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Limitations of measuring product sustainability with carbon footprints

The carbon footprint method does not capture the overall environmental impact of manufactured products, and according to a recent study which found it unsuitable for assessing the toxicity of pollutants generated by products.

Various methods are used to evaluate the environmental consequences of producing goods or services. Product carbon footprinting (PCF) methods estimate the amount of greenhouses gases emitted during the life cycle production of goods or the provision of services. This life cycle includes the extraction of raw materials, processing, transportation and storage and end-of-life disposal.

In a similar manner, Life Cycle Assessment (LCA) evaluates the environmental impact over the entire life cycle of the product or service from 'the cradle to the grave'. However, LCA additionally assess the impacts on the wider environment, not just carbon emissions.

To see if PCF could also be used to predict wider environmental impacts of products, in terms of human toxicity of emissions, the study compared the results of PCF and LCA for a variety of commonly manufactured products, including metals, chemicals, plastics, textiles and paper. The LCA focused on the life cycle impacts on human health, or the HTI, (Human toxic impacts, which are non-cancer effects). HTI occurs when pollutants are released to the environment at any stage of the production process. They combined the HTI and PCF results to create an overall environmental indicator.

In general, the study found that the environmental impact, as measured by HTI, dominated the overall indicator. For plastics, textiles and paper goods the contribution of the HTI was considered to be 10 times greater than that of the PCF and 1000 times greater for metals and chemicals.

There were also wide differences within each product group, for example, the relative differences between using the HTI or the PCF varied by up to 10 times for a variety of aluminium, steel and nickel products. This implies that PCF makes only a small contribution to the total environmental impact.

The environmental impact of energy generation is often significant so the study investigated the influence of the energy supply source in the life cycle production of aluminium, copper (coupled with nickel) and carbon monoxide. Either natural gas or wind energy was used to replace coal as the energy source and natural gas was substituted for coal as the heat energy supply during production.

For all three products, the negative environmental impact fell if natural gas or wind power were used as the source of energy, as measured by both HTI and PCF. However, reductions in environmental impact occurred at different points of the product's lifecycle, depending on the product. For example, they could occur at the energy production stage or at the waste disposal stage. These variations suggest that PCF cannot be presumed to adequately measure toxic effects on human health, or any other environmental impacts. It is suggested that if PCF is used to assess products for sustainability, this needs to be conducted on a case-by-case basis.

Source: Laurent, A., Olsen, S.I., Hauschild M.Z. (2010) Carbon footprint as environmental performance indicator for the manufacturing industry. *CIRP Annals - Manufacturing Technology.* 59: 37-40.

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