

## Editor Initial Decision: Reconsider after minor revisions (Editor review)

Dear Dr. Shindell,

Thank you very much for your positive and constructive response. We have, as discussed below, revised the paper according to your suggestions.

1) On page 3, lines 91-94 it states that previous studies included banks but ‘the focus in discussing climate change effects was only on emissions and radiative forcing’. This is a useful addition you made in response to reviewer 2, but I think could be even clearer, as your study also presents emissions and radiative forcing. You might add at the end of that line something like ‘only on emissions and radiative forcing and did not highlight (or point out) the lag between production and emissions’.

**Response:** We agree that it is important to be as clear as possible. The following text has been added at the end of the sentence: “... and the fact that the time lag between production and emissions results in a bank and associated hidden climate impacts was not discussed.”.

2) That same sentence states that previous studies such as Velders et al 2012 included banks but did not focus on them. However, on page 4, lines 102-104 it says: the benefits of earlier HFC phaseouts will be greater than previous estimates, where only emissions, concentrations, and radiative forcing were considered but not banks (UNEP, 2011a; Velders et al., 2012). This seems to contradict the prior statement about banks being included in the earlier work. The same sentence on p4 still seems not perfectly clear to me either. Did the previous estimates include emissions based on production with no banking? Wouldn't that lead to about the same benefits in the long-term, and they would simply have been too early in the prior studies? The results of the current study seem clear and are well presented, but it seems very important to be as clear as possible about how they relate to the prior studies and that's still not quite clear to me.

**Response:** You are correct that the sentence is not completely clear. Banks were sometimes used in the modelling (in e.g. Velders et al., 2012), but the effect on climate of only the BAU HFC emissions up to, e.g., 2050 were considered, not the effect of the bank remaining in 2050. In a mitigation scenario the effect of the bank would be implicitly included, but the previous studies (Velders et al., 2012, Gschrey, 2011) mostly discussed BAU scenarios.

The sentence has been changed to “Here we show that the benefits of earlier HFC phaseouts will be greater than previous estimates, where emissions, concentrations, and radiative forcing were considered, but not the effects of the banks remaining at the end of the period examined ...”.

3) At the start of section 4 you state that you will use 100-yr GWP to create a CO<sub>2</sub>e scale. Here I think it is important to note that 100-yr GWP provides only a rough approximation to the climate impact at that point in time, and does not imply equivalent impact at either shorter or longer timescales. This is quite an important issue when you're comparing gases with very different lifetimes, as you can get the same GWP<sub>100</sub> from a short-lived HFC as from a long-lived gas like CO<sub>2</sub>, but the short-lived HFC will have all of its impact on RF (and hence much of its impact on climate) early on in the 100 yr integration period while the long-lived will be

much more evenly distributed, and hence even the 100 yr temperature change is unlikely to be equal (let alone other times). I know this is not your primary point and I think it would be distracting to use multiple timescales or metrics, but it's nonetheless important to point out that CO<sub>2</sub>e doesn't really mean the emissions are equivalent to CO<sub>2</sub> emissions or to each other for the various gases studied here (see, e.g., the discussion of CO<sub>2</sub>e in chapter 8 of IPCC AR5), especially for something like this paper that will hopefully be read by policy-makers.

**Response:** You make a valid point here. The GWP(100 yr)-weighted emissions are only a metric used here to compare the different quantities (production, emissions, banks) and species. Clearly, the effects for climate of short-lived HFCs are different than of longer lived CO<sub>2</sub>.

To point this out we added the following sentences to Section 4: "CO<sub>2</sub>-eq is used as a simplified climate metric to compare different quantities in terms of their integrated radiative forcing over this time horizon. However, it is important to recognize that even for two emission scenarios of identical CO<sub>2</sub>-eq, if the emitted gases have different lifetimes, the effects on climate will be different at different times (Myhre and Shindell, 2013). For example, in the case of identical CO<sub>2</sub>-eq emissions, the shorter lifetimes of HFCs (compared with the atmospheric residence time of CO<sub>2</sub>) will result in a faster and larger larger short-term climate response to radiative forcing (e.g., on a 20-year time horizon) changes after HFC emissions than the much longer and nearly irreversible response after CO<sub>2</sub> emissions (Solomon et al., 2009)".