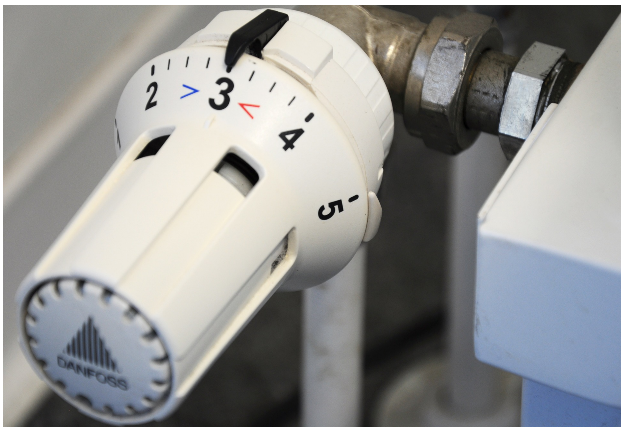
JRC PESETA III Science for Policy Summary Series

CLIMATE CHANGE AND RESIDENTIAL ENERGY DEMAND

Climate change will alter the balance between energy demands for heating and cooling respectively across the EU. Reductions in heating demand will compensate for increases in cooling demand. As a result, overall energy demand across the EU could decline by 26% under a high warming scenario by the end of the century. Introducing policies that lower energy demand through improved energy efficiency, such as increased insulation, could achieve even larger savings of up to 40%.



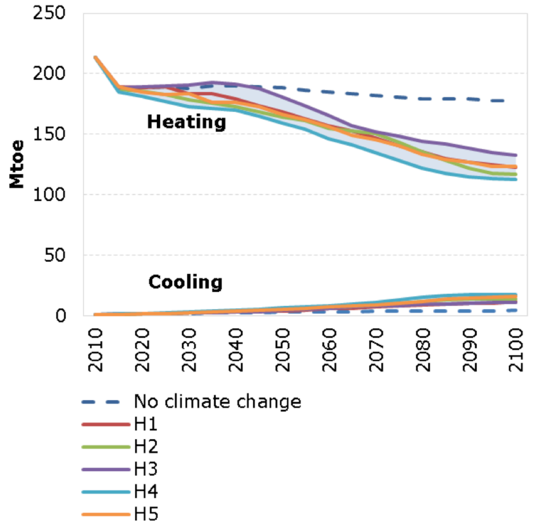
IMPACTS WITH NO MITIGATION AND NO ADAPTATION

Overall energy demand could be 26% lower across the EU due to climate change, under a high warming scenario by the end of the century, and without adaptation. This is in large part due to heating demand being 27% lower under the high warming scenario (Figure 1), as a result of warmer annual temperatures.

On the other hand, cooling demand could more than double due to climate change, under the high warming scenario (and again assuming no adaptation). Whilst in percentage terms the effects of climate change at the end of the century are much larger for cooling than heating demand, the demand is much larger in absolute terms for heating because cooling demand (around 17 Mtoe[1]) is only around 14% of heating demand (around 125 Mtoe). Overall energy demand is driven by a warmer climate that reduces heating demand, which makes up for the increase in cooling demand.

Most of the increase in cooling demand is concentrated in countries in Southern Europe (around 50% of the increase) and Central-Southern Europe (around 30% of the increase), where temperatures are the warmest and where air conditioning diffusion is the greatest. In the simulations, the diffusion of air conditioning reaches 95% in Southern Europe by the end of the century under the high warming scenario, in response to increasing temperatures. Even without climate change, there would still be a slight increase in air conditioning diffusion due to increases in revenue (independently of increases in temperature) (Figure 1). There is also a decline in heating demand in the no climate change scenario due to improvements in technology efficiency.

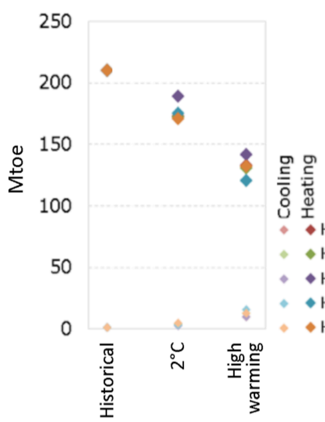
Figure 1. Annual energy demand (Mtoe[1]) for heating and cooling across the EU, assuming no adaptation, under a high warming scenario. H1-5 is the demand according to using five different climate models. Also shown is a "no climate change" scenario with some reduction in residential heating needs thanks to efficiency improvements (particularly insulation).



IMPACTS WITH MITIGATION AND NO ADAPTATION

Overall energy demand is projected to be higher with climate change mitigation than without mitigation (assuming no adaptation; Figure 2). This is because of the apparently positive effect of warming associated with climate change on overall residential energy demand.

Figure 2. Annual energy demand for heating and cooling (assuming no adaptation) in the historical period and under the 2°C warming and high warming scenarios, by the end of the century.



[1] 1 Mtoe = 1 Megatonne of oil equivalent. 1 Megatonne = 1,000,000 tonnes.

The impact of unmitigated climate change on energy demand should not be interpreted as beneficial. The modelling approach does not consider the adverse impacts of climate change on energy infrastructures. These could be more prevalent in a non-mitigation scenario, e.g. precipitation changes on power plant energy production (hydropower, thermal power); disruption to energy distribution networks due to lightning, high wind speeds and flooding; and changes in bioenergy crop yields. Further model development and research is needed to account for the above factors fully in the modelling process, in order to understand completely the overall effect of climate change on residential energy demand.

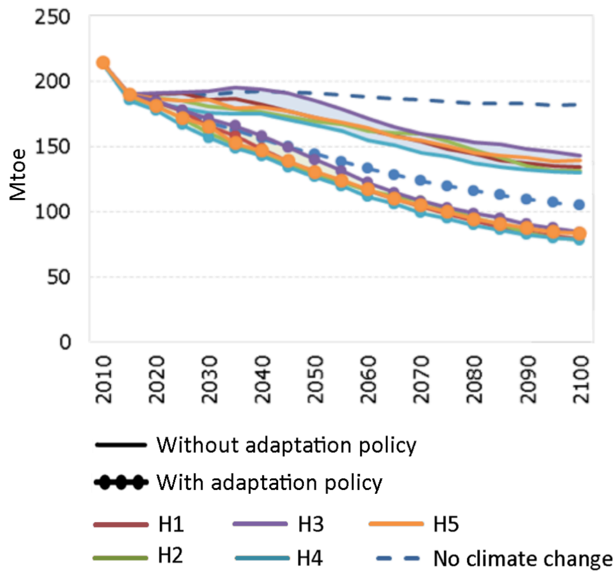
Impacts with adaptation policy and no mitigation

With unmitigated climate change (i.e. the high warming scenario), overall annual energy demand could be 40% lower with a policy that aims to reduce energy demand by increasing residential insulation, compared to without the policy (Figure 3). Even without climate change, the effect of introducing the policy is that overall energy demand declines because of the benefits of insulation in reducing heating and cooling demand (Figure 3).

The introduction of policies that improve energy efficiency through enhanced insulation is one of many adaptation strategies that could be introduced to lessen the impact of climate change on energy demand. Complementary adaptation options that are focussed on improving energy efficiency may also include: improving the efficiency of air-conditioning installations; product labelling that describes the efficiency of household electrical products; the requirement for energy efficiency certificates to accompany the sale and rental of buildings; and the introduction of financial instruments such as tax deductions for improving building energy efficiency.

These adaptation options also provide the co-benefit of climate change mitigation because they reduce energy consumption, and in turn reduce greenhouse gas emissions (where the energy has been produced by the combustion of fossil fuels).

Figure 3. Overall annual energy demand (Mtoe) across the EU for heating and cooling combined, under a high warming scenario, with policy to lower energy demand and without policy respectively. Also shown is a "no climate change" scenario with some reduction in demand thanks to efficiency improvements (particularly insulation).



Approach

PESETA III assessed the impact of climate change on residential energy demand by estimating changes in heating and cooling demands under a future with climate change, relative to a future with no climate change. Climate change was projected with five different climate models (H1-5). The projected climate was used as input to a residential energy demand module from a global energy model that simulates the entire energy system, from primary supply (fossil fuels, renewables) to transformation (power, biofuels, hydrogen) and final sectoral demand. In practice, heating and cooling needs are affected by income, energy prices, building insulation and improvements in technology efficiency, which are all simulated internally by the model used. Energy demand was estimated for three main scenarios:

1) A high warming scenario (no climate change mitigation) with no adaptation policies;
2) A 2°C warming scenario (climate change mitigation) with no adaptation; and
3) A high warming scenario (no climate change mitigation) with adaptation policies.

The adaptation scenario was investigated by looking into improvements of building performance (increased insulation) to investigate the potential for planned adaptation strategies seeking energy efficiency. The geographical scope of the study was the EU Member States.

Read more

PESETA III Task 5: Energy. Available on our website https://ec.europa.eu/jrc/en/peseta