Referee #1 (L. Kuijpers)

We thank Dr. Kuijpers for his comments and helpful suggestions on how to improve the manuscript. Below we provide detailed point by point replies to the questions. Referee comments are quoted in italics with authors' responses in blue.

1. *The paper describes the various F-gas emission issues, via the referencing of literature sources, in an exhaustive way. In so far, it is good to note that the GAINS results support emissions for the years 2005 or 2010 as published in other sources (section 1). The assumption for the growth in emissions between 2005 and 2050 is something different and specific for this investigation reported. However, currently, the (future) F-gas consumption and emissions variables are changing rapidly due to technology changes and due to ongoing implementation of national and international regulations. It implies that many references to numbers or orders of magnitude dated 2005, 2007, 2009 etc. may support certain numbers calculated or used in this investigation, however, if they are used with later references (or numbers based on later assumptions) they must be adding to the uncertainties level. A comment in the beginning, in section 1, underlining this, would be desirable.*

Authors' Response: We have incorporated all national and international regulations to control F-gas emissions adopted before July 2016 in our baseline scenario as shown in Table 1 of the manuscript. As suggested, a comment in the beginning in lines 21-23 of Section 1 is added. "*A baseline scenario for future F-gas emissions is developed taking account of future emission control expected from national and international legislations adopted before July 2016 when this paper was first submitted. Hence, the baseline scenario does not account for the effects of the amended Montreal Protocol agreed in Kigali, Rwanda, in October 2016.*"

2. *On the same issue, it is not until page 7 that the paper mentions the adoption of the Kigali Amendment. The Kigali agreed measures may not have much of an impact on certain existing regulations in some larger developed countries or regions, they will have substantial influence where it concerns the global consumption and emissions of F-gases (in particular from developing countries) after 2020-2025. Rather than mentioning this in a paragraph on page 7, this issue should be part of section 1. Furthermore, the article mentions that the (future) Kigali induced changes will be subject of a further (future) analysis. It would be helpful if the authors could give an indication in how far the results in the present paper (GAINS investigation) remain valid and in which way they are expected to change via the introduction of "Kigali induced changes" in the model calculations that will form the basis of the future analysis of abatement potentials and costs.*

Authors' Response: As the first submission of this paper was a few months before the Kigali amendment was agreed, we could not have foreseen the result of the meeting and therefore

consider it outside the scope of this paper. It is however our duty to make sure readers early on are aware of that the baseline presented here does not take account of the effects of the Kigali meeting. To stress this even further, we now mention this already in Section 1 lines 22-23. The Kigali meeting does of course not change the F-gas analysis tool of the GAINS model which is presented in this paper. It changes the input assumptions on the level of control adopted and would render a lower expected baseline emission pathway. But making a complete analysis of the impact of the Kigali amendment is out of scope for this paper. It is however our intention to include it in a separate forthcoming paper.

3. *On page 8, lines 24-25, it mentions that HFC-23 emissions are expected to remain at the current level. Is this consistent with the considerations of the Chinese approach to mitigate HFC-23 emissions as reported in lines 12-23 on this same page?*

Authors' Response: Yes, we have tried to find a compromise that is reasonably consistent with the limited information that is available. Our assumption is that the current level of control (not emissions!) remains constant (at 36%) also into the future. It is of course difficult to speculate about the effectiveness of the Chinese subsidy-scheme in the long run as it is phased-out by 2020, but with the additional policies directed at new installations, we come to the conclusion that the current level of control is at least not likely to decline in the future. Hence, the assumption that the current level of control is maintained into the future. To make the adopted assumption clear, we have added a sentence on this in p.8 lines 24-29 – "*Due to difficulties in assessing the overall impact of the above-mentioned Chinese policies to control HFC-23 emissions from HCFC-22 production, we make a general assumption in the baseline scenario that the current control level of 36 percent will at least not decline and keep it constant into the future.*"

4. *On page 12, line 17, it says, "under the MP, HCFCs in emissive use should be virtually phased out by 2030, but still allowing for refills of the existing stock until 2040". One would need to consider that the MP allows for a remaining 2.5% of the HCFC baseline between 2030-2040, but that is not necessarily a refill of the existing stock (servicing), although it is true that the allowed consumption should be used for servicing.*

Authors' Response: Thank you for pointing this out. We have now replaced the word "refills" with "servicing" which is probably a more accurate term to use in this context.

5. *On page 12, line 18-19 it is mentioned that the HFC-23 emissions are expected to grow significantly in China. Is this consistent with what is mentioned on page 8? (as far as I have seen information for the period after 2013, there is a continuous decrease in China for HFC-23 emissions from HCFC-22 production, including feedstock).*

Authors' Response: Yes it is consistent with the assumptions from p.8. As explained above, we assume the level of control remains at the current level of 36% also in the future. As production of HCFC-22 for feedstock use is expected to grow in China (in GAINS driven

proportionately to expected growth in industry value added), the result is a steady growth in future emissions from this source.

6. *Page 16, line 24, change to "fluorinated".*

Authors' Response: Corrected in the revised manuscript.