NanoFASE Exposure Assessment for Industry

This document is linked to the Clickable Framework's Industry welcome and FAQ page

Innovation is wanted to provide solutions to societal needs and the planet's diminishing resources. Nano-enabled products are contributing to renewable energies, clean air and water, food production, cancer diagnosis and treatment and antibiotic resistance and represent major areas of investment and growth for the European economy.

Manufacturers are well aware of the importance of safe working practices that ensure minimal release of **engineered nanomaterials (ENMs)** both within and around production plants. Increasingly they must have foresight into the full life cycle of the product.

In NanoFASE work has been carried out to **guide industry in their response to future nanomaterial regulatory obligations**. NanoFASE seeks to advance the understanding of environmental fate: where ENMs end up during their lifecycle and what changes they may have gone through. **NanoFASE has focussed on the exposure side of the risk equation,** delivering mathematical tools to model the predicted environmental concentration (PEC) of nanomaterials to which organisms in the environment could be exposed.

The NanoFASE Clickable Framework provides a host of resources to understand exposure assessment of ENMs in the environment:

- Key processes of transformation that nanomaterials may undergo before, during and after being emitted into the environment;
- Fate descriptors that can be used to quantify rates of nanomaterial transformation in the different compartments or 'reactors' of the environment (air, soil, water and biota) as well as waste management installations;
- The NanoFASE Model Catalogue including the NanoFASE water–soil–organism (WSO) model.

Visit the Site Map to get a full overview of the 160 pages available in the Clickable Framework. They have for the most part been written with a broad range of stakeholders in mind.

In NanoFASE we are road-testing our exposure assessment framework. Seeking to bridge industry requirements with the environmental science community we bring realism to production volume estimates and release estimates while being clear that there is more work to be done to avoid overestimations and uncertainties in these quantities.

The NanoFASE case studies of nano-enabled products systematically highlight potential emission routes during the life cycle of a product all of which can be checked during industry safety assessments. Depending on the industrial methods and applications performed at each life cycle stage, release rates and pathways to different environmental reactors will differ. NanoFASE therefore collected information for a detailed **release pathway analysis** of a dozen nano-enabled products, through direct surveys of industry actors as well as from the literature, especially regarding the transformations ENMs might undergo during use or end-of-life release. On the way NanoFASE developed the **first inventory of ENM production, ENM use and ENM release modelled at European Member State level** for TiO_2, Ag, ZnO, carbon black and Cu-based nanomaterials.

Tiered Assessment Approach

While the NanoFASE Clickable Framework is not a live decision-support tool (exposure assessment cannot be run online here) we have included a detailed example of workflow – explaining how our mathematical algorithms and models fit into a tiered assessment, moving from a first-tier 'back of envelope' estimate of predicted environmental concentration, through to third-tier precise numbers that can be provided by NanoFASE models regarding the spatiotemporal distribution of nanomaterials. Use of a higher-tier model is useful in the case that lower-tier findings when compared with risk management standards indicate that more detailed assessment is required. We have road-tested this approach and each tier of assessment by considering a hypothetical scenario based on one of our case studies involving the application of a catalytically active form of titanium dioxide to roads to reduce vehicular exhaust pollution.

The knowledge assembled here for the models, and in the NanoFASE technical reports and scientific deliverables, is most directly applicable by experienced consultants assisting industry in the case where REACH registration is required – that is, in the case where production volumes reach the threshold amount of more than one tonne of nanomaterial per year (a figure that is not to be confused with the very much larger volume of manufactured products in which the produced ENMs would in turn be employed).

> *"As a small company designing, developing and manufacturing new nanoparticle dispersions,* ***we prefer to get a competent expert in for such an important obligation as filling out a REACH dossier.*** *First of all, we have to be sure that we get it right – and secondly, the amount of time needed to address the dossier without the relevant experience would far surpass the time spent by the expert consultant to complete the process."* - Dr Selina Ambrose, Promethean Particles (NanoFASE partner and supplier).

The model furthermore could be used to predict the consequences of an incident (e.g. spill or leak) in which a one-time high concentration input of 'as manufactured' particles enters the environment at a single location.

NanoFASE Industry Insights

NanoFASE benefitted from the collaboration of a range of industry partners and advisors, who supplied particles for the empirical work, developed advanced techniques and instruments that going forward will serve Europe and other regions, pilot-tested nano-enabled applications in controlled experiments to help refine our models, and/or participated in road-testing the models.

Three short interviews highlight different facets of the NanoFASE experience for some of these valued partners.

Read more

Visit the Regulator and Academic stakeholder welcome pages.

A word from the wise (11.2017) - Interview with Prof. Peter Dobson OBE, former NanoFASE International Advisory Board Chair
Nanomaterial tracking to limit impacts on the environment (8.2017) - Article in Horizon, the EU Research and Innovation Magazine

Link awaited: Model road-testing report: Industry-centred guidance –**Visit the searchable NanoFASE Library to find reports and summaries, presentations, and peer-reviewed articles (50 and counting)** as they are continuously uploaded.

Relevant publications from inside and outside the project are referenced on most pages of the Clickable Framework.

NanoFASE is assembling the project learning into fact sheets and a set of major publications planned for submission in Autumn 2019. This includes an Environmental Science: Nano virtual special collection detailing the empirical methods and conclusions, exposure modelling, and the overall impact on environmental risk assessment. The Stakeholder Welcome page and our Downloads menu will be updated as such publications become available.

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With thanks to our interviewees:

		
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