Integration of a 5RC thermal building model from ISO 13790 with an interface to the tabula building data bank

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Motivation

- The savings potential of operationally optimized buildings is unknown to occupants
- Generating building models with a minimum input data, but at the same time a reasonable degree of accuracy
- Simplify the creation of building models

Objectives

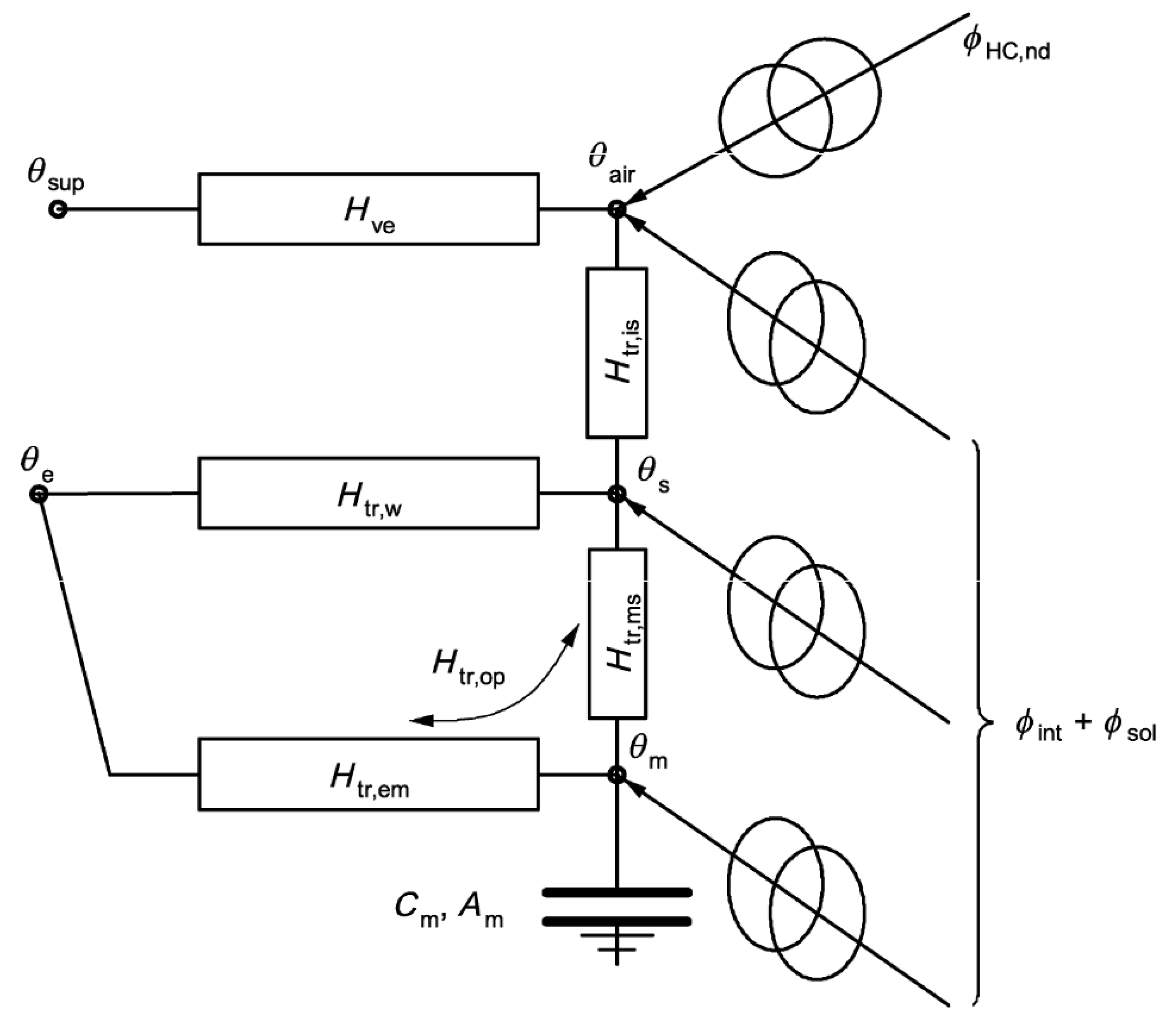
- Use of the building mass as a thermal storage
- Operational optimization of the building's indoor temperature to save costs and CO2
- Formation of an easy to use interface between 5RC building model and tabula database

Datasets & Methodology

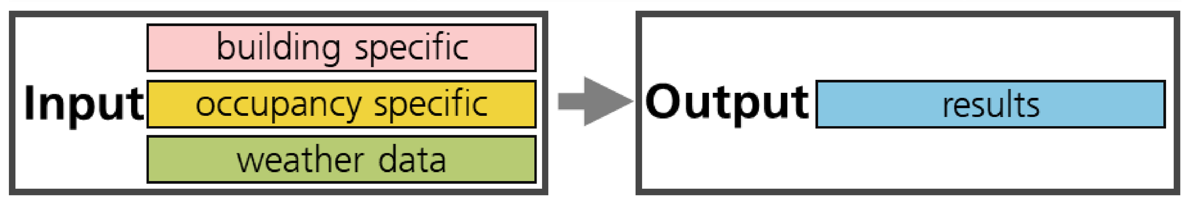
Theoretic background 5RC building model

ISO13790
Energy performance of buildings – Calculation of energy use for space heating and cooling

- Hourly resulted thermal resistor-capacitor networks
- Capacitance represents the thermal storage capacity, while resistances represent thermal losses
- Simplification of a dynamic simulation to a linear-optimizable model
- A uniquely defined, bounded set of equations that allows traceability of the calculation process



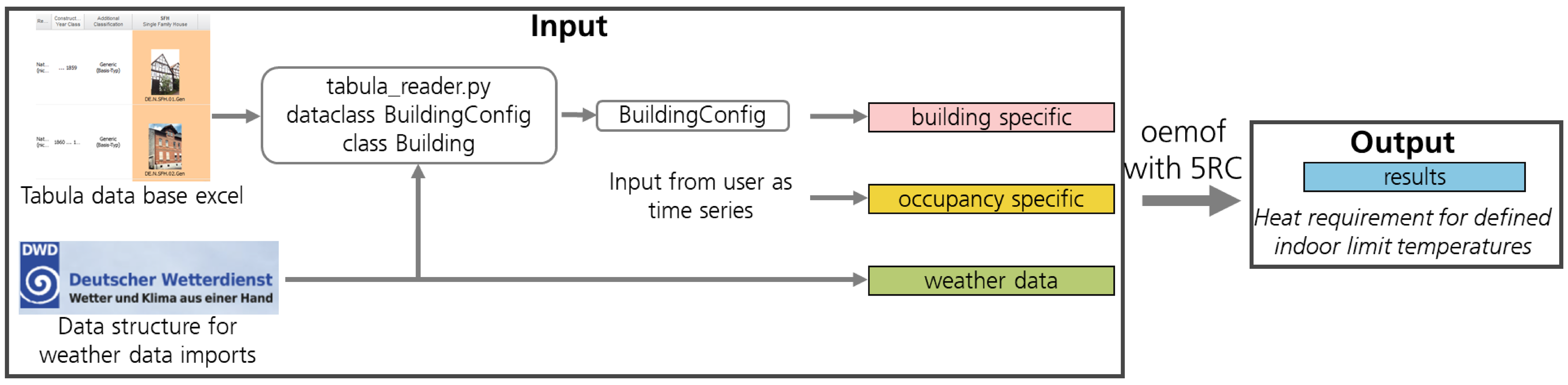
temperature θ	resistor H	heat gains Φ	capacity C
θ_{air} room air temperature	H_{ve} ventilation	Φ_{int} intern	C_m thermal storage capacity of building envelope
θ_{sup} supply air temperature	$H_{tr,w}$ transmission windows	Φ_{sol} solar	
θ_s auxiliary temperature	$H_{tr,em}$ transmission emission	$\Phi_{HC,nd}$ heating and cooling	
θ_m average radiation temperature	$H_{tr,is}$&$H_{tr,ms}$ thermal coupling value		
θ_e outdoor temperature	$H_{tr,op}$ opaque parts		



Interface to the tabula data base

Tabula Data Base

- Building typologies with a set of exemplary buildings representing residential building stock
- Classifies building for 21 countries according to construction year, 4 types of buildings (SFH, MFH, TH, AB) and 3 retrofit status



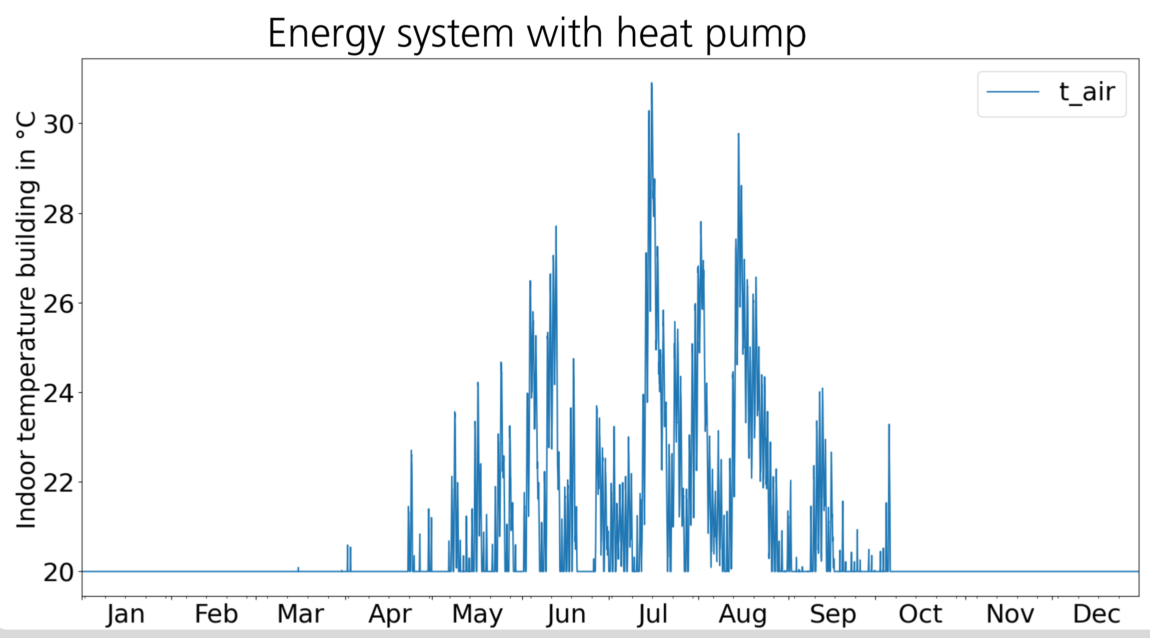
Results

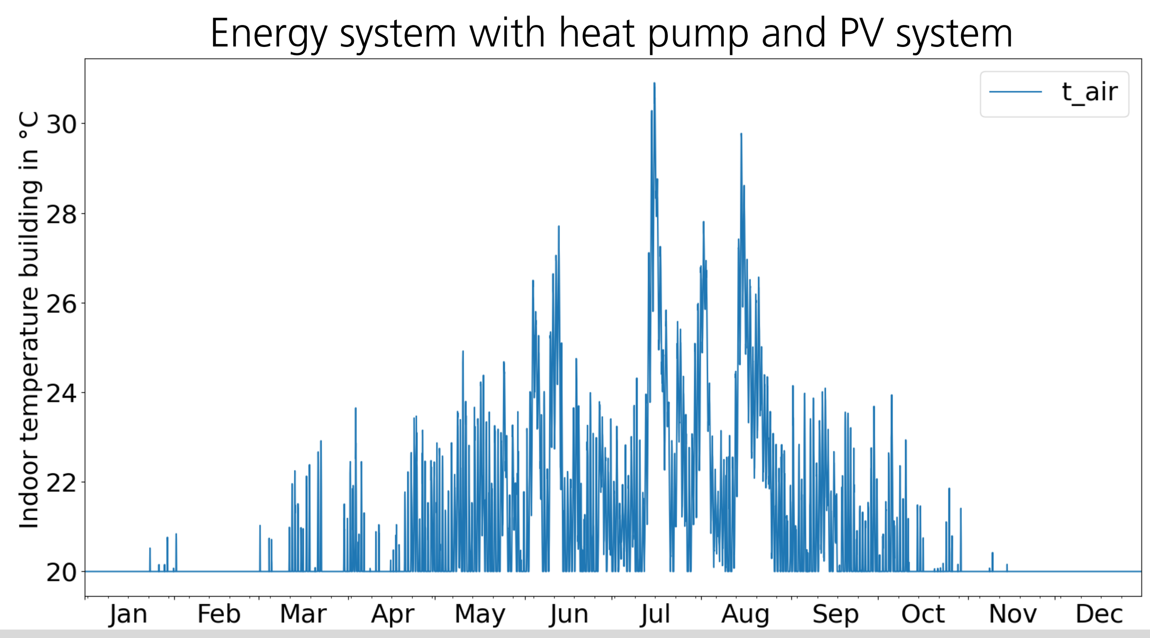
Research object

- German single family house constructed in the year 1986 with the retrofit status standard
- One building energy system with heat pump and one with heat pump and own PV system
- Minimum indoor limit temperature is 20 C°

Results for the operational optimization for both building energy systems

Key result Increasing the self-consumption of the PV system by using the building as heat storage by controlling the inner temperature of the building can reduce the total cost or CO2 emissions





Summary & Outlook

- The 5RC model in oemof can shift heat loads to save cost or CO2
- In the next step, the validation of the 5RC model is performed with other models and real buildings and, if necessary, the 5RC model is calibrated

References

(1) ISO 13790:2008. Energy performance of buildings – Calculation of energy use for space heating and cooling. Geneva, Switzerland: International Organization for Standardization.
(2) IEE Projects TABULA + EPISCOPE (www.episcope.eu)

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