Exposure coefficients in the EUCalculator

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# Introduction

The exposure coefficients of the EUCalculator (EUC) are based on the GAINS model. The GAINS model methodology is described in (Amann et al., 2011). It is an integrated assessment model of air pollution, and features both an emissions model for various air pollutants (relevant here are primary PM2.5, SO2, NOx, NH3 and VOC), as well as a reduced-form atmospheric transfer model, which can be used to calculate annual average PM2.5 concentrations at the grid level or as a population-weighted mean at the national scale. For Europe, the atmospheric transfer matrices used for the concentration and exposure calculations were derived from the EMEP model. They have been used by GAINS and the EU Commission to design proposals for the National Emission Ceilings Directive in a series of assessments (Amann et al., 2012b; Rafaj et al., 2012; Oenema et al., 2012; Borken-Kleefeld and Ntziachristos, 2012; Cofala and Klimont, 2012; Amann et al., 2012a, 2012d, 2012c; Kiesewetter et al., 2013; Amann et al., 2013, 2014a; Kiesewetter and Amann, 2014; Amann et al., 2014b, 2014c) , as well as for designing a potential flexibility mechanism under the directive (Amann and Wagner, 2014).

# Data and caveats

The data are based on GAINS, and in particular, on a scenario that reflects both the World Energy Outlook 2018 Energy scenario of the International Energy Agency (IEA), as well as the energy structure of the PRIMES model and air pollution controls at the country level (WEO2018\_NPS\_CLE\_UPD). Data are available for EU28 and Switzerland, and the years 2005 until 2050 in 5-year steps. The present data set contains four subsets of data:

1. Energy-related exposure per person per PJ. In these units this corresponds to a concentration in mu g/m^3 in a receptor country per PJ combusted in a source country. Source and receptor countries are given as ISO codes. The sectoral structure (agriculture, power, industry, transport, buildings), subsector and technology structure is the EUC structure; the GAINS structure was mapped onto the EUC structure. The data are time-dependent, reflecting the change in the air pollution legislation over time and its impact on emission factors (and penetration of emission control technologies).
2. Process-related exposure per person per unit of product. In some industrial production processes PM2.5 and its precursors are not only related to the energy combustion used for the process, but to the process itself. This is reflected in this factor. The total contribution from producing a product is thus the sum of the energy-related part and the process-related part. The unit of product is typically Mt of product, except for livestock (where the unit is livestock-unit LSU), and fertilizer application. [exception: for non-metallic minerals (cement, lime, and glass), all emissions are absorbed into the process-related emissions, and thus intensities are only given per unit of product.]
3. A specific set for transport related emission factors is supplied for brake and tyreware.
4. Finally, an exposure- or concentration related transfer factor is presented that can be used more generically on emissions of pollutants (i.e. not per unit of activity). In this context it is important to note that the coefficients are still sector-specific, since low-level sources enter the calculation differently from high-level sources. Again, the methodology that was applied here has been described in the TSAP reports.

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