

Interactive comment on “Perfluorocarbons in the global atmosphere: tetrafluoromethane, hexafluoroethane, and octafluoropropane” by J. Mühle et al.

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Thank you very much for the opportunity to comment on this important paper, which clearly demonstrates, through advanced measuring and modelling methods, a gap between atmospheric concentrations of CF₄, C₂F₆ and C₃F₈ and available historical national and sectoral bottom-up emission inventories.

However, the variability in bottom-up data quantity and quality and lack of clarity in inventory methodologies does not allow for sources of the “missing emissions” to be identified. The authors’ discussion of such sources is out of place in this paper – given that the discussion detracts from the quality of science behind the atmospheric

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concentration and emission trend data - and their conclusions conjectural and without basis.

p6489, lines 10-12 Uncertainties in the magnitude and temporal evolution of emission factors from non-aluminium industry sources is a limiting factor of greater importance than uncertainties in the aluminium sector data. The methodology employed by the IAI anode effect survey to develop global annual sector wide emission factors is transparent and consistent (ref.). No such bottom up methodology exists for semiconductors/electronics and extrapolation of EDGAR data (a hybrid of bottom up and top down sources – p6506, line 5) for these industries will realise emission factors as indicative of global electronics/semiconductor industry emissions as using EDGAR data for aluminium industry emissions (i.e. uncertain, under estimated and tautological).

Therefore, in the absence of a comparable methodology for calculating non-aluminium industry emissions bottom up, the task of estimating contributions from sectors is currently impossible. A highly uncertain route, though one which would be more certain than that employing linear extrapolation of EDGAR hybrid data would be to subtract the bottom up aluminium industry data from atmospheric measurements to develop estimates of emissions from other (non-reporting) industries. I could understand why the authors would not want to do this, though I cannot see why they might follow the converse route of subtracting extrapolated EDGAR based (uncertain) electronics data, plus annual IAI (more certain) anode effect and PFC measurement data, from atmospheric measurements and apportioning the remaining emissions to unreported aluminium industry sources.

Ergo, there is no place in this document for apportioning emissions by sector.

p6507, lines 4-8 China has only been PFPB-only producer since the mid 2000s. It should be made clear that the average China emission factor (median) derived from measurement data can only be applied to the industry as a whole since China became

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a 100

p6507, lines 18-30, p6508, lines 1-5 The order in which potential causes of error in CF4 emissions are discussed does not reflect their relative probability, but rather a value judgement of the authors. "Indications" of technology upgrades in the semiconductor/electronics industry should not be given more credibility than published measurement data from Chinese smelters and transparent, consistently reported annual, bottom up survey data. Nor should the linear extrapolation of methodologically "unclear" EDGAR data be rated more credible and accurate than IPCC methodologies that are subject to a regular review process.

p6507, line 30 Please expand on potential mis-application of IPCC methodologies by IAI, or delete.

p6508, lines 11-15 IAI Anode Effect Survey reported data has almost 100

P6511, lines 2-6

I don't believe the authors can go further than this statement, other than to point out the relative certainty in the databases and therefore where one might look for the "missing" data/emissions. There is an "inherent underestimation" in the bottom up inventory of emissions sources, but why this should be apportioned to the IAI anode effect survey (the global aluminium industry) and not to other sources is not clear.

P6514, lines 20-24 There is a missing element in the list of emission estimates

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(UNFCCC, EDGAR, IAI) and that is the bottom up estimation of semiconductors/electronics. The fact that such an estimation/methodology does not exist does not exclude it from scrutiny.

If we look at (relative) availability of data and transparency of methodology it is clear that there are other places to look than the IAI's database for "missing emissions" (see Fig 1).

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	Inventories				
	AGAGE	UNFCCC	EDGAR	Aluminium sectoral (IAI)	Semi-conductor sectoral
Transparency of methodology	Green	Yellow	Red	Green	n/a
Coverage (before extrapolation)	Green	Yellow	Yellow	Yellow	Red

Fig. 1. Inventory data availability & quality of methodology