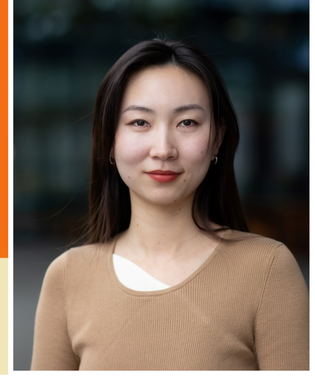
REACHING POSITIVE ENERGY NEIGHBORHOODS BY OPTIMIZING OCCUPANT BEHAVIORS

A DECISION-SUPPORT TOOL APPROACH

Keywords: PEDs/PENs, occupant behaviors, multi-agent system, multi-objective optimization, energy consumption.



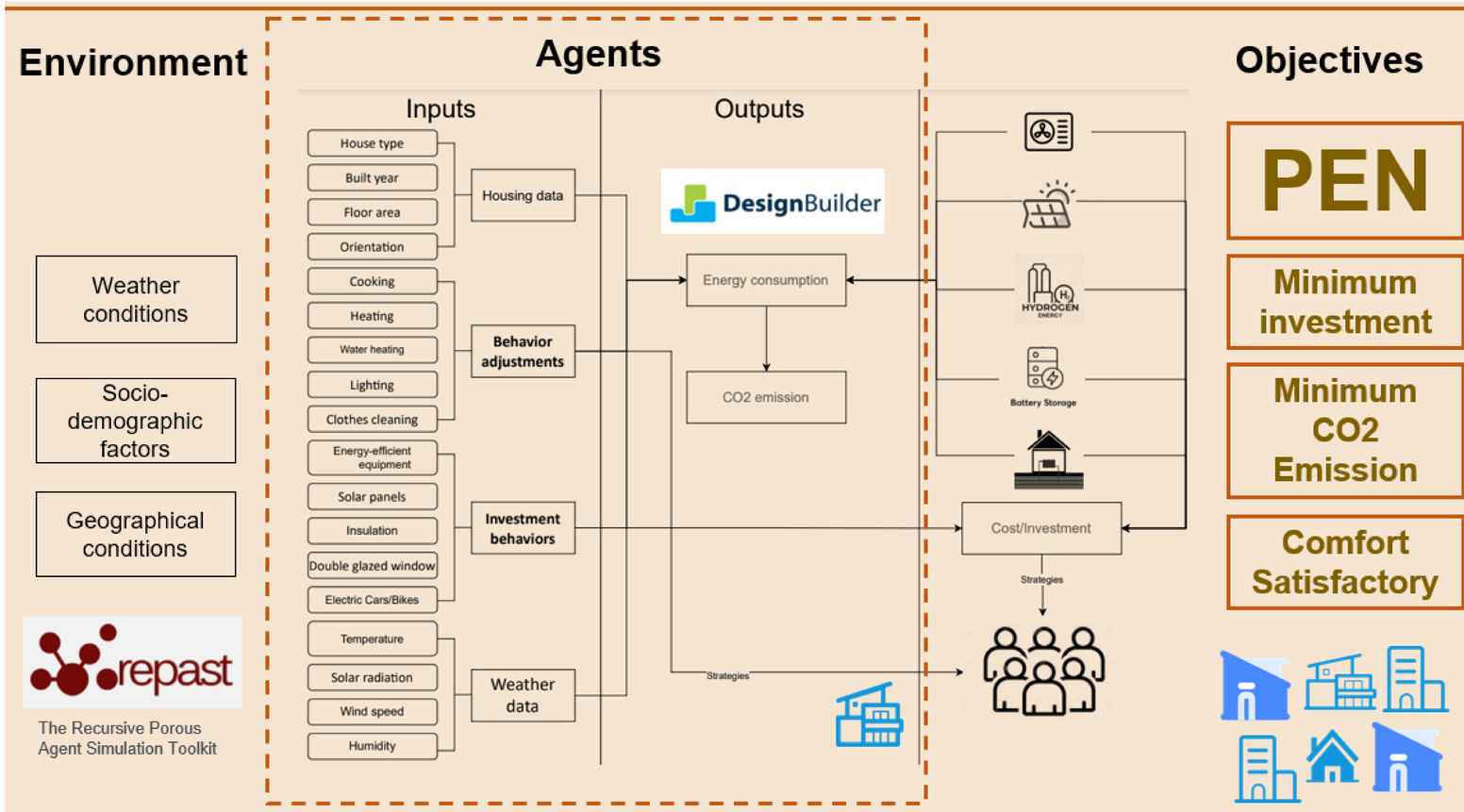
Bei Wang

Information Systems Built Environment, Urban Resilience Lab, TU/e

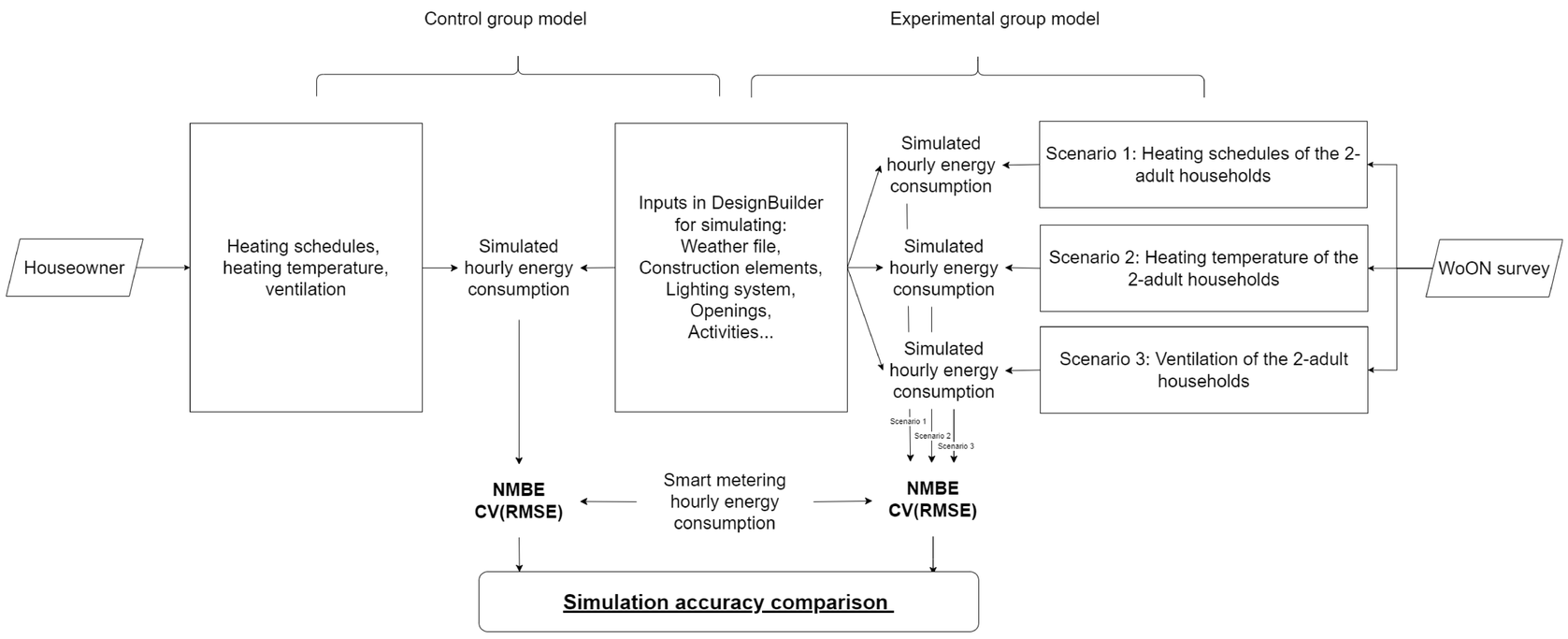
PROJECT SCOPE

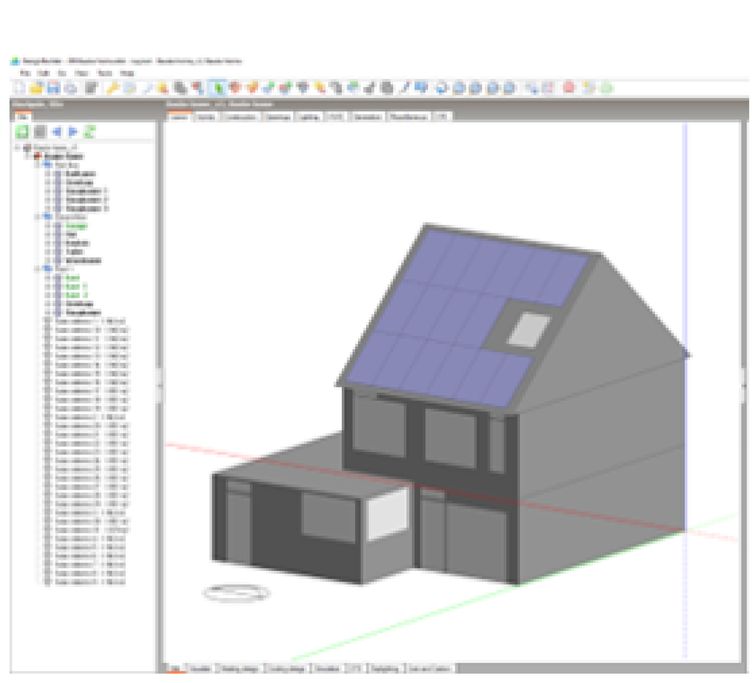
The project focuses on analyzing occupant behaviors at the household and neighborhood levels to achieve Positive Energy Neighborhoods (PENs). The successful implementation and replication of PENs in existing regions would significantly contribute to the sustainability of cities.

- Behaviors include behavior adjustments and investment behaviors.
- Utilize DesignBuilder, EnergyPlus, and Repast with Python (dealing with a multi-agent system) to simulate energy consumption at the household and neighborhood levels, respectively.
- Implement optimization strategies at both levels to ensure occupant comfort while reducing the energy gap towards PENs.
- Involves investing in neighborhood projects to offset the energy gap, allocated based on households' financial status for energy justice.
- Incorporate multi-objective optimization, aiming to minimize investment and CO2 emissions.



CONFERENCE PAPER: ASSESSING THE ADDED VALUE OF OCCUPANT BEHAIVOR DATA RELATED HEATING AND VENTILATION IN ENHANCING ENERGY SIMULATION ACCURACY: USING A REAL BUILDING CASE IN THE NETHERLANDS





INTRODUCTION

This paper investigated the impact of three specific occupant behaviors—namely **heating schedules, heating temperature, and ventilation**—on simulation accuracy in an existing residential house in the Netherlands, a case study using data offered from the house owner and WoON database.

CONCLUSION

- In this case study, the adjustment of heating schedules affected the simulation accuracy by 5.45%, and they were 0.46% and 0.17% when adjusted heating temperature and ventilation. It revealed that adjustments to heating schedules have a more pronounced effect on simulation accuracy than the other two factors examined. Therefore, among these three factors, the simulation needs to grasp more of the heating schedules/hours when explore occupant behaviors and their impact on the accuracy of energy simulations.
- These findings contribute to a nuanced understanding of the relationship between occupant behaviors and simulation accuracy, offering insights into data collection practices conducive to achieving acceptable levels of accuracy in building performance simulations.

Table 7: Results about simulated hourly energy consumption in February in the control group and three scenarios in the experimental group compared to smart metering data and changes of NMBE, CV(RMSE)

Variables	February's energy consumption	February NMBE/CV(RMSE)	Changes of NMBE/CV(RMSE)
Actual situation (smart metering data)	634.12kWh	-	-
Control group	677.35kWh	6.38% 4.27%	-
Scenario 1 (heating schedules/hours)	719.24kWh	11.83% 4.82%	+5.45% +0.55%
Scenario 2 (heating temperatures)	674.01kWh	5.92% 4.38%	-0.46% +0.11%
Scenario 3 (ventilation)	676.09kWh	6.21% 4.28%	-0.17% +0.01%

NEXT STEPS

- Explore the accuracy of co-simulation integrating OB models with Building Performance Simulation programs.
- Apply co-simulation to energy efficiency on houses and neighborhoods.