Climate change impact on the energy performance of residential buildings in Portugal
Heating Degree Days (HDD)

BACKGROUND

Commonly the climate policies in the energy sector are focused on emissions mitigation, although is increasing awareness on the **climate vulnerability and adaptation needs of the energy sector**.
The results can help inform decision-making regarding energetic efficiency and building energy use over its useful life and thus a substantial influence on the primary energy needs, on the expenses to heat residential buildings and on the future trends of building design and envelope requirements.

Heating Degree Days (HDD) reflects the demand for energy requirements to heat a building. In the present work the potential effects of climate change on future variations of heating energy demand in the household sector were investigated.

METHODOLOGY

Daily minimum and maximum near-surface air temperature were obtained from six high-resolution bias-adjusted EURO-CORDEX 0,11° climate models (ALADIN53, HIRHAM5, CCLM4, REMO2009, RACMO22E and WRF331F) for three separate timeframes: 1) historical (1971-2000); 2) rcp4.5 emission scenario (2021-2050) and; 3) rcp8.5 emission scenario (2021-2050).

Daily HDD were computed based on the daily air temperature deviations below a given temperature threshold value according to the UK Meteorological Office equations (Day, 2006). Winter climatic zones are defined from the number of HDD corresponding to the heating season according to the Portuguese Legislation, with 18°C temperature threshold value: a) **I1 HDD ≤ 1300** (low heating demand zone); b) **I2 1300 < HDD ≤ 1800**; and c) **I3 HDD < 1800** (high heating demand zone)
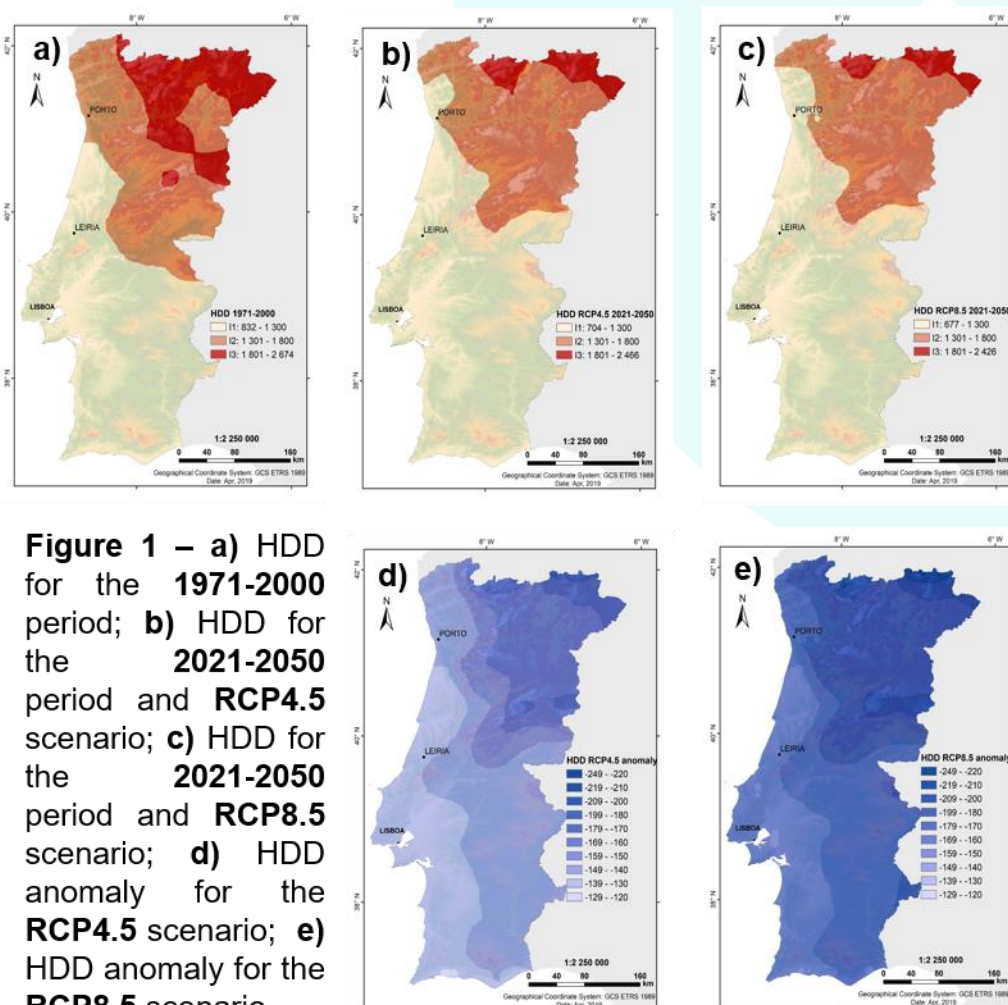
RESULTS AND DISCUSSION

Figure 1 – a) HDD for the 1971-2000 period; b) HDD for the 2021-2050 period and RCP4.5 scenario; c) HDD for the 2021-2050 period and RCP8.5 scenario; d) HDD anomaly for the RCP4.5 scenario; e) HDD anomaly for the RCP8.5 scenario.

The future effects of climate change on the magnitude and spatial patterns of heating demand sensitivity in Portugal usually address to the indicators of heating HDD and winter climatic areas I1, I2, and I3 (**FIGURES 1 a), b) and c)**). Results hint at an increase in the I1 area of about 20% and a decrease in I2 and I3 areas of 6% and 14%, respectively, on both scenarios (not shown). Areas that currently have high HDD values will have relatively large decreases, whereas areas with intermediate HDD values will experience relatively low decreases (**FIGURES 1 d) and e)**).

Looking at the weather-related energy demand, by the middle of this century (until 2050), significant decreases in HDD are projected, decreasing largely, in the North and East regions of Portugal, far from the Atlantic Ocean Coast. Under the RCP8.5 scenario, in Oporto city (in the Northern region), the heating demand is anticipated to become more like Leiria located in the centre of Portugal. The heating demand will decrease all over the territory for both scenarios. Future studies will be focused on the **CDD (Cooling Degree Days)** trends.