

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1 OBJECTIVES

- To estimate the heat demand for single buildings as well as aggregated at different levels, such as quarters and communities based on address data and public building information.
- Assessing the increasing share of electrified heating systems and their respective electricity demand.
- Validation of the developed estimation methods based on real-world consumption data.

2 CONTRIBUTION TO PATHFDNR

In the residential sector, space heating and domestic hot water contribute to more than 80 % of the energy demand. Based on the thermal inertia of buildings, the prediction of the heating demand/profile for buildings helps to assess its flexibility and supports future sustainable energy systems. Accurate estimation of the respective electricity demand profiles for residential, and commercial sectors is essential to model and identify the peak usage periods and patterns, and underpins the development of strategies for load management and peak shaving.

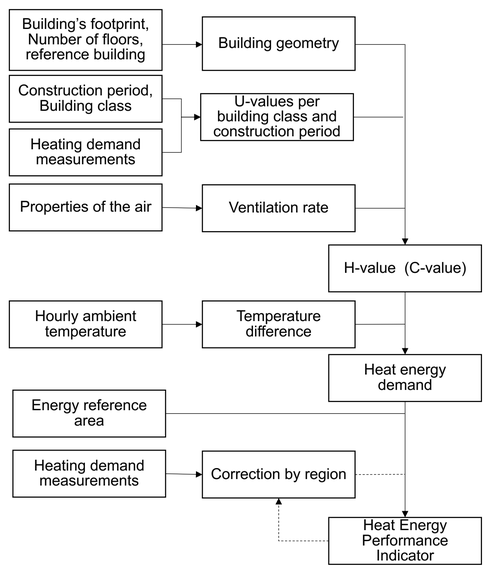
2 METHODOLOGY

The two different models H4C and GWR3 are

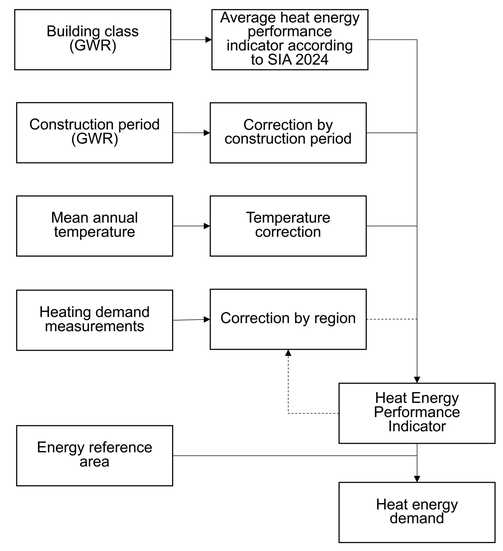
- based on building characteristics from the RBD[1], weather data from the Meteostat and its Python library, and reference values from literature[2].
- calibrated and validation based on real-world consumption data.

The detailed workflows are displayed in the flow diagrams.

H4C model: based on a simplified power-balance equation



GWR3 model: based on heat energy performance indicator per



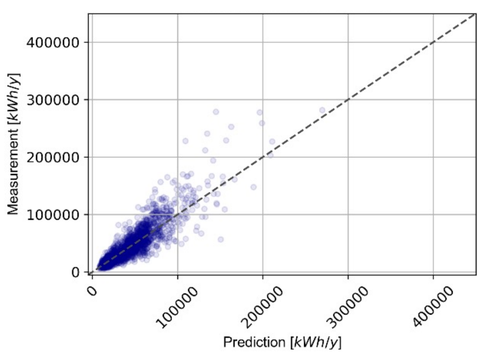
3 RESULTS

Validation of the calibrated model using measured data of a Swiss city and canton

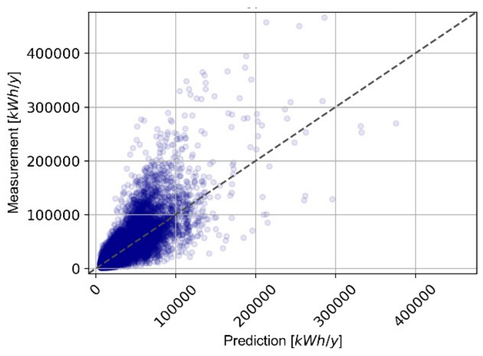
- Calibration leads to higher model accuracy.
- Both models are robust against outliers.
- H4C model appears to estimate individual building heat energy demands with greater accuracy than the GWR3 model.
- The GWR3 model, on the other hand, is more suitable for estimating the total heat demand of a larger region compared to the H4C.
- Both models demonstrate higher accuracy when applied to city-level modelling compared to a canton-level modelling, likely due to the greater diversity within cantons, which encompass urban and rural areas.

Model	Data	sMAPE [%]	MAPE [%]	R2	Deviation	
					Total [GWh]	Relative [%]
GWR3	Swiss city	12.63	27.53	0.73	-2.19	-2.515
H4C	Swiss city	12.07	26.55	0.78	3.138	3.604
GWR3	Swiss canton	17.27	42.09	0.45	5.48	0.567
H4C	Swiss canton	15.85	38.1	0.61	64.4	6.663

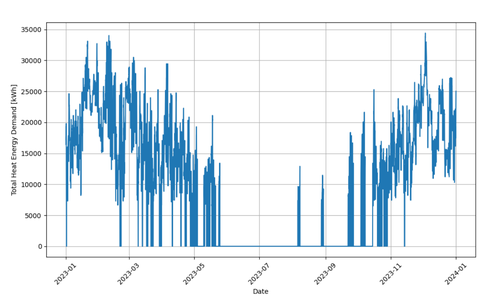
H4C calibrated and validated with measured data from a Swiss city



H4C calibrated and validated with measured data from a Swiss canton



Hourly heat demand profile for 2023 for a Swiss city



REFERENCES

1 Federal Register of Buildings and Dwellings (RBD), Federal Statistical Office, https://public.madd.bfs.admin.ch

2 A. Pongelli, Y. D. Priore, J. P. Bacher, and T. Jusselme, "Definition of Building Archetypes Based on the Swiss Energy Performance Certificates Database", 2023; and D. Klauser, "Solarpotentialanalyse für Sonnendach.ch", 2016

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