The actual carbon footprint of products and services can differ considerably according to how energy used to manufacture the product was generated – for example, whether it was generated by fossil fuel or renewable sources. A recent US study has therefore recommended that differences in regional power supply should be acknowledged by life cycle assessments of products and services.

The environmental impact of most products is strongly linked to the power consumed during manufacture, which can differ according to the local source of energy. The mix of energy generating technologies varies regionally according to resource availability and regional policy.

Carbon emissions and other environmental impacts of products or processes may be calculated using life cycle assessment (LCA) standards, which mostly pre-specify the use of average electrical mixes. However, this may attribute environmental impacts to a product arising from a power generation technology it does not use. For example, in the US, over a fifth of aluminium manufacturers are in the Pacific north west region, where around 75 per cent of energy is generated by hydropower. Using a national US average for carbon emissions from energy generation would therefore be inappropriate for calculating the carbon footprint of aluminium.

To illustrate the potential scale of difference in regional averages for the US, in West Virginia 98 per cent of power comes from coal fired power stations and has embodied emissions of 961 gCO₂/KWh (grams of carbon dioxide per kilowatt hour). Washington, on the other hand, has a large share of hydropower which embodies only 123 gCO₂/KWh; and energy in Vermont embodies only 15 gCO₂/KWh.

The average power mix consumed by particular industries will therefore depend on their geographical distribution and the study suggests that power supply variability should be more widely acknowledged in LCA results, until more complete data are available and used.

In a case study approach, the researchers calculated the carbon footprints of five industrial sectors in the US (coal mining, steel manufacture, automobile manufacture, semi-conductor manufacture and hotels) using different ‘average’ mixes of energy: the national average mix, the state average mix, the state mix with imports of energy from other regions (to make up shortfalls in local supply), and a mix specific to the sector – i.e. which represents more closely the actual mix of energy used for each sector.

Embodied emissions from steel and automobile manufacture were found to be close to the US national average of 600 gCO₂/KWh. In 2006, around half of energy in the US was generated by coal, around 20 per cent from nuclear and 20 per cent from natural gas, with the remaining 10 per cent from a range of mostly renewable sources. Emissions for the semi-conductor industry, however, were found to be overestimated when using the US average mix. Assuming an energy mix specific to this sector, its carbon footprint was estimated to be closer to 400 gCO₂/KWh. This is because this sector is largely based in California where a high percentage of energy is generated by gas-fired power station.

Although this study used examples of emissions and industries in the US, the researchers suggest that the conclusions can be generalised for any region of the world that uses a wide range of technologies for generating energy.


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