Summary: This paper develops a conceptual model that brings together lifecycle accounting of energy impacts with various types of energy rebound into a single conceptual framework made implementable through the assumption of a CES utility function that can be used to assess the total amount of energy rebound likely to occur with any energy efficiency upgrade (or EEU as referred to in the paper). The paper provides a fairly comprehensive commentary on the literature, graphical illustrations of rebound in energy, expenditures and xxx spaces and some sample case study applications of the model to an efficient vehicle upgrade and to a lighting upgrade. It also includes sensitivities of various parameter assumptions in the two case studies and the impacts on rebound. Finally, the paper includes some discussion of policy implications partially drawn for the model and partially going beyond the model.

Commentary: This paper is way too long to be published as a journal article and is really more of a stand-alone monograph on the topic of rebound. To make it into a journal article (or a series of journal articles) the authors will need to make some difficult choices. A variety of approaches are possible.

1. One approach could be to separate the conceptual model development from the empirical implementation and make the two case studies into a separate paper. This would perhaps ask a lot of the readers of the conceptual model because the numerical implementations do provide a different form of intuition that could resonate with some readers.
2. Shrink the literature review and the presentation of the model and merge it with one of the case studies and use that as an illustration.

All of the approaches would require a shortening of the introduction and of the discussion of the literature. Also, dramatically shortening section 5 in the paper on contributions as a lot of this material is covered in earlier sections.

Smaller ways to shorten could include:

- Focusing the graphical illustration of the components of rebound on the energy part and leave the other two graphs aside (or put them in an appendix).
- Shrink the long explanation of diminishing returns from increases in energy efficiency parameter after figure 11.
- Drop the sensitivity to capital cost as assuming that capital cost is truly independent of efficiency seems too artificial.
- The findings that higher energy prices leads to more rebound (mean
- Section 5 seems to restate material from earlier in the paper. Dramatically shrink it.
- Condense policy considerations or cover in an appendix
- Move calibrating K section into an appendix

The aspiration of finding a unifying theory that combines all concepts of rebound is admirable as economics papers often focus on only one or two of the components addressed in the paper. The framing of the analysis refers to connecting economics with “energy analysis” approaches. However, energy analysis is never defined in the paper, and it is unclear what qualifies as energy analysis that is outside of economics. From the context it appears to largely be a discussion of embodied energy but that is not clear. I hesitate to ask for more explanation in a paper that is already too long, but a definition of energy analysis frameworks and how they differ from economics seems to be warranted here.

Also, the authors never define the phrase EEU and really need to do so. While the meaning is clear from the context, all acronyms that are not in common use should be defined in the paper.

One other thing that is complicated by putting the four measures of rebound together is that it doesn't lend itself to analysis of emissions impacts because the forms of energy reflected in the various measures (embodied energy versus energy use and macro effects) could rely on very different sources of energy with different emissions intensities and putting the different measures together as this paper does would require further untangling for a discussion of emissions. Some effort to address this would be useful.

The term "rate" is used throughout the paper, and it is not always clear why or that it is being used in a consistent fashion. The discussion on page 23 suggest that rate is used to describe the annualization of fix costs (capital cost or disposal costs) or other fixed attributes (embodied energy and energy related to disposal.) But in other places (like page 25) rate is used to refer to flow variables and it's not clear what rate means in this context (per fixed period of time). Also, the notation for rate used in the paper is to put a dot above the variable name. This is a confusing approach because the dot notation usually refers to a rate of change and that is not what rate means in the context of the model developed in this paper.

Also, it's unclear to me about the timing of these various rebound effects that are being added together. In particular, the embodied energy component is clearly in the past and the macro rebound is likely at some time in the future (uncertain when) so the total rebound is essentially not pinned to a particular point in time, another aspect that makes the translation to emissions consequences difficult. This should be discussed more (or at least explained).

The elasticities presented in the examples are fixed values from previous research. It would be helpful to discuss these sources and why you think these elasticities can be considered constant across increasing efficiency examples. For example, are these elasticities generated from research on small changes in efficiency that you are extending to large changes in efficiency? Is this appropriate? This seems like a critical component of the model that could use more justification/explanation.

The sensitivity analysis section has a lot of problems given that several of the variables are not independent and thus jointly distributed. Is it possible to do some sort of representation of joint distributions of some of the variables (give example) and show the results of a Monte Carlo analysis that represents draws from those joint distributions instead of the one variable at a time approach, which assumes more independence than really exists?