Review Responses #1: Characterizing Fusion Market Entry via an Agent-based Power Plant Fleet Model

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Reviewer #1: The authors should be commended on a very interesting and well presented paper.

I have some recommendations for improvement.

Regarding the limitations, I would prefer the model to include costs which I think can be done relatively easily (although I agree endogenous power plant economics (competition) would be a different model not using predefined diffusion curves).

Thank you for the suggestion and thank you for your comments and review.

The point you make here is an important point for us to clarify so as not to confuse readers. You are correct that our model does not explicitly include cost or price as an exogenous input or endogenous dynamic; however, our model does incorporate cost information implicitly. Our model is tied to projections of power plant fleet make-up detailed in the US Energy Administration's (EIA) Annual Energy Outlook (AEO) which incorporates various interactions between energy supply, demand, prices, and capital costs. "The AEO is developed using the National Energy Modeling System (NEMS), an integrated model that aims to capture various interactions of economic changes and energy supply, demand, and **prices**." as an example: "On a percentage basis, renewable energy grows the fastest **because capital costs fall** with increased penetration and because current state and federal policies encourage its use." Adding our own cost modeling might complicate or contradict some of the model aspects rather than provide additional insight.

To help clarify the approach we've taken, we have added the following to the text:

To section 3.1: *"Although price does not explicitly drive choices in the model, it is implied through the relationship to the AEO projections. The AEO uses an underlying model called the National Energy Modeling System (NEMS), which is an integrating*

model seeking to endogenously incorporate interactions between economic changes, energy supply, demand, and price. As AEO incorporates these dynamics into its model, the same price related dynamics that affect its future energy supply are implied in our model."

And in section 3.6: *"To incorporate a range of potential cost considerations for yet-to-exist fusion power plants, we have used the 10%, 50%, and 99% maximum market penetrations as a proxy for how cost-competitive fusion technology might be."*

In addition, we have removed language from the "limittations" section that implies that our model does not at least indirectly consider cost.

Also, validation is limited and some other means of validation would have been helpful, e.g. expert opinion, which could consider the effect of other limitations such as the yearly tick.

Very fair observation. As we were building our model, we looked at prior work of others to help inform our approach. We found a recent Fusion Energy distillate by the Andlinger Center at Princeton that included an Economics section and used GCAM to model future energy markets -- that reference helped us confirm many aspects of our approach (eg, base case, fusion entry timeline, capacity factor, variability in fusion cost estimates), and their results show qualitative agreement with our agent-based model approach. This report is a gold standard in the field and is very much an expert validation. Therefore, in this resubmission, we increase the extent to which we explicitly point to this Andlinger Center report as a reference. This includes these two references:

1. in the next to last sentence of the first paragraph of the Background: "...has been applied to a limited set of fusion scenarios [2, add ACFD]."

2. add a last sentence to the Conclusion: "To the best of the authors' knowledge, this work is the first time an agent-based model has been applied to simulating fusion power market entry; the results, however, agree qualitatively with other well-established energy market modeling tools [add ACFD]".

Takeaways from ACFD's approach that are relevant for substantiating our approach:
- There is a wide range of estimates for the cost of electricity from future fusion power plants.
- The model's base case assumes that the first fusion power plant becomes available in 2035, at least ten plants are operating in 2050, and at least 100 plants are on line in 2065

- The plant is assumed to run 90 percent of the time.

There is some presentational issue at the end of the paper with Figure 4 appearing after the end of the paper, and the references after the appendix and not beneath the references heading. Some of the references to figures appear to be wrong and should be re-checked.

Thank you for catching these mistakes. We have rectified them in the final text.

Model scenarios for market are described as 10, 50, 90 earlier in the text, and then as 10, 50, 99. Please rectify to consistent rates.

Thank you for catching this error. 90% was never a parameter that we ran the model with; it was a typo. We have fixed the error in the text.

The paragraph in the introduction starting : Recently, the U.S. Department of Energy's Advanced
should be removed and a short, appropriate acknowledgement should be added.

Thank you for catching this conflict of interest. We have removed the paragraph and added a section in the acknowledgements.