Journal: Atmospheric Chemistry and Physics

Title: Electricity savings and greenhouse gas emission reductions from global phase-down of hydrofluorocarbons

MS No.: acp-2020-193

Referee #1 (Anonymous)

The authors have significantly improved the presentation and figures of the manuscript.

Authors' Response: We thank the Anonymous Referee for his/her constructive comments and many helpful suggestions on how to improve the manuscript. Below we provide detailed point by point replies to the questions.

Minor comments:

1. *L21-23: Mention here that this is under the assumption that the current technologies are used to generate electricity. If the world rapidly switched to sustainable energy the savings are different.*
   Authors' Response: We do agree with the reviewer's comment that the savings in greenhouse gas emissions will be lower if the world rapidly switched to sustainable energy. In L21-23, the higher number - 631 Pg CO_2 equivalent (under technical energy efficiency potential) follows the assumption that the current technologies are used to generate electricity under IEA/WEO current policies scenario. The lower number - 411 Pg CO_2 equivalent (under economic energy efficiency potential) follows the IEA/WEO sustainable development scenario that outlines an integrated approach to achieving internationally agreed objectives on climate change, air quality and universal access to modern energy. In addition, Table 5 presents the full range of the cumulative reductions in greenhouse gas emissions 2018-2100 under different scenarios analyzed in this study due to electricity-savings induced by HFC phase-down when assuming technical and economic energy efficiency improvement potentials (by Kigali Amendment party groups) following the current policies, new policies and sustainable development scenarios. As suggested, we have rephrased the sentence as follows (L21-24):

   "The combined effect of HFC phase-down, energy efficiency improvement of the stationary cooling technologies and future changes in the electricity generation fuel mix would prevent between 411 and 631 Pg CO_2 equivalent of GHG emissions between 2018 and 2100, thereby making a significant contribution towards keeping the global temperature rise below 2°C."

2. *L32: mention "for a 100-yr time horizon"*
   Authors' Response: As suggested, we have rephrased the sentence as follows (L32-34):

"Many HFCs are potent greenhouse gases (GHGs) with a global warming potential (GWP) up to 12400 times that of CO_2 per mass unit (IPCC, 2013) *over a 100-year time horizon*."

3. *L161: "reduced greenhouse gas emissions …"*
   Authors' Response: As suggested, we have rephrased the sentence as follows (L160-163):
   "Extended refrigeration of food would also mean reduced food losses, which apart from having important implications for meeting nutritional needs, would also contribute to *reduced greenhouse gas emissions* from food production and better use of the 23–24% of global cropland and fertilizers currently used to produce food that is eventually wasted (Kummu et al., 2012; Hiç et al., 2016)."

4. *L303: the term 'non-Article 5 countries' is used here for the first time. Mention in brackets 'developed countries'.*
   Authors' Response: Thanks for pointing this out. As suggested, we have rephrased the sentence as follows (L302-305):
   "Many of these alternatives are widely used in non-Article 5 *(developed countries)* countries in response to national or regional regulations that require reductions in HFC use. The availability and uptake *of these alternatives* is rapidly increasing also in Article 5 countries (Reese, 2018; UNEP, 2019)."

5. *L464: 'to be used'*
   Authors' Response: As suggested, we have rephrased the sentence as follows (L464-465):
   "Hydrofluorocarbons (HFCs) are manufactured *to be used* as substitutes for ozone-depleting substances that are being phased out globally under Montreal Protocol regulations."

6. *L465: HFCs are greenhouse gases, not their emissions. Rephrase "HFCs are strong greenhouse gases and as such their emissions are targeted …"*
   Authors' Response: As suggested, we have rephrased the sentence as follows (L465-466):
   "HFCs are strong greenhouse gases, with a global warming effect up to 12,400 times greater than carbon dioxide, and their emissions are rising strongly."

7. *L498: I don't think it is only up to policymakers to address energy efficiency improvements. Industry and consumers also play a role here.*
   Authors' Response: Thank you for pointing this out. As suggested, we have rephrased the sentence as follows (L498-501):
   "Hence, significant additional reductions in global warming can be achieved if *policymakers, manufacturers, industry and other stakeholders (e.g. consumers, utilities etc.)* address energy efficiency improvements in cooling technology simultaneously with requirements for HFCs substitution."

8. *L501-502: Mention here that this is under the assumption that the current technologies are used to generate electricity. If the world rapidly switched to sustainable energy the savings are different.*
   Authors' Response: As suggested, we have added the following sentence here (L507-509):
   "It may be noted that the higher range follows the assumption that the current technologies are used to generate electricity under the current policies scenario whereas lower range reflect transition towards sustainable energy under the sustainable development scenario."

9. *L509: "as the associated greenhouse gas emission reductions …"*
   Authors' Response: As suggested, we have rephrased the sentence as follows (L512-513):
   "A key policy finding is the importance of paying careful attention to the electricity-savings that can be reaped in the transition away from HFCs in stationary cooling appliances, *as the associated greenhouse gas emission reductions are significant*."

10. *L851: "Greenhouse gas emission mitigation …"*
    Authors' Response: Corrected in the revised version of the manuscript (see: L855 o the revised manuscript).