



Poor energy use is chemical industry's top environmental issue

A new study suggests that the energy sources used in chemical production contribute significantly to environmental damage in developed countries. The researchers recommend increasing the efficient use of heat and electricity, in addition to reducing direct emissions of harmful pollutants, to dramatically improve the environmental impact of the chemical industry.

Strict monitoring of pollutant emissions under the chemical industry's Responsible Care¹ Global Charter (2006) have ensured significant reductions in the environmental impact of chemical production. However, there has been little focus on the indirect environmental impacts of energy use at chemical plants. Some energy is required in the production process itself, but some may even be used as part of efforts to curb pollutant emissions. For example, waste gas incineration, recycling and wastewater treatment may all lead to higher energy consumption.

The study assessed the relative importance of energy use to the total environmental impact in the production of 99 different chemicals in Western Europe. The analysis included common inorganic chemicals, such as ammonia, chlorine and sulphuric acid, and organic chemicals, ranging from simple compounds, such as hexane and methanol, to more advanced dyes and pigments.

Life-cycle Inventory (LCI) data were collected for each chemical using the ecoinvent database and information from partners in the chemical industry. The inventory data included all energy and material inputs and all releases to air, land and water that occurred before and during production. All inputs and releases were categorised as either 'energy-related' or associated with 'remaining causes'. Energy-related factors were further divided into those related to transport and those related to heat or electricity production. Remaining causes included direct emissions during production and waste treatment, and the provision of raw materials.

Using Life Cycle Impact Assessment (LCIA) methodology, the researchers calculated the environmental impact of producing each chemical, including both energy-related and non energy-related factors. They then compared this with the result when energy-related factors were removed from the analysis, so that their environmental impact could not contribute to the overall impact score.

The scientists used several types of LCIA to assess different aspects of environmental impact: (1) Cumulative Energy Demand (CED), which evaluated the use of primary resources, (2) Global Warming Potential (GWP), which considered the release of Greenhouse Gases, (3) three Ecoindicator 99 indices relating to human health, resources and ecosystem quality (using the hierarchist weighting scheme) and (4) several Ecological Scarcity indices, which measured ecological performance across a range of categories, including freshwater input and land occupation. This combination of methods provides a range of viewpoints, although the study acknowledges that other methods may offer additional perspectives.

Energy-related factors accounted for 40-80 per cent of the environmental impact for most LCIA methods. The impact was particularly high for the Global Warming Potential, for which energy-related processes were responsible for up to 80 per cent. On average, half of the energy-related impact could be attributed to the use of steam and other forms of heat, with the use of electricity responsible for a further 40-50 per cent. The remaining five per cent was attributable to transport. The study revealed that direct pollutant emissions were responsible for less than ten per cent of the total impact of the industry on human health.

The research highlights changes in energy use are likely to bring the greatest improvements to the chemical industry's environmental performance. For these reasons, the researchers suggest that implementing more efficient and sustainable sources of energy, such as natural gas and renewable energy, will be the most effective available tool to help reduce and monitor the environmental impact of the chemical industry in Europe.

1. See: www.icca-chem.org/en/Home/Responsible-care/

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