Environmental performance assessment of the use stage of buildings using dynamic high-resolution energy consumption and data on grid composition

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During the use stage of buildings, their consumption of electricity has proved to influence considerably their environmental performance. The impacts associated with using electricity are directly related to the electricity grid that delivers the power and hence are also closely associated with the impacts induced by the production of each kWh delivered to the grid. Life cycle assessment (LCA) usually does not account for the variations in the energy sources that supply an electricity grid every day, month and year. This study addresses the dynamic nature of electricity grids and accounts for the source variations in electricity production using electricity grid data at high temporal resolutions. The study compares inventory data on electricity grid composition at hourly, daily and monthly resolutions with the conventional yearly average grid compositions from the ecoinvent database. The high-resolution electricity grid inventory data are subsequently paired with data sets for electricity consumption by buildings with matching resolutions in order to quantify the differences in the environmental performance of buildings resulting from the application of temporally high-resolution grid data. Finally, environmental building performance (EBP) calculated using high-resolution grids is compared to EBPs generated from conventional data resolutions. The results indicate that the contribution to global warming potential is closely related to the data resolution of the grid composition and that the EBP may be overestimated by up to a factor of two when compared with conventional grid inventory data with yearly (i.e. low) data resolutions.

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