



Final publishable summary report

Nanomaterials have a great market potential for SMEs due to the high added values and the reduced batch sizes compared to their corresponding conventional bulk materials. Unfortunately the introduction of nanomaterials is hampered due to the unknown human and ecological risks. It may take many years to fill all knowledge gaps. However, the SMEs have to address the various different aspects and perceptions of risks, in communication with their stakeholders. For this reason, SMEs need guidance to assess the risks and benefits of their nanoproducts in comparison with the conventional (non-nano) products.

The main goal of LICARA is to develop a structured life cycle approach for nanomaterials that (1) enables to balance health/environmental risks of nanomaterials in view of paucity of data against their benefits and (2) that further allows a comparison with the risks and the benefits of the conventional (non-nano) products.

Therefore the LICARA framework is developed based on a dual approach: (1) LICARA nanoSCAN: scanning of the risks and benefits, which can be performed by SMEs, and (2) in-depth assessment: comprehensive and thorough method to assess the risks and benefits, which is performed by professionals.

In the **LICARA nanoSCAN**, a general method is developed that is able to scan potential applications of specific nanomaterial-based innovations. It can take place in an early product development stage and with limited data, mostly of a qualitative nature. The approach is to identify the risks and benefits for the application of nanoproducts by answering pre-defined questions on the nanoproduct and its application. It is operationalized in a simple spreadsheet tool, which enables SMEs to perform this scanning method by themselves. In case the LICARA nanoSCAN result is positive or ambiguous, a company can (let) perform an **in-depth assessment** to obtain a better underpinned decision e.g. in case of large investments. For the in-depth assessment a more extensive method is being developed to assess the risks and benefits of a specific nanoproduct into detail, based upon merely quantitative data and the state of the art methods available for risk assessment (RA) and life cycle assessment (LCA) as well as methods to deal with data paucity and data uncertainty in general and specifically regarding the risk and benefits of nanomaterials. In the in depth assessment, LICARA developed a method to **aggregate risks across the entire life cycle of the product** in combination with 'conventional' LCA assessment and its impact parameters. Therefore, **workers and consumers exposure was integrated** in the RA approach within the LCA. The method is based on six methodological steps to derive characterisation factors, which can be included in the LCA.

The LICARA nanoSCAN and in-depth assessment were applied to four case studies within the LICARA project: (1) an antibacterial coating on door handles (nano Ag), (2) a microfiber cloth (nano Ag), (3) an self-cleaning coating for outdoor façades (nanoTiO₂) and (4) a catalyst for fuel cell applications (MWCNT).

The life cycle inventories for three of the most frequently used nanomaterials (nanoAg, MWCNT, nanoTiO₂) have been compiled with a very high level of detail. In particular nanoAg and MWCNT data rely on industrial data gathered with our SME partners and it is fair to assume that uncertainties on these data are by far smaller than average uncertainties in life cycle inventory modelling.

Finally, LICARA guidelines were elaborated based on the conceptual framework and the case studies in order to deal with the specific questions on benefits and risks by SMEs.

For the SMEs and SME Associations, LICARA was also very successful. The SMEs are very happy with the LICARA nanoSCAN, the guidelines, the fact sheets on the case studies and the socio-economic valuation of the nanosilver coating on door handles. The outcome of the socio-economic valuation was that the benefit of the lower infection rate by applying a nanosilver coating on the door handles in hospitals to reduce the amount of hospital infections outweighs all direct and indirect costs. The LICARA results are beneficial to the whole nano community working with nanomaterials.