

# Evaluating Urban Heat Risk through Coupled Detection and Indoor Overheating Analysis

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## Research Motivation and Objectives

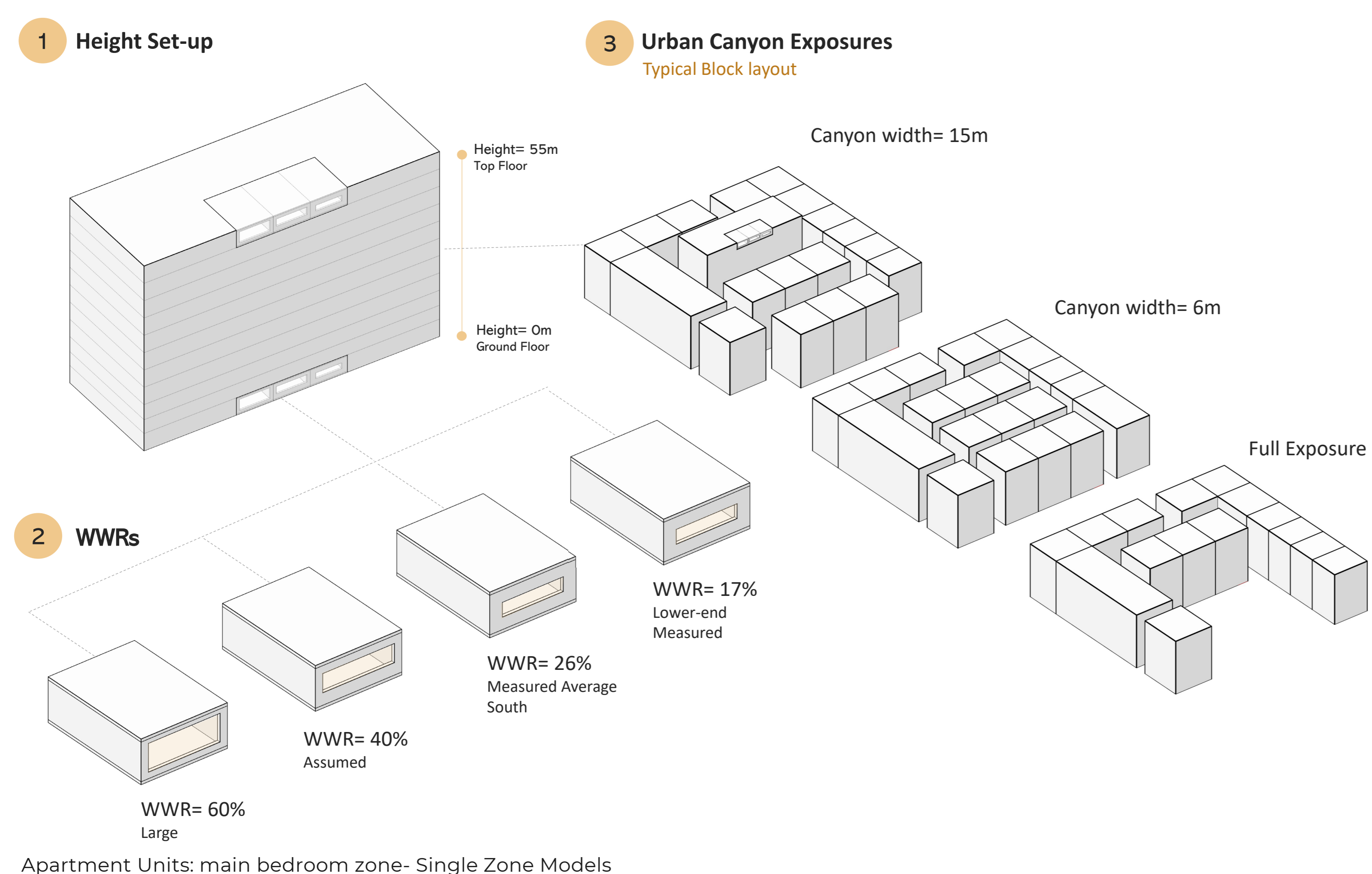
With the growing occurrence of elevated temperatures and prolonged heat waves, cities need to understand the resulting health risks for their most vulnerable constituents. Understanding heat risk in urban environments is imperative to facilitate intervention and better aid cities in strategically targeting areas and buildings most vulnerable to heat. **So, how can we leverage data on city structures and urban features to locate buildings with the highest potential for annual overheating?**

Firstly, this study utilizes an urban feature extraction algorithm that uses computer vision models to detect window to wall ratios (WWRs) from building facades in 3 parishes in Lisbon [1]. Secondly, a parametric thermal simulation model is developed and applied to understand what type of urban feature combinations, e. g. top floor + south orientation, lead to the highest number of overheating hours. Finally, the results are used to map overheating potential on an example neighborhood. The outcome is a color-coded map of apartments with their predicted annual overheating hours assuming 2080 climate for Lisbon.

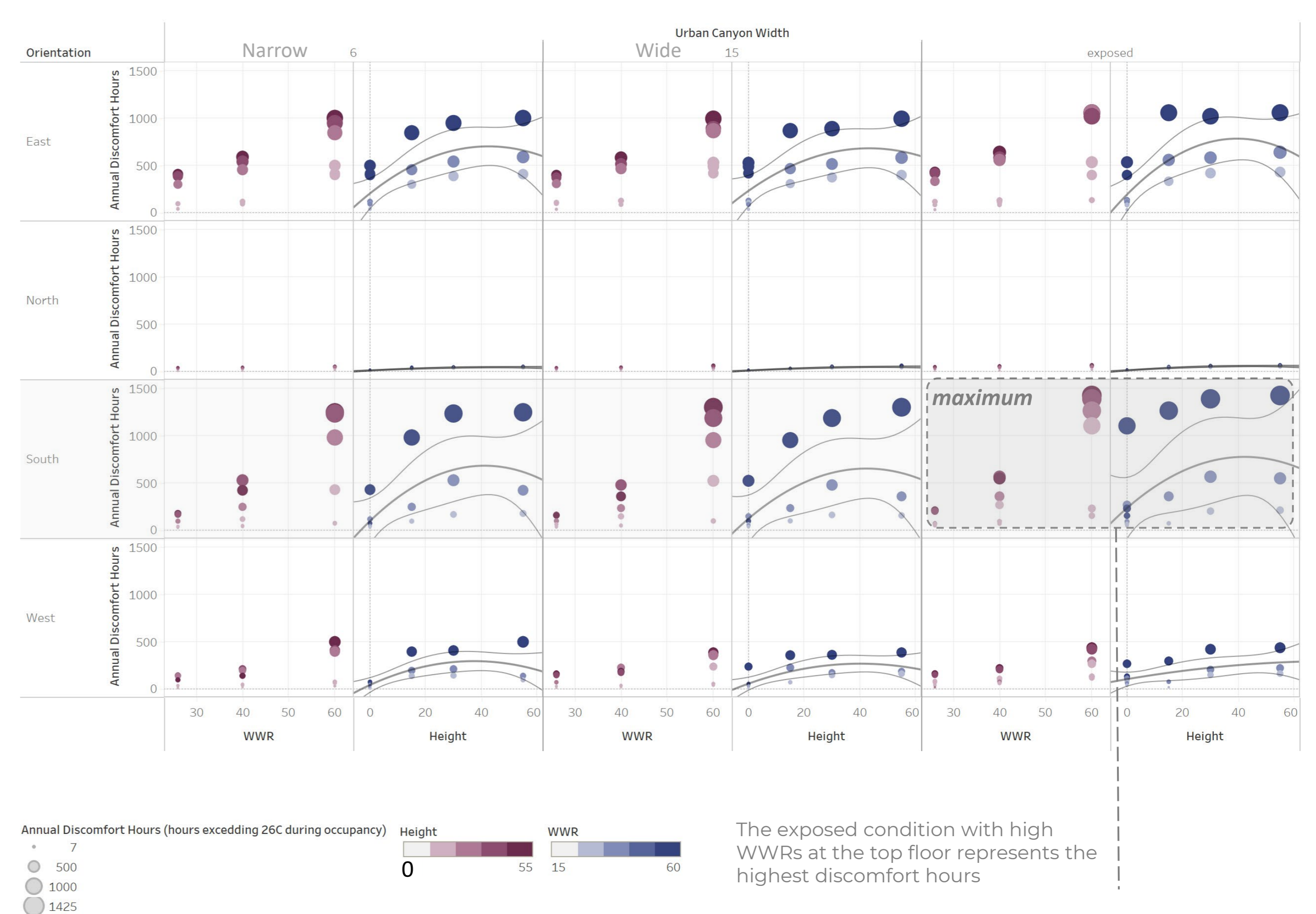
## Methodology and Parametric Study

The parametric model was divided into 2 streams. The first set-up looked at varying building density, built-up area and urban canyon exposures found in the 3 Lisbon parishes. The second set of explorations looked at varying building height, orientation, exposure and WWRs as extracted from the detection step. For each set, a combined thermal and airflow model was simulated to evaluate annual indoor overheating hours exceeding 26C as prescribed by CIBSE[2].

Summary of building parametric study set-up

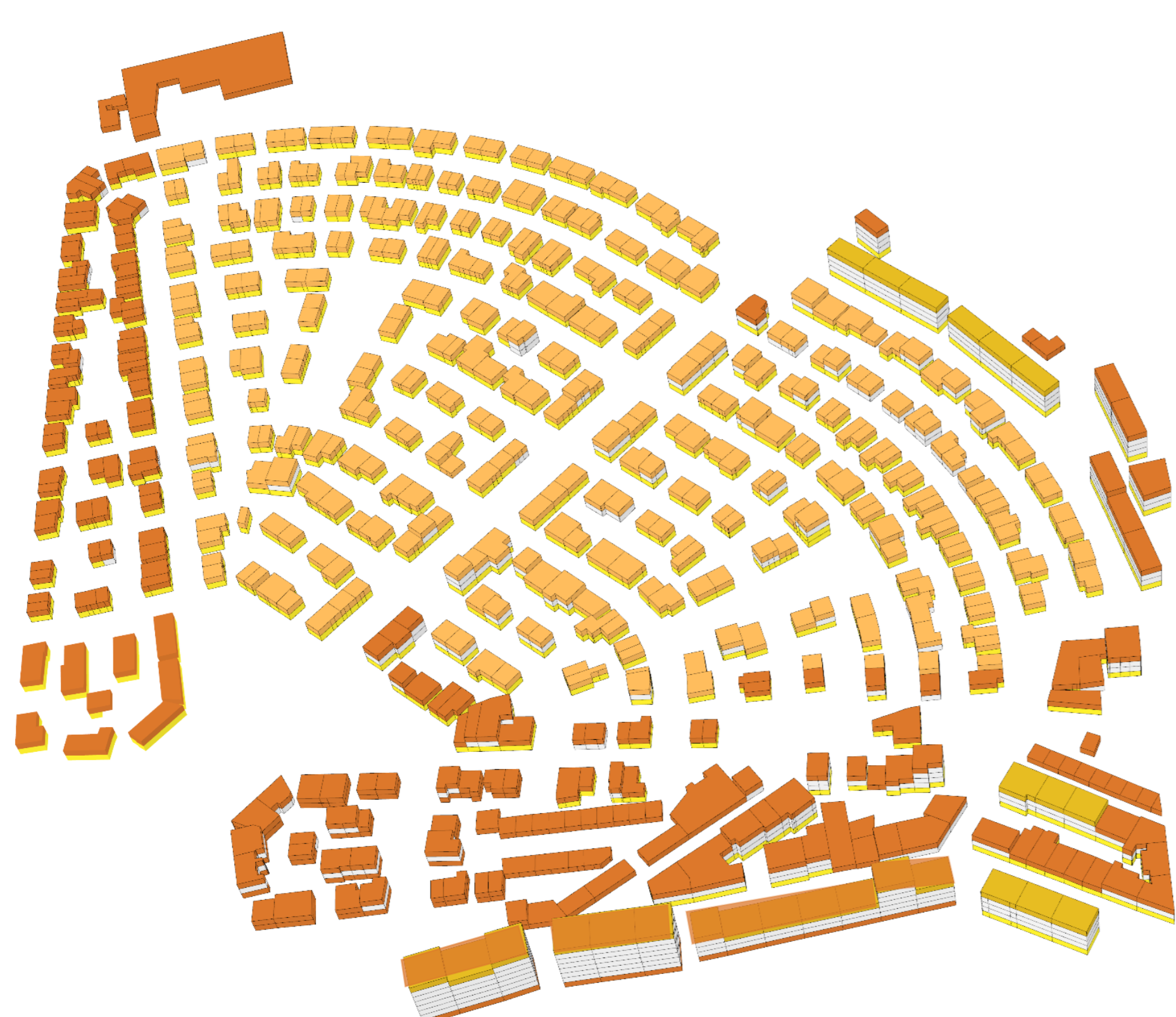


Results: Annual Overheating hours in different parametric set-ups

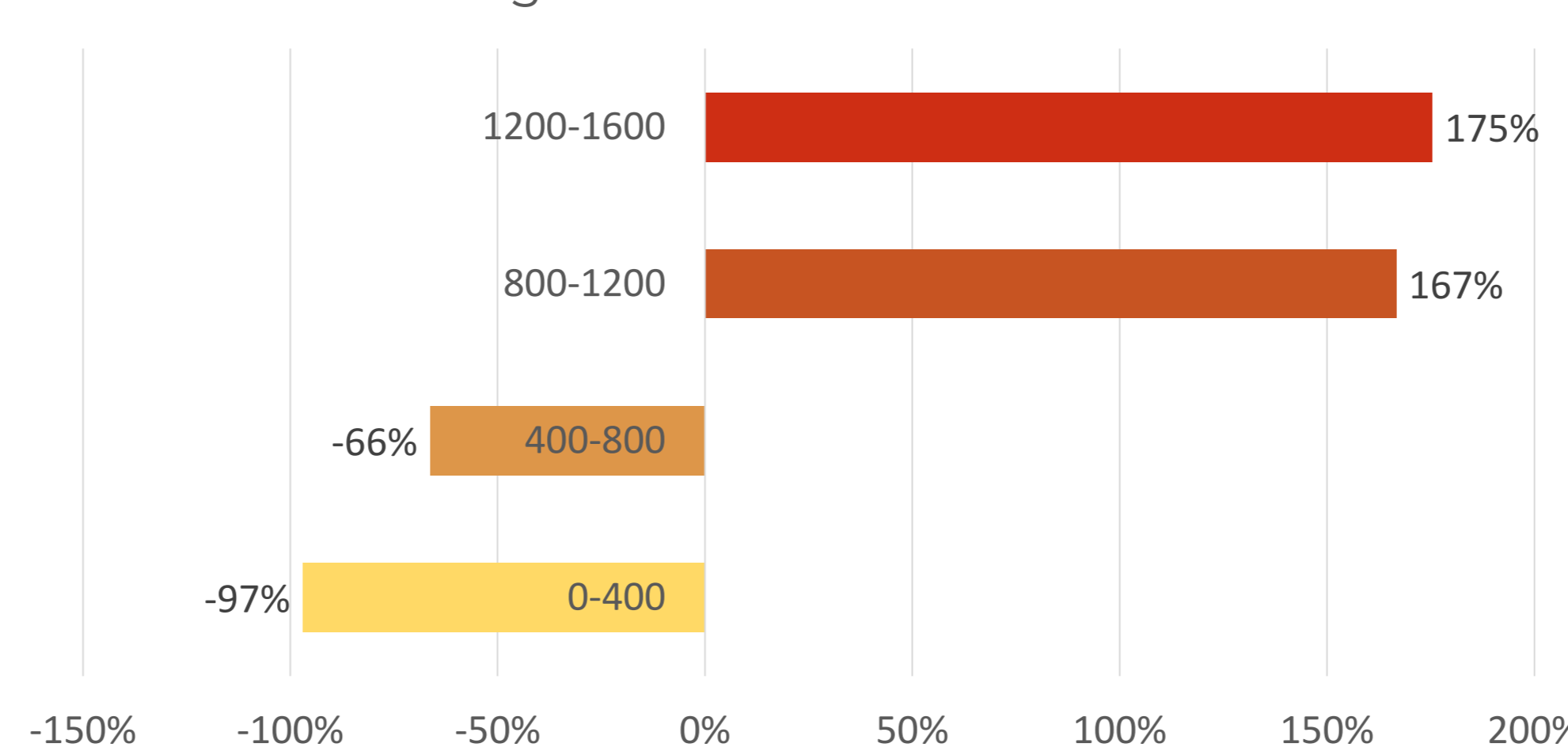


## Preliminary Results: Urban Heat Maps

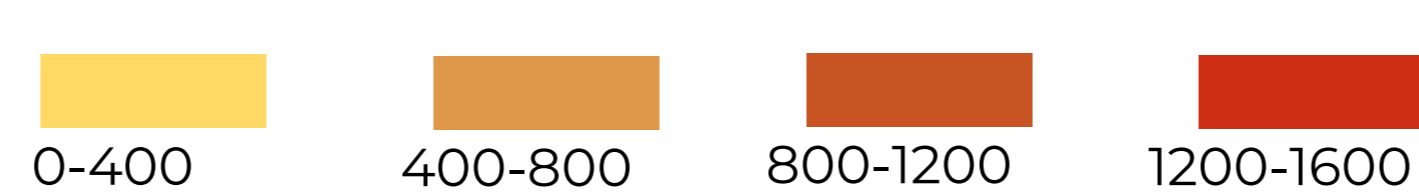
Current Condition



% change in hours from Current to 2080

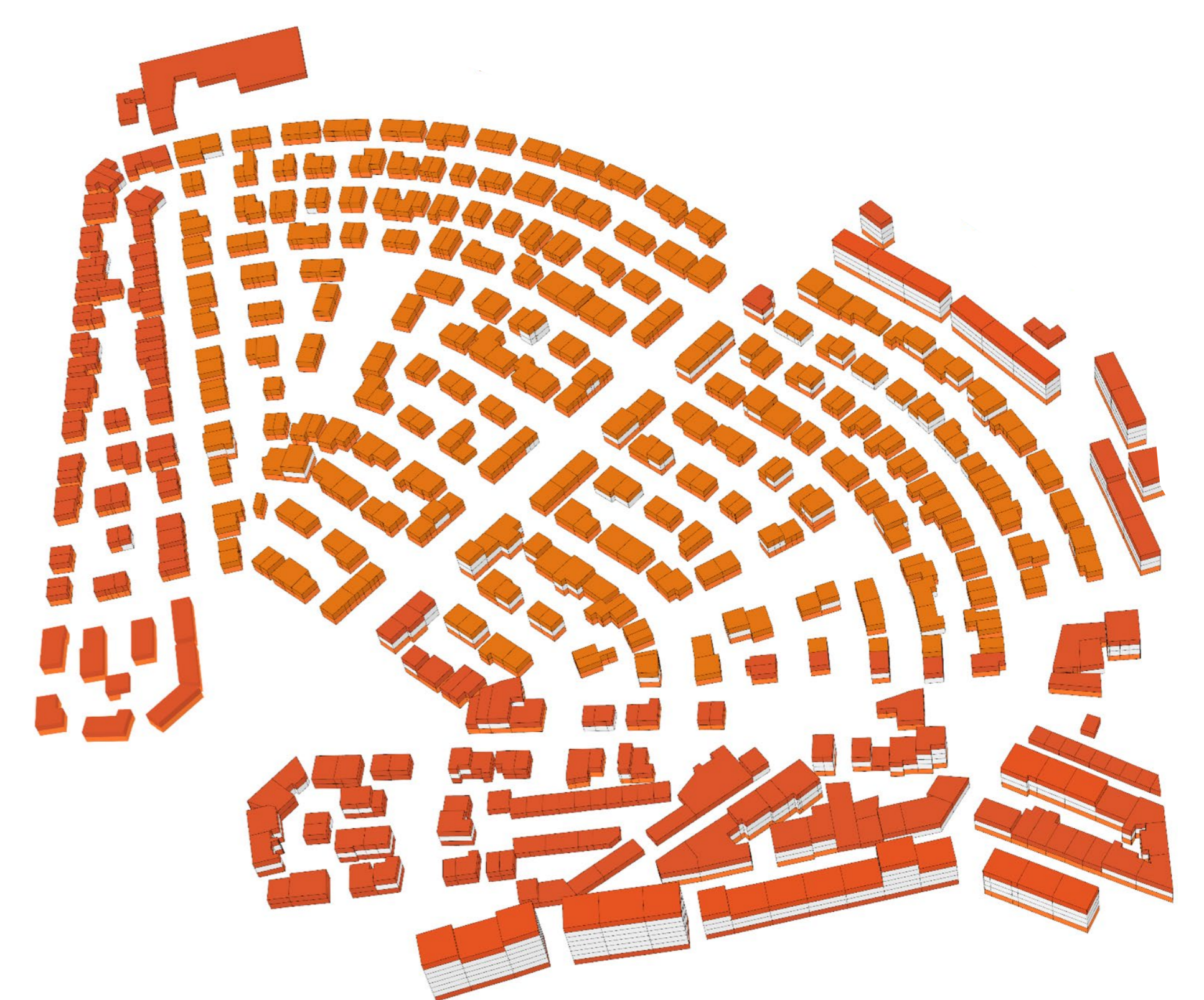


Highest overheating potential shifts



Annual overheating hours (temperature exceedances above 26C during occupied hours)

Future Condition: 2080



### References:

- [1] N Tarkhan, S Letellier-Duchesne and C Reinhart. 2022. "Capturing Façade diversity in Urban settings using an Automated Window to Wall Ratio Detection Workflow" In Proceedings of the Symposium on Simulation for Architecture and Urban Design (SimAUD). San Diego, USA July 2022.
- [2] Standard Reference: CIBSE(Chartered Institution of Building Services Engineers) TM49, 50- 2020