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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The effects of energy paths and emission controls and standards on future trends in China's emissions of primary air pollutants" *by* Y. Zhao et al.

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Title: The effects of energy paths and emission controls and standards on future trends in China's emissions of primary air pollutants

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We thank very much for the valuable comments from reviewer 1, which help us improve the quality of our manuscript. Following is our point-by-point responses to those comments and corresponding revisions.

Reviewer #1

1. The paper predicted annual emissions of SO2, NOX, and PM for 2015, 2020, and 2030 based on different scenarios. Is it possible to also include emissions for 2025?

Response and revisions: We thank the reviewer's comment. Yes, in the revised manuscript, the emissions for 2025 are carefully analyzed with the same methods for 2015, 2020, and 2030. Relevant tables and figures are correspondingly updated as well, integrating the detailed information of the year 2025.

2. Total PM shall be TSP. In addition, the energy related activities also emit VOCs. Is it possible for the authors to give the results of VOCs emissions?

Response and revisions: We thank the reviewer's comment, and TSP is consistently used in the revised manuscript. We agree with the reviewer that VOC comes partly from energy related activities. However, high uncertainty might exist under current framework of emission projection in this work, since VOC is less stressed in current emission control polices and standards. It is similar for some other species such as NH3 and CO. Therefore we have added a paragraph in Section 4.2 in the revised manuscript, with discussion and suggestion for future work for VOC emissions.

3. Page 7923 Line 24-27: although the authors give a reference here, it is better that they give a brief description on how they consider the slower increases in electricity demand and more penetration of renewable power.

Response and revisions: We thank the reviewer's suggestion. In the revised manuscript, we've added a paragraph explaining the assumptions and the reasons for slower increase in electricity demand and more use of renewable power. It is mainly driven by the decreased electricity consumption per unit production of GDP and the development plan of renewable energy by National Energy Administration of China. The most recent report by National Energy Administration is also added as a new reference.

4. MMT used in the manuscript: is it for physical coal amount or coal equivalent? In

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fig. 1, the MMT is also used for oil consumption, is it MMT oil? Please clarify

Response and revisions: MMT in the manuscript is used as physical amount unit, both for coal and oil consumption. As required by the reviewer, the units in Fig.1 are clarified in the revised manuscript.

5. Table 1: the authors assume that the recently issued emission standards will be fully implemented under the STD scenario, which means that the emission standards would not be fully implemented under the other two scenarios. At what levels the standards will be implemented under BAS and REF scenarios? What are the rationale of this assumption? This point shall be clarified.

Response and revisions: We thank the reviewer's crucial comment here. In the BASE, we conservatively assume that emission control levels would be unchanged from those in 2010, and in the REF, new improvements of emission control are taken into account according to the national action plan of air pollution prevention and control (NAPAPPC). Those actual emission levels, however, do not necessarily satisfy the current emission standards, particularly for small and energy-inefficient industrial sources. The reasons include 1) some old and small sources have not been retrofitted with new emission control devices; and 2) the more important, the actual benefits of air pollutant control devices (APCD) are not as sufficient as expected, attributed mainly to relatively poor management and operation of APCDs for cost saving. Such situation still exists across the country according to Ministry of Environmental Protection (MEP) and our field investigation (unpublished yet). In the STD, not only current but also some proposed emission standards with more stringent emission limits are assumed to be fully satisfied, and it is thus an ideal case exploring the potential of those standards on emission abatement. We clarified this at the first paragraph of Section 3 in the revised manuscript.

6. Section 3: There have been quite a few new studies on the emission factors of Chinese sources. This reviewer suggests the authors to include the most recent studies

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in this paper.

Response and revisions: We thank the reviewer for pointing this out, and yes, we have checked through the recent studies conducted in China and updated the emission factors, particularly for transportation and residential sectors. We stress this issue in Sections 3.5, 3.6 and 4.5 of the revised manuscript. The relevant papers have been added as new references in the manuscript.

7. Fig. 2: This figure is hard to read. To make it clearer, I suggest the authors to separate this figure into two. One figure shows the projected trends in penetrations of technologies for typical sources in China from 2010 to 2030. The other one gives the changes of emission factors, which shall be exact values and not the percentage relative to 2010 levels.

Response and revisions: We thank for the reviewer's comment. In the revised Figure 2, we follow the reviewer's suggestion and indicate the exact values of emission factors in each panel. The detailed penetrations of APCDs are independently provided in Figure S2 and S3 in the supplement, thus we illustrate the penetrations of production technologies and emission factor trends in the same panels for comparisons in Figure 2. The figure captions and the titles of y-axis are improved as required by the reviewer to avoid ambiguity.

8. In current manuscript, only the trends of technologies penetrations and emission factors for NPS are given. I think it is also important to give such information for CPS and 450S.

Response and revisions: As we mentioned in the manuscript, the penetrations and emission factor trends for CPS and 450S are similar as those for NPS. Given the paper length, we have provided the information for NPS in the main text (Figure 2), and added the information for CPS and 450S in the supplement (Figure S4 and S5, respectively).

9. Fig. 3: results for PM10 shall be given.

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Response and revisions: The results for PM10 have been illustrated in Figure 3(d) of the revised manuscript, as required by the reviewer.

10. Section 4.2: Except for the emission control levels, the activity levels have significant impacts on future emission trends. The reviewer is wondering whether it is possible to add more discussions on the uncertainties of future energy consumptions used in this study.

Response and revisions: We thank the reviewer's comment and agree with the reviewer that the projection of energy trends play important roles on future emission estimate. In particular, the energy trends could be significantly influenced by the national/local energy policies that are currently unavailable and thus cannot be combined into the emission inventory framework. We have added a paragraph in Section 4.2 stressing such uncertainties from activity levels, as required by the reviewer.

11. Section 4.3: Please include the following study in the comparison: S. X. Wang, B. Zhao, S. Y. Cai, Z. Klimont, C. Nielsen, M. B. McElroy, T. Morikawa, J. H. Woo, Y. Kim, X. Fu, J. Y. Xu, J. M. Hao, and K. B. He. Emission trends and mitigation options for air pollutants in East Asia. ACP, 2014, acp-2013-1012

Response and revisions: The study has been included in the revised manuscript, and Figure 4 has been revised accordingly, as required by the reviewer.

12. In addition, the reviewer suggests a thorough grammar-checking by a native English speaker before the paper is published by ACP.

Response and revisions: We thank the reviewer's comment and the language of revised manuscript has been improved by native English speaker.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 7917, 2014.