Reviewer 1

I appreciate the authors' efforts to respond to my comments and feel that my concerns have been adequately addressed in the revised manuscript. I have a few additional suggestions below that may further improve the manuscript before final publication.

Comment 1- Figures 10-15. While greatly improved, I would still recommend using whole numbers (and perhaps a smaller number of levels) on the color scales to improve the visuals.

Response 1 – The number of color levels has been reduced from 14 to 10 in Figures 10-15, and the max/min values have been adjusted to values that generate more logical boundaries for each concentration level.

Comment 2 - I would recommend adding the explanation presented in "Response 2" of the authors' response, related to methods applicability outside of California, to the manuscript text.

Response 2 – This text already included starting at line 766 of the revised manuscript.

Comment 3 - For some reason, the citations in the updated text have 2 authors listed.

Response 3 – corrected.

Comment 4 - Response 28: While Ostro et al. show an association between ischemic heart disease and ultrafine PM, they do not argue that the association is necessarily stronger than that with PM2.5. The evidence of a higher toxicity associated with PM0.1 is still limited, and I believe the conclusion that "PM0.1 emissions reductions could amplify the potential health benefits … beyond the level expected from PM2.5 emissions reductions" may not be very strongly substantiated.

Response 4 – a number of toxicology studies have demonstrated that ultrafine particles have greater toxicity per unit mass than fine particles [1-4]. These studies have been cited in the revised manuscript to support the statement that PM0.1 emissions reductions are potentially important.

References:

1. Donaldson, K., et al., *The pulmonary toxicology of ultrafine particles.* Journal of Aerosol Medicine-Deposition Clearance and Effects in the Lung, 2002. **15**(2): p. 213-220.
2. Donaldson, K., et al., *Ultrafine particles.* Occupational and Environmental Medicine, 2001. **58**(3): p. 211-+.
3. Elder, A., et al., *Translocation of inhaled ultrafine manganese oxide particles to the central nervous system.* Environmental Health Perspectives, 2006. **114**(8): p. 1172-1178.

4. Kreyling, W.G., M. Semmler, and W. Moller, *Dosimetry and toxicology of ultrafine particles.* Journal of Aerosol Medicine-Deposition Clearance and Effects in the Lung, 2004. **17**(2): p. 140-152.

Reviewer 2

The authors made great strides to address my concerns from my review of their original submission to GMDD. My remaining suggestions are largely editorial. I have only one content-related suggestion:

Content suggestion:

Comment 1 - Page 3 / line 89: I still feel that the process of interpreting the results by the reader would be improved greatly if two graphics were added to the text of the manuscript... stacked bar or area charts of sectoral GHG emissions for the BAU and GHG-Step scenarios. These graphics would allow the reader to understand how the model is responding to the constraint, which is important since those responses are what drive the emissions changes highlighted later in the manuscript. While the revised text has been modified to refer to where to find such information, and while the supplemental info now includes the GHG-Step plot, I think both these graphics should be explicitly included in the body of the manuscript. I don't think this is a required change, per se, but it would improve the manuscript.

Response 1 – graphic added as requested.

Comment 2 - As an aside, the authors suggest that the GHG-Step constraint being implemented at a single future year (as opposed to phased in) does not result in a discontinuity in the model's response. When I look at the GHG-Step graphic, I do see a discontinuity in 2050, so I think the authors' revised text indicating that there is no discontinuity is not correct or is at least too strong.

Response 2 - The CA-TIMES model has foresight and changes are occurring in the years 2040-49 to prepare the base needed for 2050. Actions in this time frame include decarbonizing the grid, the important task of stock turnover in vehicles and stock turnover in building appliances. 100% of sales of fully clean and electrified vehicles and appliances in 2050 would not be enough to decarbonize these sectors if changes were not already occurring between 2040-49. 100% of sales in a given year doesn't translate to 100% of the fleet being converted to that technology. Vehicles have a 15 year lifetime in CA-TIMES, therefore 1/3 of the fleet changes every five years. Similar trends are true for appliances.

We have modified the description in the manuscript to read

"This 2050 GHG constraint causes aggressive change over the period 2040-49 but does not shock to the energy system in 2050 because the CA-TIMES model has perfect foresight and optimally minimizes the energy system cost (with a 4% discount factor) over the entire period from 2010 to 2050 making investment decisions to meet targets."

Editorial suggestions:

I feel that the authors' language and choice of words could be tightened. For example, below are some particular items:

Comment 3 - Page 1/line 9 "sophisticated programs" - It is unclear what is meant by "programs." Computer programs? Management programs? Whether they are "sophisticated" also seems very subjective. Perhaps "comprehensive" would be a better adjective (although I recognize that this can also be subjective).

Response 3 – “Sophisticated programs” changed to “sophisticated emissions control programs”. The authors assert that California has some of the most sophisticated GHG emissions control programs in the world, and hence the statement is not subjective.

Comment 4 - Page 1/line 11 "aggressive GHG reduction" - One person's "aggressive" is another person's "moderate," and another person's "lenient." I think these terms are best used when comparing policies (e.g., policy A is more lenient than policy B). I suggest just referring to this as a GHG policy. If you feel it is aggressive, perhaps you could cite a reference to this interpretation?

Response 4 – “…aggressive GHG reduction…” replaced with “…80% GHG reduction…”.

Comment 5 - Page 1/line 13 "necessarily include changes in..." - I think "necessarily" is too strong here. Also, I would add "across economic sectors" at the end.

Response 5 – changed as requested.

Comment 6 - Page 1/line 23 "manifests most notably through a comparison" - I don't think this use of manifest is correct... This reads as if the act of comparing the results leads to the behavior occurring, which I do not believe is the intent. Perhaps "apparent most notably through a comparison"...

Response 6 – changed as requested.

Comment 7- Page 1/line 31 "debating optimal strategies" - "optimal" typically refers to the mathematically least cost option. Policymakers don't generally think in those terms. I suggest "debating alternative strategies", "debating candidate strategies", or "debating cost-effective candidate strategies".

Response 7 – changed to “debating cost-effective candidate strategies” as requested.

Additional editorial suggestions:

Comment 8 - Page 29/ line 689 - "each ... experience" should be "each ... experiences"

Response 8 – changed as requested.

Comment 9 - Page 33 / line 773 - This refers to having evaluated multiple GHG policies, but you really only evaluated one here.

Response 9 – We evaluated a single scenario that includes multiple policies. No changes made in response to this comment.

Comment 10 - Page 1/line 21 "with obvious implications" - At least one style guide that I have read suggests avoiding words such as "obvious" and "clearly".

Response 10 – deleted “obvious”.

Comment 11 - Page 1/line 25- Page 1/line 26 "PM2.5", "PM0.1" should use subscripts

Response 11 – changed as requested throughout the manuscript.

Comment 12 - Page 1/line 25 "vs." Spell out "versus"?

Response 12 – changed as requested throughout the manuscript.

Comment 13 - Page 1/line 32 "including (among other things)..." - This is redundant since "including" implies you may not be listing all those things.

Response 13 – deleted “(among other things)”.

Comment 14 - 15/360 - Not necessary to use apostrophe on "CA-TIMES"

Response 14 – deleted apostrophe as requested.

Throughout:

Comment 15 - I don't recall ever seeing in-text citations of this format... two authors, followed by "et al" (e.g., Curly, Moe, et al., 2015). Please check the journal requirements. Usually these in-text citations would just be: (e.g., Curly et al., 2015).

Response 15 – shortened to one author in citations.

Comment 16 - Commas are not used in a consistent manner in the abstract and introduction sections

Response 16 – corrected.

Graphics:

Comment 17 - For Figure 9: I think this is OK, but it is not necessary to include the data under the table. The data could be provided in the Supplemental Information instead.

Response 17 – data table removed from the bottom of Figure 9 as requested.

Comment 18 - For Figures 10 through 15: I greatly prefer the formatting of these figures to the versions in the original submission. I have only a minor suggestion. It would be helpful to readers to more explicitly identify the right hand column as depicting deltas. Also, having the units on the graphic itself would be useful. Finally, I think it should be more clear that the column on the right is comparing both results for the year 2050. One possible suggestion would include the following changes:

(i) change the heading over the left column to:

2050 BAU (ug m-2 min-1)

(ii) and the right column to:

2050 GHG-Step minus 2050 BAU (ug m-2 min-2)

It this is too much text for the right-hand column, perhaps you could put the units under the column name?

Response 18 – changed as requested.