

Key considerations for environmentally benign nanotechnology: a conceptual framework

What are the key considerations when assessing the environmental impact of nanotechnology? First, the cradle-to-gate environmental impacts of an ENM is one of them. However, limitations of LCA used for EMNs should be duly noted. Second, the net environmental impact of EMN applications during the use phase: ENMs may replace existing processes or materials reducing materials and energy that would have been otherwise needed, and life-cycle environmental impacts associated with the materials and energy avoided provide a credit; EMNs may enable creating new demands instead of displacing existing ones, and additional impacts of such new demands can be attributed to ENMs that enabled the demand. Third, rebound effect or socio-economic response can be considered. Efficiency improvements generally lower the cost which either increases demand or enables additional surplus that can be spent on others. Creation of new demands may divert existing consumption expenditures avoiding the environmental impacts associated with them. In summary, (1) technical characteristics that determines cradle-to-gate impacts of ENMs, (2) substitution/addition structure during the use phase, and (3) socio-economic responses would be some of the key considerations in characterizing the environmental impacts of nanotechnology. Additionally, human well-being implications should also be taken into account.