We thank reviewer#1 for their comments on our paper.

- Our responses are given in RED.
- Green indicate changes to be made to the text.
- Line numbers are as per the original paper

Anonymous referee #1

The paper deals with a significant topic of anthropogenic heat from buildings. Unfortunately the authors were not aware of recent developments (e.g., the capability of EnergyPlus to calculate heat emissions from buildings in version 9.1released in 2019) and directly relevent publications which are not mentioned at all in the manuscript, such as:

Modeling and Analysis of Heat Emissions from Buildings to Ambient Air. Applied Energy, 2020. https://doi.org/10.1016/j.apenergy.2020.115566

A Simulation-Based Assessment of Technologies to Reduce Heat Emissions from Buildings. Building and Environment, 2021. https://doi.org/10.1016/j.buildenv.2021.107772

EnergyPlus already can calculate in detail (at sub-hourly timestep) heat emissions from buildings to ambient air by components. There is no need to re-invent the wheel (a new definition or formulas).

The reviewer unfortunately has missed the key essence of our study. The two papers referred to by authors from Lawrence Berkeley National Laboratory calculated the heat emission from buildings using EnergyPlus, but not TRUE anthropogenic heat emission.

We have clarified this (Line 53):
If $Q_{F,B}$ is the heat released from buildings into the atmosphere as a result of human activities inside the building (including human metabolism), when the building is completely unoccupied (e.g. no operational appliances, no people; 'ghost cities' in China (Shepard, 2015) or vacant in Dublin, Kelly and Scott 2018), $Q_{F,B}$ is zero. However, heat emission from the unoccupied building is non-zero as there is still heat exchange between building and ambient environment, as there is in other environments with large mass, such as forests (e.g. Oliphant et al. 2004), and rocks (e.g. stone forest in Wang et al. 2018). $Q_{F,B}$ differs from building heat emission (BHE) (e.g. Hong et al., 2020; Ferrando et al., 2021) as the latter refers to the absolute heat flux released from buildings to the ambient environment. Shortwave and longwave radiation can enter the unoccupied internal building space through windows and conduction through walls. This energy modifies the internal building volume, influencing storage heat flux and the other terms of the energy balance. These are not anthropogenic heat flux when the energy leaves the unoccupied building but influence the heat emissions from the building.

References to be added:

- *Kelly, O and Scott, P. City vacant: Dublin's hundreds of multimillion-euro empty sites and properties. The Irish Times. https://www.irishtimes.com/news/environment/city-vacant-dublin-s-hundreds-of-multimillion-euro-empty-sites-and-properties-1.3635595, 2018*
- *Ferrando, M., Hong, T. and Causone, F. A simulation-based assessment of technologies to reduce heat emissions from buildings, Build. Environ., 195, 107772, doi:10.1016/j.buildenv.2021.107772, 2021.*
- *Hong, T., Ferrando, M., Luo, X. and Causone, F. Modeling and analysis of heat emissions from buildings to ambient air, Appl. Energy, 277, 115566, doi:10.1016/j.apenergy.2020.115566, 2020*
- *Oliphant AJ, CSB Grimmond, HN Zutter, HP Schmid, HB Su, SL Scott, B Offerle, JC Randolph, J Ehman. Heat storage & energy balance fluxes for a temperate deciduous forest Agriculture & Forest Meteorology, 126, 185-201, 2004*
- *Shepard, W. Ghost cities of China: The story of cities without people in the world's most populated country, Zed Books Ltd., 2015.*
- *Wang, K, Li, Y, Li, Y, Lin, B. Stone forest as a small-scale field model for the study of urban climate. Int J Climatol, 38: 3723– 3731,2018*

We further added one session (3.4- Line 350) to compare $Q_{F,B}$ and building heat emission (BHE).

3.4 Comparison between $Q_{F,B}$ and building heat emission (BHE)
Comparison of building heat emissions (BHE), determined using the Hong et al. (2021) approach, to $Q_{F,B}$ (this study) for the case (ov3, in Table1), shows that the former is much larger than $Q_{F,B}$ during the day but smaller at

night (Fig. 4) and have different diurnal patterns. Convection from the exterior envelope (Q_H, Figure 1b, e, h, k) is the main contributor to BHE, therefore influences the BHE diurnal pattern in each season. During the day, solar radiation is large and a major control, whereas $Q_{F,B}$ is relatively small and consistent but modified by building-human interactions (e.g., opening windows, activation of mechanical heating and cooling systems). In the scenario, natural ventilation and mechanical cooling dominate $Q_{F,B}$ in summer and shoulder season; while in winter in their absence convection and longwave radiation are more important.

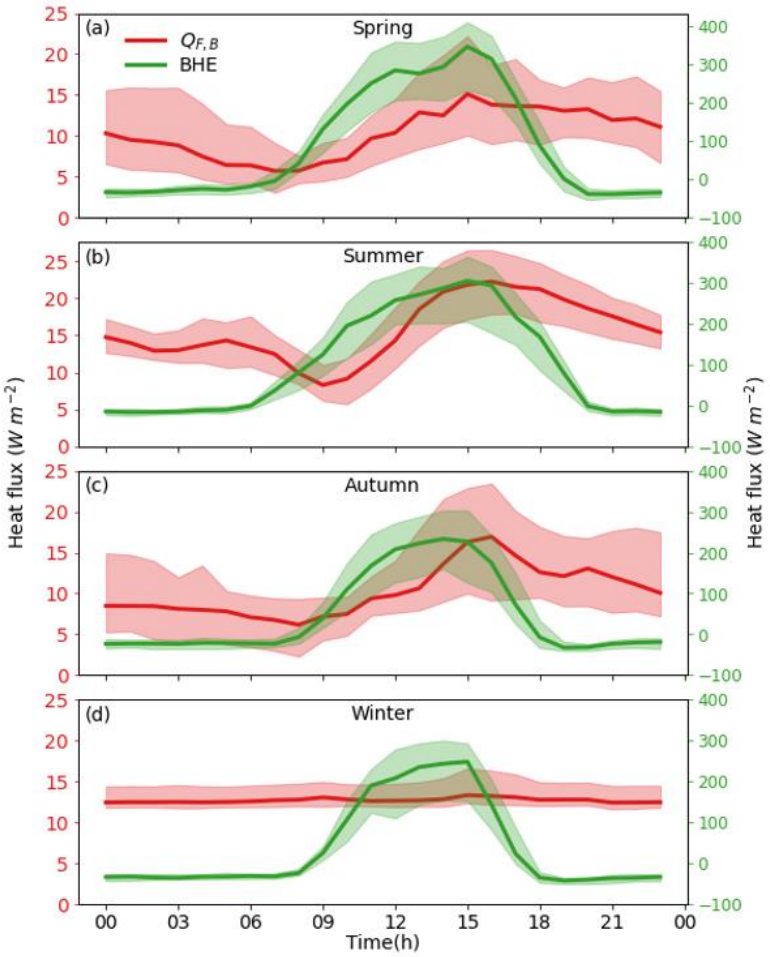

Figure 4 Comparison of seasonal diurnal $Q_{F,B}$ (ov3-us) and BHE (ov3) for (a) spring, (b) summer, (c) autumn and (d) winter.

The use of the shoebox model to simulate and analyze the building heat emission is questionable as the shoebox model is not a real building. In ASHRAE Standard 140 context, the building model is used as a common simplified benchmark model to test and compare results from various building energy modeling tools. Why use this model? If the analysis is to study how human activities influence building operation and thus heat emissions, a real residential or commercial office building model should be used.

As we propose a new approach to calculate the anthropogenic heat from buildings. We use a well-validated simple 'shoebox' case to generate fundamental insight on how human activities (i.e. open/close windows, space heating/cooling) affect the temporal variation of anthropogenic heat and change of storage heat flux. Use of office/residential building model could provide more realistic result of anthropogenic heat profile, but also bring other layers of uncertainty and difficult to generalize. Our goal, in this paper, is not to calculate a particular anthropogenic heat flux for a particular condition - but to demonstrate the validity of the approach.

The manuscript has some typos, e.g., "and time lag and are poorly quantified"

Thank you for spotting this. We will revise accordingly and proof-read the whole manuscript to correct any other possible typos.