Response to Reviewer's Comments

We sincerely thank the reviewers for the insightful comments on our paper "Modeling performance and cost dynamics of Lithium-ion Battery for Mobility". We believe that the comments have helped us to improve the quality of the paper significantly.

Reviewer 1's Comments

1. I think it is not very clear how a reduction in LIB demand reduces the Total Energy Requirement. A clarification would be useful.

   Response: We thank and acknowledge the observation by the reviewer. We have edited the paper based on the reviewers' comments to improve clarity. We improved the causal loop diagram (CLD) (page 6). We made the corresponding changes in "Balancing loop, B2 - Battery capacity dynamics" and "Reinforcing loop, R2 - Learning effect" (page 5-6). Details about corresponding loops are added in paragraph 1 of Page 6 as follows:

   "'Battery capacity dynamics' loop depicts the impact of total Battery Capacity installed for a given LIB. In the model 'Total energy requirement' is defined as the sum of battery capacity and impact of range anxiety on battery capacity as shown in the stock-flow diagram (SFD) (page 7). The total energy requirement will increase the battery price. With the increase of battery price, EV price will increase, which reduces the EV demand. A reduction of LIB demand leads to a reduction in total battery capacity installed in EVs. In contrast, an increment in total battery capacity installed in EVs will increase the experience accumulation factor, reducing the battery cost per kWh and, hence, battery price. A reduction in battery price leads to a decrease in EV price that will increase EV demand and, hence, LIB demand. An increase in LIB demand leads to a rise in Li demand which increases the Li price. Battery price increases with the increases in Li price."

2. On page 3, there is a graph that shows how battery cost/kWh reduces with battery capacity. The authors say that "This cost reduction in USD/kWh is attributed to the learning effect that these large capacity LIBs bring on the production". I am confused about this relationship. Why exactly larger battery capacity result in learning curve effects? If developing larger capacity gave more experience, the same experience can be used for smaller batteries, can it not? Is there some other scale economics going on?

   Response: We thank and acknowledge the observation by the reviewer. We have edited the paper based on the reviewers' comments to improve clarity. The following text is added in paragraph 2 of Page 3:

   "In this analysis number of battery packs produced per year remains constant. This cost reduction in USD/kWh is attributed to the learning effect that these large capacity LIBs bring on the production (Nykvist et al., 2019). Higher capacity batteries (in kWh) increase the plant production capacity in gigawatt-hour (GWh) as compared to the smaller battery when the number of battery pack produced per year remains constant. As per the learning curve concept, as the cumulative plant production capacity increases, battery production costs per kWh show a declining trend governed by a power law."

3. I think the biggest concern for this paper is that the effect of range on EV sales is not included. That would have a substantial effect on LIB demand. I understand that the model is already comprehensive.

   Response: We thank and acknowledge the observation by the reviewer. This point is already considered in Conclusion section (Page 16, paragraph 2, last line).

Reviewer 2's Comments

Congratulations, it is an excellent work. Really relevant and pertinent.

Response: We thank and acknowledge the observation by the reviewer.

Reviewer 3's Comments

1. I'm intrigued with your implicit assumption that EV sales depend principally on EV price (and the underlying LIB cost). This view seems to presume that prospective EV buyers don't really care about CO2 emissions and are immune to social and regulatory pressures from the environmental movement. I'd like to see more explicit justification for such 'cost/price conscious' buyers.This modification will require better positioning of your particular emphasis on battery technology-cost (relative to broader assumptions found in other contemporary SD studies of EV adoption dynamics).

   Response: We thank the reviewer for the comment. The following text is added in paragraph 4 of Page 4 to explain the rationale behind the assumption of dependence of EVs sales on EV price :

   "Department of Energy and the Advanced Battery Consortium estimated that battery cost has to fall below 125US$/kWh for wide adoption of EVs. According to McKinsey's Centre for Future Mobility, USD 100/kWh will be the price at which EVs will be more economical than Internal combustion engines (ICEs). Therefore, battery price and hence EV price plays a crucial role in increasing the market share of EVs."

   Social and regulatory pressure from the environment movement like Paris agreements impact of EV sales is considered as the future direction of study and included in the last paragraph of Page 17 as follows:

   "Environmental awareness of consumer, CO_2 emission target set by different countries for OEMs in lieu with the target set through Paris agreement has a significant impact on EVs sales, and this also adds to one of the dimensions for the future direction of this study."

References

Nykvist, B., Sprei, F., Nilsson, M., 2019. Assessing the progress toward lower priced long range battery electric vehicles. Energy Policy 124, 144–155. doi:10.1016/J.ENPOL.2018.09.035.