The impact of the weight and thickness of the insulation layer in commercial building designs

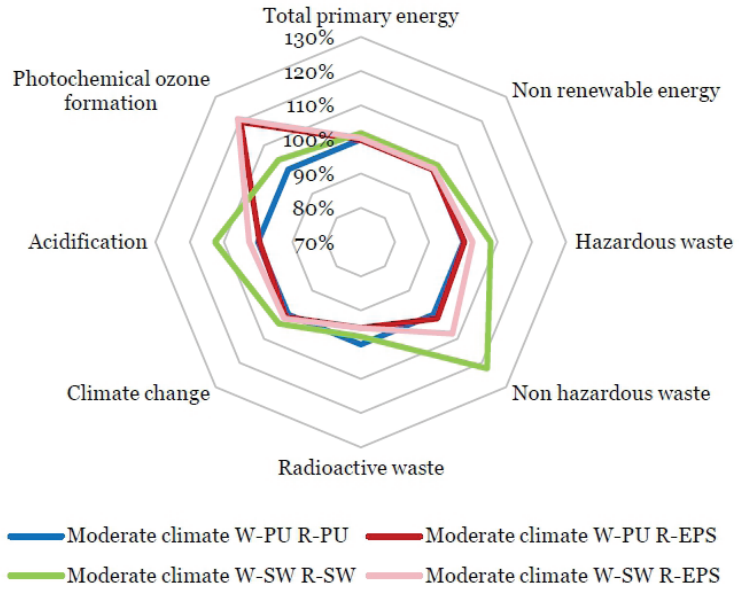
A new commercial building is designed with a surface of 2 300 m^2 featuring sandwich panel walls and an insulated steel deck roof. The U-value of the external walls is 0.17 $W/m^2 \cdot K$ and that of the roof 0.16 $W/m^2 \cdot K$.

Main results:

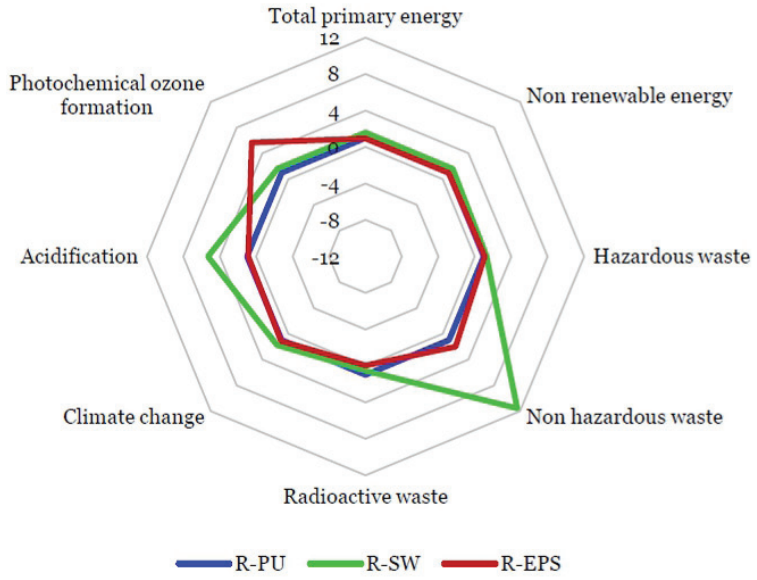
- The choice of the insulation material can have a substantial impact on the overall building footprint or the available internal floor area. In particular the latter affects life cycle costs through income from rent. The impact can be shown when changing the functional equivalent from the internal surface to the external building footprint. In that case, the PU solution offers 24 m^2 of additional surface area and 674 m^3 of additional volume when compared to another insulation solution. If an annual rent of €400 per year and m^2 is assumed, the additional income thanks to the PU solution over a 50 year life cycle sums up to €480 000.
- The choice of the insulation material can have knock-on effects on the whole building structure. As a matter of example, the steel structure of a 2 300 m^2 steel deck flat roof can be about 15 t lighter when the PU solution is used rather than another insulant. This gain of about 10 % is due to the fact that the insulation layer of the PU roof weighs only 4.6 t compared to 37.5 t for the alternative insulation layer.

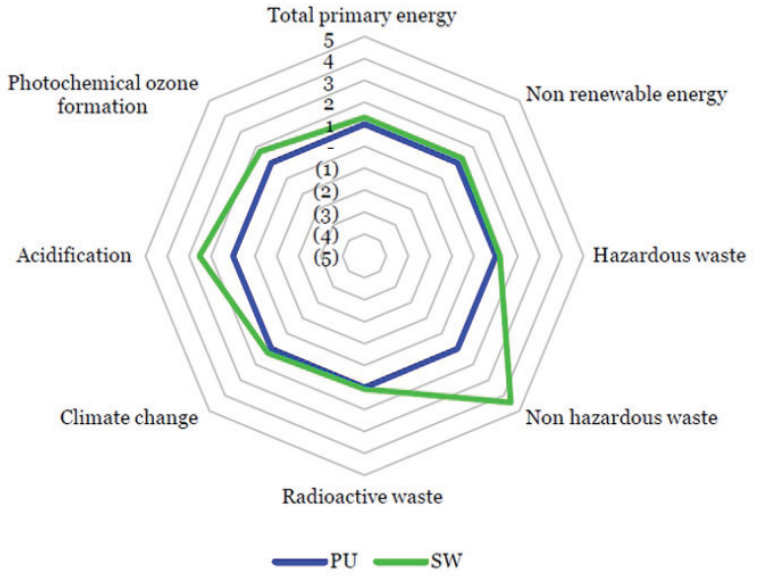
Life Cycle Analysis (W = wall, R = roof)

The PU solution shows a very good environmental performance in all impact categories both at the whole building and the building element level.



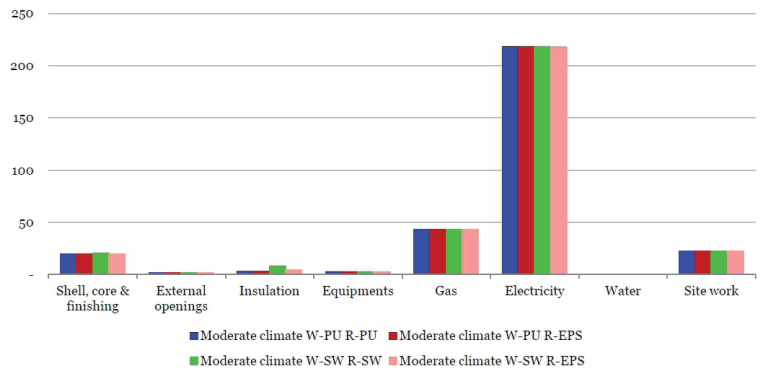
Relative performance on the whole study period for the whole building (W-PU, R-PU scenario being 100)





Relative results for the flat roof and the wall (moderate climate, PU solution being 1.00)

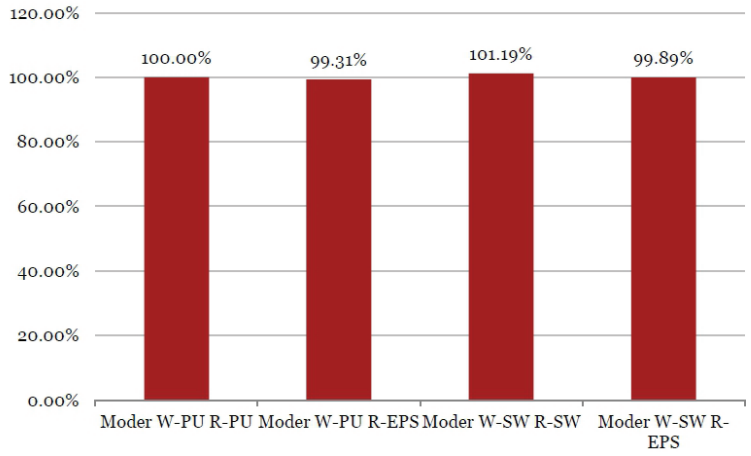
The following graph shows that the impacts from the building construction are about eight times lower than those due to the energy consumption in the use phase. The impact of the insulation is at least 30 times lower than that from the energy consumption, and this independently from the insulant used. The primary energy embodied in the insulation ranges from only 1 % to 2.7 % of the building level impact over the whole study period.



Breakdown of total primary energy for the whole building life cycle (construction, use, demolition)

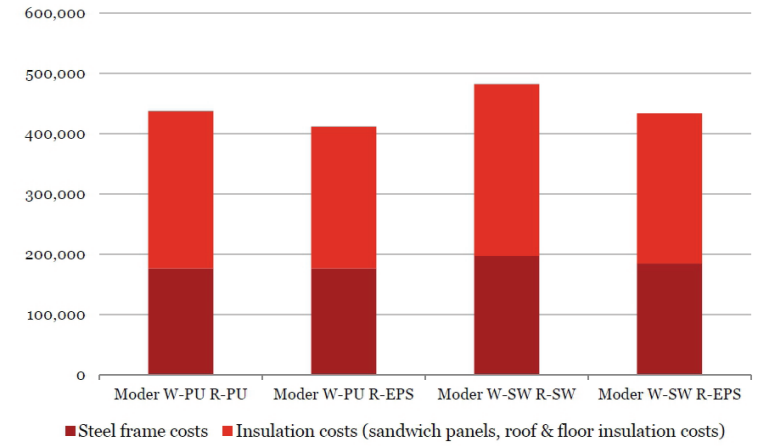
Life Cycle Costs

Total life cycle costs for the whole building are very similar for all scenarios.



Relative life cycle costs for the whole building (PU/PU solution being 100 %)

The analysis of the initial construction costs shows relatively small differences. The use of stone wool in the flat roof and the sandwich panels would be most expensive.



Construction costs (steel frame, sandwich panels and roof insulation)

Source: http://www.pu-europe.eu/fileadmin/documents/PU_Europe_files_2013/PU_13-136_PWC_for_PU_Europe_-_Environmental_and_economic_analysis_of_insulation_products_in_low_energy_buildings__May_2013_.pdf