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Cooling degree models and future energy demand in the residential sector. A seven-country case study

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Abstract-

The intensity and duration of hot weather and the number of extreme weather events, such as heatwaves, are increasing, leading to a growing need for space cooling energy demand. Together with the building stock’s low energy performance, this phenomenon may also increase households’ energy consumption. On the other hand, the low level of ownership of cooling equipment can cause low energy consumption, leading to a lack of indoor thermal comfort and several health-related problems, yet increasing the risk of energy poverty in summer. Understanding future temperature variations and the associated impacts on building cooling demand will allow mitigating future issues related to a warmer climate. In this respect, this paper analyses the effects of change in temperatures in the residential sector cooling demand in 2050 for a case study of nineteen cities across seven countries: Cyprus, Finland, Greece, Israel, Portugal, Slovakia, and Spain, by estimating cooling degree days and hours (CDD and CDH). CDD and CDH are calculated using both fixed and adaptive thermal comfort temperature thresholds for 2020 and 2050, understanding their strengths and weaknesses to assess the effects of warmer temperatures. Results suggest a noticeable average increase in CDD and CDH values, up to double, by using both thresholds for 2050, with a particular interest in northern countries where structural modifications in the building stock and occupants’ behavior should be anticipated. Furthermore, the use of the adaptive thermal comfort threshold shows that the projected temperature increases for 2050 might affect people’s capability to adapt their comfort band (i.e., indoor habitability) as temperatures would be higher than the maximum admissible values for people’s comfort and health.

Index Terms- CDD; CDH; energy demand; energy poverty; climate change

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