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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.

**Anonymous Referee #3**

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General comments

This is an interesting paper, giving new insights on the possible development of air pollution in China. Compared with other publications on this issue, which were based on a limited access to the Chinese-specific information, the paper applies recent projections of the development of the Chinese power generation and transport sectors, up-to-date information on the Chinese air pollution control legislation as well as country-specific performance of pollution control devices.

The paper concentrates on the effects of pollution controls from power generation,



heavy industries, and from transport, which are the priority sectors in the current air quality policy. It concludes that since the Chinese legislation already requires installation of control equipment in those sectors, further reduction potential is limited. Thus it recommends more efforts aimed at a reduction of emissions from small combustion sources in the residential and commercial sectors.

Another interesting finding is that faster reduction of PM emissions and thus also alkaline substances contained in ashes compared with the reductions of acidifying substances (SO2 and NOx) may cause increased acidification of ecosystems. Interesting is also a discussion of the effects of changes in emissions of air pollutants on radiative forcing.

However, there are several issues that need to be clarified before the publication. Also, the paper needs to be carefully edited.

Page and line numbers in my review refer to the original version of the paper.

Specific comments

1. Assumed in the paper removal efficiencies of SO2 and NOx measures are lower than for the same type of control installations used in the OECD countries. Reasons for it needs to be better clarified in the paper. In particular, please explain if lower efficiencies result from different design and quality of pollution control equipment or is it due to lack of proper operation and maintenance of installed technologies.

2. Page 10: explain why the study assumes that emission standards issued will be implemented only in the STD scenario. This implies non-compliance with standards in the REF scenario. How is it possible? Does it mean that the standards are not part of the NAPAPPC?

3. Page 17, last paragraph: explain how the emission factors were measured: during test cycles or in real-life operating conditions. Current test cycles do not properly reflect the real operating conditions and thus the average emission factors are for some

vehicle types and driving modes higher than the values from the test cycles. Vehicle ageing is not the only reason for differences.

4. Explain why the “best guess” scenario assumes only partial implementation of the NAPAPPC.

5. Use TSP (as in the last line of Page 4) or total PM (as on Page 11) consequently in the whole paper.

6. Last sentence of abstract and conclusions: what wider range of pollutants do the Authors have in mind?

7. Page 7: MW electric or MW thermal input to the boilers?

8. Page 7: Is assumed coal consumption per unit of electricity constant over time? Newer units are likely to have higher efficiency.

9. Page 7, lines 10 and 11 from the bottom and Table 2: if coal consumption is given in physical tons, provide information on calorific value assumed. If the numbers are in tons of coal equivalent, specify it in the unit.

10. Page 14, 1st paragraph: it is unlikely that FGD would be used to reduce emissions from coking. Coke gas desulfurization will be used instead.

11. Page 18, 9th line: explain what the rural vehicles are.

12. Page 18, Section 3.6., 5th line: explain what is assumed. Does the replacement of coal stoves with boilers mean more district heating? Or do you mean replacement of stoves with boilers for single family houses?

13. Page 18, Section 4: Change the title to “Results and discussion”.

14. Page 20: do not understand the last sentence of the 1st paragraph. Little (or no) reduction of emissions from Stage III and IV vehicles compared to Stages I and II is due to the fact that the test cycles do not reflect real driving conditions.



15. Page 26, end of Section 4.4: I do not understand the last sentence. Reformulate or delete.

16. Conclusions: What does it mean “Compromised operational conditions. . . of e.g., SCR systems”? Does it mean that the efficiency is lower than the design efficiency? Explain. 17. I could not find the citation of the reference (MIIT, 2010). 18. Figure 4 is difficult to analyze. Suggest replacing with a table.

19. Figure 5: (a) delete “CPP” from the legend; (b) delete “for CPP+CEM+ISP”. Description of the sectors covered in (a) and (b) is in the figure caption. Rename the 2nd axis to % of national total.

20. Table S2: say that values are in percent.

21. Citations of the references in the supplement are missing.

Technical corrections

Below I suggested couple of changes in the wording for consideration by the Authors. [. . ..] means text as it is.

Page 2, line 8: unit should be teragrams.

Page 6, Section 2.2., 6th line: instead “in details” say “in detail”.

Page 14, last paragraph; replace with: For blast-furnace iron production, a national survey (MEP, 2010) determined current average emission factors for SO2 and NOx at 0.15 and 0.2 kg/t iron. These factors were applied in previous work (Zhao et al., 2013a) and used in BAS and REF cases of this study. Regarding STD. . .. technologies were investigated (SSC, 2007). The report determined the emission factors at . . ..and PM. These values were used as emission standards. . .

Page 15, 3rd and 4th lines from the bottom: Better: . . .(Zhao et a., 2013). In REF, more application . . . than cyclones is assumed, resulting in a considerable reduction. . .

Page 18, 3rd sentence, reformulate to: This is of course an ideal case providing minimum emission levels for a given vehicle population. . .

Page 18, Section 3.6: 2nd line: say . . .implemented in the near future.

Page 19, 5th line: . . . they may decrease (not it); 6th line: growth of SO2 emissions is expected (not are)

Page 20, 2nd line: better: . . .(for 450S) and to 3079 Gg. . .

Page 20: do not understand the last sentence of the 1st paragraph. Little (or no) reduction of emissions from Stage III and IV vehicles compared to Stages I and II is due to the fact that the test cycles do not reflect real driving conditions.

Page 21, 8th line from bottom: say . . .expert judgment had to be applied. . .( not have)

Page 21, 3rd line from bottom: change to: . . . uniform emission standards have been set. . .

Page 22, 7th line from bottom and Page 23, 6th line from bottom: use “differences” (not discrepancies)

Page 25, 2nd paragraph: Change to: Figure 5 shows the. . . (Figure 5(b) as well as their shares in total national emissions. It is. . .

Page 25, 7th line from bottom: change to: . . .the contributions of those sectors to national emissions are estimated to rise again after 2015. The only exception are the emissions of PM10. . .

Page 26, line 11 from bottom: change to: Implementation of energy saving and emission control measures in those sectors will be challenging because of the geographic dispersion of sources and much greater. . .

Page 27, 8th line form bottom: change to: . . .For comparison, the analogous data on PM10 and SO2 emissions for the US (USEPA, 2011) and for the European Union



(CEIP, 2011) for the period 1990 to 2010 are shown. In contrast. . . faster decrease of PM (and thus also Ca) emissions . . .

Page 28, 1st line: delete "within in".

Page 28, 2nd line: Change to: . . .improvement, further abatement of . . ..acid deposition, if further reduction of SO2 reduction is constrained.

Page 28, 13th line from bottom: change to: . . .estimate. Figure 7 shows the effects of changes in Chinese emissions between 2005 and 2030 on radiative forcing for five scenarios. Three of them: best guess (NPS-REF), CPS-REF, and 450-REF evaluate the effects of energy paths. The other two: NPS-BAS and NPS-STD demonstrate the effects of control strategies. Global emissions. . . (in preparation). The latter applies. . .

Page 28, 5th line from the bottom: play, not played.

Page 29: 1st line: delete “effects”.

Page 29: 5th line. Modify the last sentence of Section 4 as follows: Efforts to reduce emissions from the dispersed (residential) sources. . .

Page 29, Section 5, 2nd line: replace “measures in energy conservation” with “measures aimed at energy conservation”.

Page 29, last line: replace “at” with “for”.

Page 30, 12th line from the bottom”: replace “discrepancies” with “differences”.

Page 30, 9th line from bottom: say “and their spatial distributions”. . .

Figure and table captions: skip “The” at the beginning of the captions.

Caption of Figure 2 contains a long explanation. Shorten the caption to the first two sentences and move the rest to the text of the paper. Second sentence, change to: All panels are for the NPS activity scenario.

Caption of Figure 3: Change 2nd sentence to: Values are for the NPS activity scenario

and three emission control levels: BAS, REF, and STD.

Caption of Figure 7: Change to: Effects of changes in China's emissions of air pollutants from 2005 (or 2010 as in the text??) on radiative forcing for selected scenarios analyzed in this work.

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