Emissions at a crossroad

– a crossroad NZE design method

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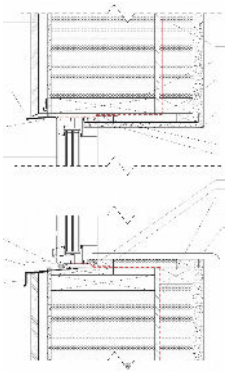
Emissions at a crossroad

Glasgow WEO2021 rapport [1] on global emissions and "ways to reach NZE (Net Zero Emissions) by 2050" show a gap between the NZE goals and the Announced Politic Steps. There is a strong focus on clan energy to do the job but there still is a big gap between 2050 Net Zero Emissions goals and APS (Announced Pledges Scenario) 2021. A global emission of almost 14 Gt CO2e in 2020 is with announced steps reduced in total by 2 Gt CO2e. Further Announced Pledges can only close 20% of the gap between Net Zero Goals and the steps taken in the e Stated Policies Scenario. Emission reductions that are political decided in the Glasgow COP2021 will bring the global temperature to 2,1 C.

Reduction strategies top-down need bottom-up solutions

Reductions to reach NZE in Buildings for heating are depending on a green electricity scenario. But could there be a crossroad here – a way to reduce Electricity emissions by lower energy demand. How can Building envelope energy related emissions be optimized together with green energy systems? A "from the bottom up" analyze reveal that the insulation impact on GWP (Global Warming Impact) is a minor part of the total Wall material GWP.



Ringkøbing K. Social Housing, Passivhouse plus and premium energy standard. Left: Window-wall detail

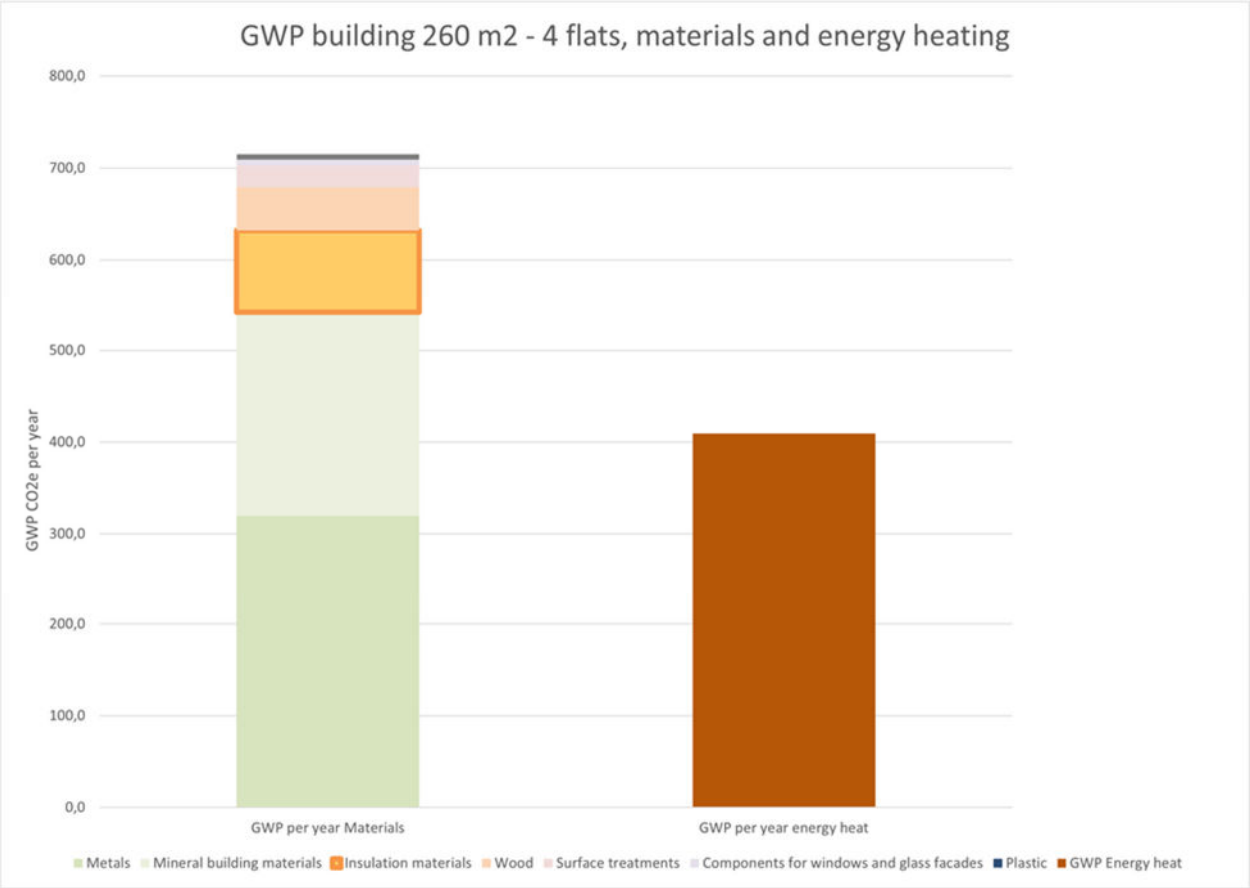


Figure: Carbon emission from outer wall in a 4 flat building. Insulation is marked yellow.

How to reduce emissions bottom-up and top down? The crossroad design method

The case is a social housing project in Denmark. A building type Class Passive House Plus and Premium. A LCA (Life Cycle Analyze) is used as a method to calculate CO2e Global Warming Impact for the Wall.

The houses are equipped with Compact ventilation and heating systems. A Passiv house energy calculation (PHPP) is used to calculate energy flow for direct electricity and heat pump electricity. This is done for different U values - different insulation dimension. Different insulation materials Lambda value is considered, and dimension is used to calibrate similar U values.

In this way different insulation materials can be compared. An option “insulation” can be compared with an option “energy effective system” as the U value steps varies.

Different insulation materials have different GWP due to different energy demand in the production process A1-A3 and the embodied energy, that can be released as CO2e, are different. This is taken into the calculation. 4 different insulation materials are compared.

The compact ventilation and energy system is working with direct electricity for peak hours. As poor insulated buildings have more peak hours – the degree of direct electricity is higher. SPF (Seasonal Performance Factor) is calculated in the Passiv house energy calculation, and so the energy mix for every analyzed step in insulation is calculated.

Different green energy scenarios will have an impact on the GWP. A German value of 0,53 electrical energy mix is compared with a Danish value of 0,22 kg CO2e/kWh[2]. Future green energy supply from sun and wind reduces the energy CO2efactor. This will also influence production emission from materials like insulation.

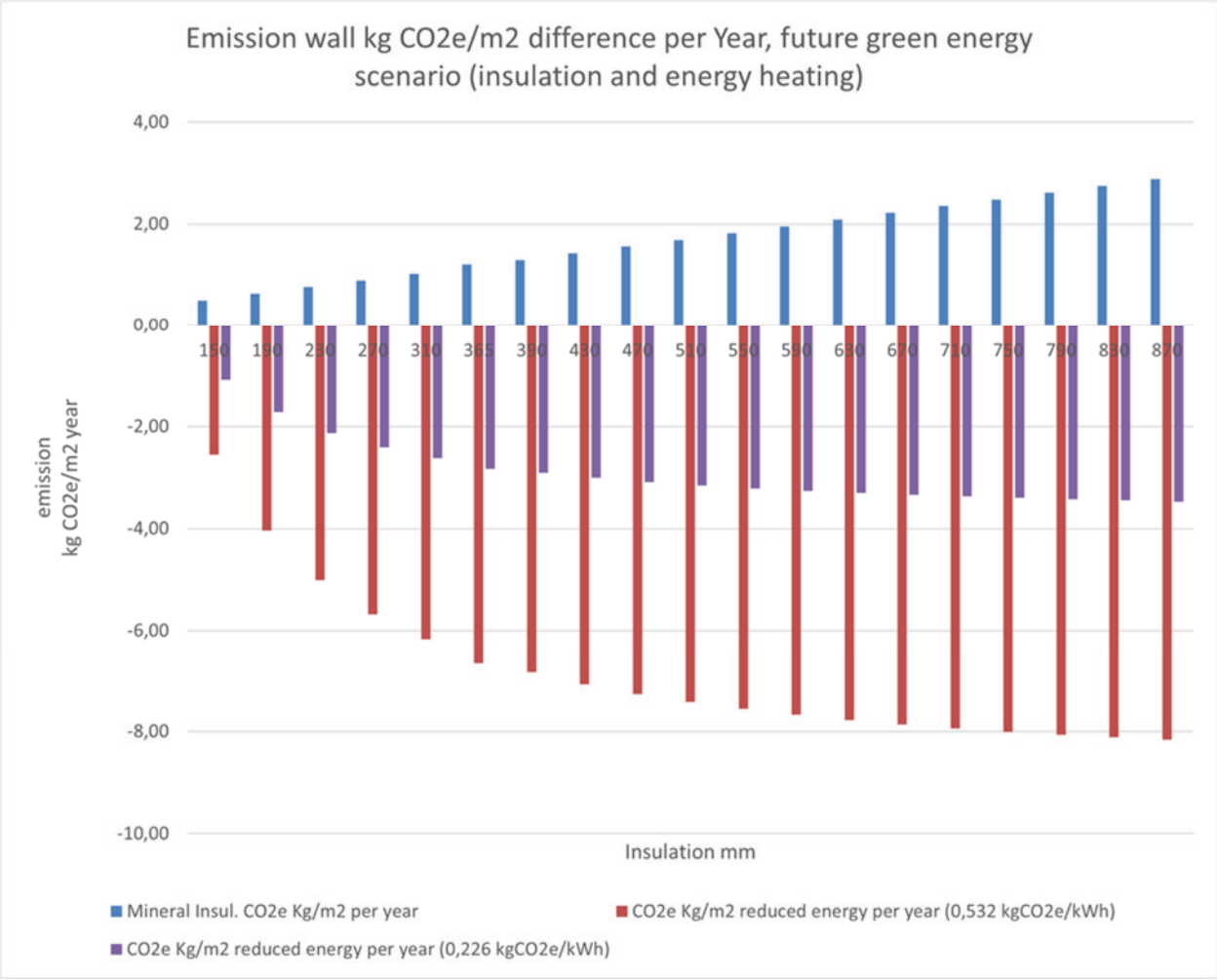


Figure: Carbon emission from more-insulation in outer wall compared to energy carbon emission. Energy carbon emission result from 2 scenarios for future green electricity energy system. All insulation dimensions show less emission by saving energy compared to emissions from same energy produced by the heatpump.

Results

Results show that there are potentials in reducing emission by a 2way crossroad design strategy.

- First a better U value reduces the energy demand for heating. The material emissions are lower than the energy emissions otherwise needed. Insulation in the build wall makes out 12% (only) of the material wall emissions.

- The effect on heating emission is 2,33 higher and almost regardless of what insulation material is used and how thick. Only wood fiber insulation in very thick insulation shows a limit by 430 mm. This is due to the high energy needed in the production process. The embodied energy is also high. It could be argued that embodied CO2e in building makes a short-term climate effect.

- Secondly the SFP factor rises from 2,19 for heating in the min. energy class to 2,39 in the Passive house standard wall – a energy effectivity gains of 14% in the active energy system with passive means!

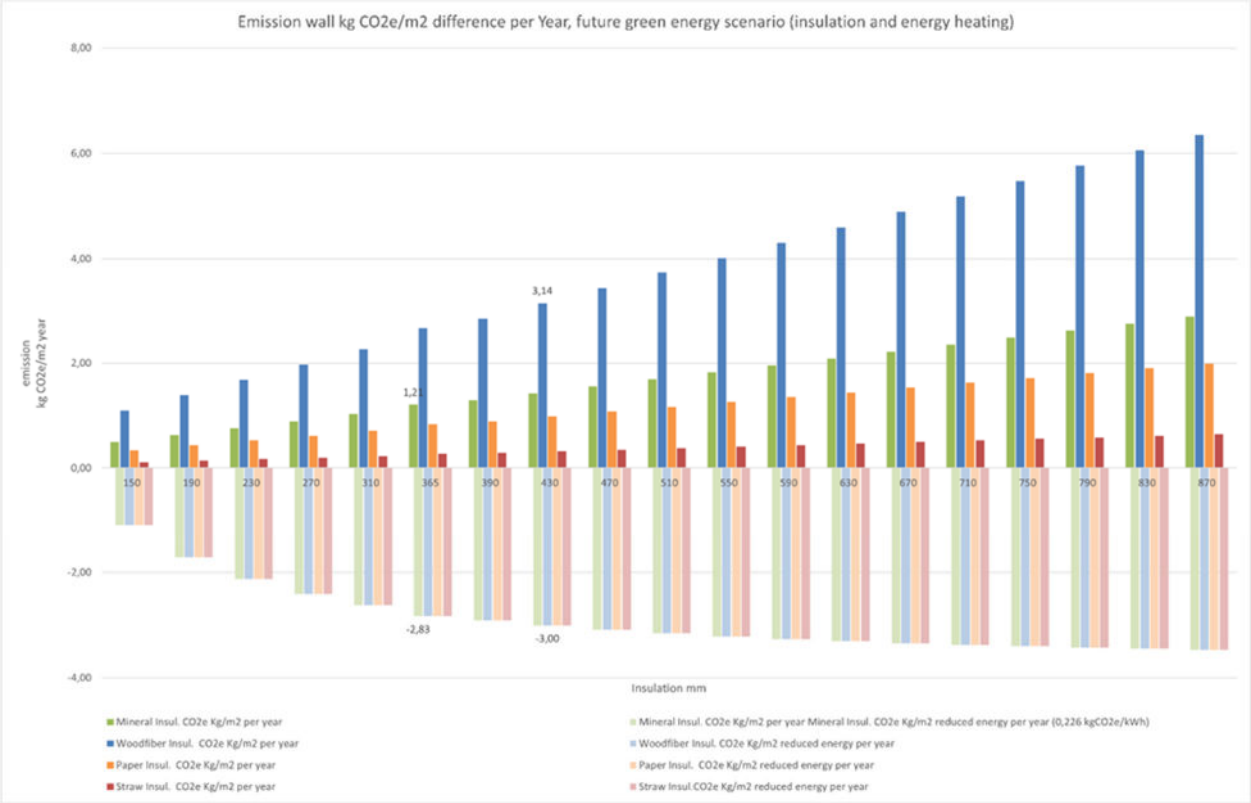


Figure: Carbon emission from more-insulation in outer wall. 4 different insulation materials are analyzed. Results of saved Carbon emission are compared to energy carbon emission from future green electricity energy system. All insulation dimensions up to passivhouse standard show less emission by saving energy compared to emissions from same energy produced by the heatpump. Woodfiber insulation show higher emission than energy produced by 430 mm – wood fiber has high embodied carbon that can substitute (faze D) biomass.

Conclusion

A focus on clean energy can bring us on track to an Nearly Zero Energy goal – but will it be the right track if it is not combined with a design cross strategy to reduce energy demand?

This analysis show that insulation is the green energy solution number 1 – as it makes the way for Green house gas reductions in both buildings and future electricity heating systems.

References

[1] https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf
[2] https://ens.dk/service/statistik-data-noegletal-og-kort/noegletal-og-internationale-indberetninger