Advancing exposure knowledge and its uptake into policy

The European exposure science strategy 2020-2030 (Special Issue)

Fantke, Peter; von Goetz, Natalie; Jantunen, Matti

Published in:
Environment International

Link to article, DOI:
10.1016/j.envint.2022.107692

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

Environment International 172 (2023) 107692

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Advancing exposure knowledge and its uptake into policy: The European exposure science strategy 2020–2030 (Special Issue)

Exposure science is an emerging field focusing on all aspects concerning the contact between chemical, biological, physical or psychosocial stressors and human and ecological receptors. With that, exposure science is central in protecting human and ecosystem health and contributes to the global transition towards green and sustainable societies. Recent advancement in exposure science has been huge. Today, the coverage of exposure methodologies extends from local microenvironments (Vuorinen et al., 2020) to cities worldwide (Apte et al., 2012), and enables, for example, aggregated characterization of population exposure to indoor and outdoor sources (Fantke et al., 2017), geospatial pollutant source-to-exposure analysis (Wannaz et al., 2018), or integrated assessments of urban and country level climate change abatement policies (Liu et al., 2017).

In Europe, however, exposure science is not yet sufficiently recognized as a scientific field, resulting in disconnected scientific advancements, underrepresentation in academia, and ineffective uptake into policies and decision support. In response, the wider European exposure science community developed an overarching 'European Exposure Science Strategy 2020–2030', as a coordinated effort under the guidance of the 'Europe Regional Chapter of the International Society of Exposure Science' (ISES Europe, https://ises-europe.org).

Starting point for building such a strategy was a stakeholder-based scoping process, in which five key priority areas were defined for advancing exposure science and improving the uptake of exposure knowledge into policy (Fantke et al., 2020). For each key priority area, a dedicated working group was formed under the auspices of ISES Europe, namely education, policy uptake, exposure models, exposure data and human biomonitoring. Working groups consolidated the state of the science in each area and developed a strategy action plan, together forming the core of the strategy. First elements of the strategy have been published in a Special Topic of the *Journal of Exposure Science & Environmental Epidemiology* (von Goetz and Fantke, 2022). These elements include more effective uptake of exposure science into policy (Bruinen de Bruin et al., 2022), advancing exposure models (Schlüter et al., 2022), and harmonizing exposure science terminology (Heinemeyer et al., 2022).

Additional elements along with the overall strategy for exposure science in Europe have been published in the present *Environment International* Special Issue. The additional elements focus on developing exposure science education (Connolly et al., 2022), advancing exposure data knowledge (Kosnik et al., 2022), increasing the relevance of human biomonitoring (Zare Jeddi et al., 2022), and discussing the crucial role of exposure science for pandemics management (Jantunen, 2022). Elements across key priority areas for exposure science have finally been compiled into an overall strategy, complemented by strategic actions for funding and international collaboration beyond European borders (Fantke et al., 2022).

All strategy elements are published open access and are available to guide the wider European and global exposure science community on its journey to advance relevant exposure knowledge and help implementing it into related policies. Furthermore, the published strategy elements are the basis of the ongoing work in the ISES Europe Working Groups, which can build on the defined overarching goals and concrete action plans. With that, the strategy enables exposure science to develop its full potential as a key discipline in protecting human and ecosystem health, and facilitating a sustainable transition of our society in Europe and worldwide.

Acknowledgements

The special issue was financially supported by the "Safe and Efficient Chemistry by Design (SafeChem)" project (grant no. DIA 2018/11) funded by the Swedish Foundation for Strategic Environmental Research, and by the PARC project (grant no. 101057014) funded under the European Union's Horizon Europe Research and Innovation program.

References

Apte, J.S., Bombrun, E., Marshall, J.D., Nazaroff, W.W., 2012. Global intraurban intake fractions for primary air pollutants from vehicles and other distributed sources. Environ. Sci. Tech. 46, 3415–3423. https://doi.org/10.1021/es204021h.

Bruinen de Bruin, Y., Franco, A., Ahrens, A., Morris, A., Verhagen, H., Kephalopoulos, S., Dulio, V., Slobodnik, J., Sijm, D.T.H.M., Vermeire, T., Ito, T., Takaki, K., De Mello, J., Bessems, J., Zare Jeddi, M., Tanarro Gozalo, C., Pollard, K., McCourt, J., Fantke, P., 2022. Enhancing the use of exposure science across EU chemical policies as part of the European Exposure Science Strategy 2020–2030. J. Eposure Sci. Environ. Epidemiol. 32, 513–525. https://doi.org/10.1038/s41370-021-00388-4.

Connolly, A., Scheepers, P.T.J., Coggins, M.A., Vermeire, T., van Tongeren, M., Heinemeyer, G., Bridges, J.W., Bredendiek-Kämper, S., de Bruin, Y.B., Clayson, A., Gerding, J., McCourt, J., Urbanus, J., Viegas, S., von Goetz, N., Zare-Jeddi, M., Fantke, P., 2022. Framework for developing an exposure science curriculum as part of the European Exposure Science Strategy 2020–2030. Environ. Int. 168, 107477.

Fantke, P., Jolliet, O., Apte, J.S., Hodas, N., Evans, J., Weschler, C.J., Stylianou, K.S., Jantunen, M., McKone, T.E., 2017. Characterizing aggregated exposure to primary particulate matter: Recommended intake fractions for indoor and outdoor sources. Environ. Sci. Tech. 51, 9089–9100. https://doi.org/10.1021/acs.est.7b02589.

Fantke, P., Bruinen de Bruin, Y., Schlüter, U., Connolly, A., Bessems, J., Kephalopoulos, S., Zare Jeddi, M., van Nieuwenhuyse, A., Dudzina, T., Scheepers, P. T.J., von Goetz, N., 2022. The European Exposure Science Strategy 2020–2030. Environ. Int. 170, 107555 https://doi.org/10.1016/j.envint.2022.107555.

Fantke, P., von Goetz, N., Schlüter, U., Bessems, J., Connolly, A., Dudzina, T., Ahrens, A., Bridges, J., Coggins, M.A., Conrad, A., Hänninen, O., Heinemeyer, G., Kephalopoulos, S., McLachlan, M., Meijster, T., Poulsen, V., Rother, D., Vermeire, T.,

https://doi.org/10.1016/j.envint.2022.107692

Available online 12 December 2022

Viegas, S., Vlaanderen, J., Zare Jeddi, M., Bruinen de Bruin, Y., 2020. Building a European exposure science strategy. J. Exposure Sci. Environ. Epidemiol. 30, 917–924. https://doi.org/10.1038/s41370-019-0193-7.

Heinemeyer, G., Connolly, A., von Goetz, N., Bessems, J., Bruinen de Bruin, Y., Coggins, M.A., Fantke, P., Galea, K.S., Gerding, J., Hader, J.D., Heussen, H., Kephalopoulos, S., McCourt, J., Scheepers, P.T.J., Schlueter, U., van Tongeren, M., Viegas, S., Zare Jeddi, M., Vermeire, T., 2022. Towards further harmonization of a glossary for exposure science – an ISES Europe statement. J. Eposure Sci. Environ. Epidemiol. 32, 526–529. https://doi.org/10.1038/s41370-021-00390-w.

Jantunen, M., 2022. Pandemic management requires exposure science. Environ. Int. 169, 107470 https://doi.org/10.1016/j.envint.2022.107470.

Kosnik, M., Kephalopoulos, S., Muñoz, A., Aurisano, N., Cusinato, A., Dimitroulopoulou, S., Slobodnik, J., De Mello, J., Zare Jeddi, M., Cascio, C., Ahrens, A., Bruinen de Bruin, Y., Lieck, L., Fantke, P., 2022. Advancing exposure data analytics and repositories as part of the European Exposure Science Strategy 2020–2030. Environ. Int. 170, 107610 https://doi.org/10.1016/j.envint.2022.107610.

Liu, M., Huang, Y., Jin, Z., Liu, X., Bi, J., Jantunen, M.J., 2017. Estimating health co-benefits of greenhouse gas reduction strategies with a simplified energy balance based model: The Suzhou City case. J. Clean. Prod. 142, 3332–3342. https://doi.org/10.1016/j.jclepro.2016.10.137.

Schlüter, U., Meyer, J., Ahrens, A., Borghi, F., Clerc, F., Delmaar, C., Di Guardo, A., Dudzina, T., Fantke, P., Fransmann, W., Hahn, S., Heussen, H., Jung, C., Koivisto, J., Koppisch, D., Paini, A., Savic, N., Spinazze, A., Zare Jeddi, M., von Goetz, N., 2022. Exposure modelling in Europe: How to pave the road for the future as part of the European Exposure Science Strategy 2020–2030. J. Eposure Sci. Environ. Epidemiol. 32, 499–512. https://doi.org/10.1038/s41370-022-00455-4.

von Goetz, N., Fantke, P., 2022. Promoting recognition and implementation of exposure science in Europe: First elements of a European Exposure Science Strategy 2020–2030. J. Eposure Sci. Environ. Epidemiol. 32, 497–498. https://doi.org/10.1038/s41370-022-00458-1.

Vuorinen, V., Aarnio, M., Alava, M., Alopaeus, V., Atanasova, N., Auvinen, M., Balasubramanian, N., Bordbar, H., Erästö, P., Grande, R., Hayward, N., Hellsten, A., Hostikka, S., Hokkanen, J., Kaario, O., Karvinen, A., Kivistö, I., Korhonen, M., Kosonen, R., Kuusela, J., Lestinen, S., Laurila, E., Nieminen, H.J., Peltonen, P., Pokki, J., Puisto, A., Råback, P., Salmenjoki, H., Sironen, T., Österberg, M., 2020. Modelling aerosol transport and virus exposure with numerical simulations in relation to SARS-CoV-2 transmission by inhalation indoors. Saf. Sci. 130, 104866.

Wannaz, C., Fantke, P., Lane, J., Jolliet, O., 2018. Source-to-exposure assessment with the Pangea multi-scale framework - Case study in Australia. Environ. Sci. Processes Impacts 20, 133–144. https://doi.org/10.1039/c7em00523g.

Zare Jeddi, M., Hopf, N.B., Louro, H., Viegas, S., Galea, K.S., Pasanen-Kase, R., Santonen, T., Mustieles, V., Fernandez, M.F., Verhagen, H., et al., 2022. Developing human biomonitoring as a 21st century toolbox within the European Exposure Science Strategy 2022–2030. Environ. Int. 168, 107476 https://doi.org/10.1016/j.envint.2022.107476.

Peter Fantke *
Quantitative Sustainability Assessment, Department of Environmental and Resource Engineering, Technical University of Denmark, Produktionstorvet 424, 2800 Kgs. Lyngby, Denmark

Natalie von Goetz
Swiss Federal Office of Public Health, Schwarzenburgstr., 157, 3003 Bern, Switzerland
Swiss Federal Institute of Technology (ETH) Zurich, Institute for Chemical and Bioengineering, Vladimir-Prelog-Weg 1-5, 8093 Zurich, Switzerland

Matti Jantunen
Research Professor Emeritus, Kuopio, Finland

* Corresponding author.
E-mail address: pefan@dtu.dk (P. Fantke).