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DOI:
10.1021/acs.est.0c05010

Document Version
Peer reviewed version

Citation for published version (Harvard):
Wemken, N, Drage, DS, Abdallah, MA-E, Harrad, S & Coggins, MA 2020, 'Response to comment on "Concentrations of brominated flame retardants in indoor air and dust from Ireland reveal elevated exposure to decabromodiphenyl ethane"', *Environmental Science and Technology*, vol. 54, no. 18, pp. 11634-11635. https://doi.org/10.1021/acs.est.0c05010

Response to Additional Perspectives on Methodology and Interpretation of Wemken et al. 2019

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We thank Thomas Osimitz and coauthors for their letter[1] regarding our paper entitled "Concentrations of Brominated Flame Retardants in Indoor Air and Dust from Ireland Reveal Elevated Exposure to Decabromodiphenyl Ethane", published last year (2019) in *Environmental Science and Technology*[2].

We are grateful that they support our view that "*High-end estimates of exposure to BDE-209 for Irish adults, toddlers, and school children are 100 ng/kg bw/day, 2500 ng/kg bw/day, and 1100 ng/kg/day, respectively, and below the USEPA reference dose (RfD) value for adults of 7000 ng/kg bw/day. Those for Octa-BDE (BDE-183), Penta-BDE (BDE-47 and BDE-99), and Σ HBCDD are also below USEPA guidelines*"[2]. We are also pleased that they highlight our previous work[3] showing that exposure of some UK children to BDE-209 via indoor dust

exceeds the USEPA's RfD. We also note that other researchers[4] have suggested a much lower exposure limit for BDE-99 – e.g. a maximal allowed intake level of 0.26 ng/kg bw/day. Moreover, in November 2017, the United Kingdom's Committee on Toxicity (UK COT) expressed "*potential concern* (about) *BDE-99 and -153 exposure from breast milk at age 12-18 months, and for exposure to BDE-99 and -209 in dust and soil in children aged 1-5 years*".[5] We further highlight that the RfD that Osimitz et al applied for HBCDD of 200 μg/kg bw/day, was calculated by the National Academy of Sciences (NAS), using data from an unpublished subchronic study performed in rats in 1970[6]. The NAS concluded that confidence in this RfD for HBCDD is low, because of a lack of other subchronic and chronic studies. Moreover, in October 2016, the UK COT stated that "*high levels* (of HBCDD) *in household dust continues to be a cause for concern*" [7], citing a toxicological reference point of 3 μg/kg bw/day.

Turning now to DBDPE, the RfD cited by Osimitz et al is not formally recognized and originates from a comment in *Environmental Science and Technology.*[8] It is based on the lowest NOAEL of 1,000 mg/kg bw/day in a 90-day repeated dose study in rats[9], with subsequent application of the EPA's maximum recommended composite uncertainty factor (i.e. 3,000). While this value does indeed provide some reassurance, we note that the NOAEL on which it is based was published in 2002. Moreover, we note further the EPA's 2014 assessment of alternatives to Deca-BDE, which rates DBDPE a similarly high hazard to Deca-BDE with respect to developmental toxicity[10]. This is concerning as the endpoint that drives the EPA's RfD for Deca-BDE is neurodevelopmental toxicity. Finally, we highlight that risk assessment based on our measurements of DBDPE concentrations in indoor air and dust, does not take into account exposures via dermal uptake from treated fabrics, from the diet, and via human milk for breast-fed infants. Taking such additional exposures into

account will inevitably increase the Hazard Quotient and in conclusion we stand firmly by our statement that "detailed study of the health implications of exposure to DBDPE is thus recommended."[2]

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