**Manuscript Title: “**Harnessing the Potential of Small Modular Reactors for Climate Change Mitigation through Energy-Mix Optimization and Hydrogen Generation”

### To: IAEA-INDICO (International Conference on Small Modular Reactors and their Applications)

**Re:** Response to reviewers

Dear Editor,

Thank you for allowing a revision of the manuscript, with an opportunity to address the reviewers’ comments.

Attached is (a) a point-by-point response to the comments (below) (response to reviewers), and (b) an updated manuscript with blue fonts indicating changes (for Review).

I would like to express our appreciation to the Editor and the Reviewers for their time and careful review. I have revised the manuscript based on the Reviewers' comments and suggestions, and the following are point-by-point responses to the raised comments, also highlighting the modifications made in the revised manuscript. I would like to thank the Editor and Reviewers for their constructive and valuable comments, which helped improve the technical and presentation quality of our manuscript. I hope that the concerns of the Editor and Reviewers have been appropriately addressed in the revised version and that the paper is acceptable for publication in this form. However, if the Editor or Reviewers still have questions or concerns, I would be more than happy to further revise our manuscript.

1. **Structure of Paper**

**i. The title of the paper may include the name of the country, Egypt, to provide clarity**

***Author response:*** *The purpose is to present a research paper that serves the scope of the conference without distraction to increase citations. "Egypt" will be used in the conference presentation. It was used as a case study and is present in the context of the research.*

**ii. The author's information lacks the names of the towns/ cities.**

***Author response:*** *The manuscript is updated and the city is added*

**iii. Some of the first level paper headings do not follow the provided template. For example, heading number 3, 'Methodology and Analysis', is not capitalized and the last heading, 'Conclusion', is not numbered.**

***Author response:*** *The manuscript is updated and modified*

**iv. Some of the third level paper headings don't follow the provided template. Subsections a and b of the second level paper heading 2.4. should be 2.4.1 and 2.4.2. and italicized.**

***Author response:*** *The manuscript is updated and modified*

**v. The bullet points do not follow the provided template.**

***Author response:*** *The manuscript is updated and modified*

**vi. Rather than using the Times New Roman 9 point regular, tables are formatted in Times New Roman 10 point heading.**

***Author response:*** *The tables were reviewed and verified to meet the criteria.*

**vii. The figures in the text have not been shortened to Fig. Despite being written in single lines, the figure captions have not been centered as the template instructs.**

***Author response:*** *The manuscript is updated and modified*

**viii. Figure 4 (The Cu-Cl cycle is a hybrid process that includes both thermo chemical and electrolysis stages) that was discussed in Section 3 is not included in the study. On the other hand, the MESSAGE model outcome for energy mixes with low and high carbon taxes is displayed in Figure 4 of the paper.**

***Author response:*** *The manuscript is updated and modified. The text is modified to Fig. 3 and the figure is added*

**ix. The text makes no reference of the figures 3, 4, 5, and 6 that are presented in section 4.1.**

***Author response:*** *The manuscript is updated and modified*

**Technical Content**

**i. In Base year 2021, shares of hydropower and wind in the electricity mix of Egypt were 6.2% and 3.0%, respectively (https://www.iea.org/countries/egypt/electricity). However, these energy sources have not been considered in optimization.**

***Author response:*** *As hydropower and wind in Egypt represent fixed values ​​that will not change, as the sources are fixed and known. This study aims to study the variables that may directly affect carbon rates and the proposal was to use the SMR and solar energy as an effective alternative. Also, the study is not at the level of Egypt as a whole, it is a case study in Egypt only and is suitable for application to cities in Egypt and to be applicable for SMR. Not all cities have wind or hydropower energy.*

**ii. At least, the study's base and terminal years' input data for Final Energy (Demand) may be provided.**

***Author response:*** *The manuscript is updated and modified. Table 3 is added in section 3.1*

**iii. Electricity System Network (Fig. 1) contains the following mistakes;**

**— Coal-PP uses nuclear fuel as an input.**

**— No fuel inputs for New\_Coal\_PP and New\_CCGT.**

***Author response:*** *I apologize for these typing mistakes. Fig.1 is edited and updated*

**iv. Fig. 2's Electricity System Network contains the following mistakes;**

**— Coal-PP uses nuclear fuel as an input.**

**— No fuel inputs for New\_Coal\_PP and New\_CCGT.**

**— There is no output for CO2\_usage technology.**

***Author response:*** *I apologize for these typing mistakes. Fig.2 is edited and updated. Regarding the CO2\_usage technology, there’s no output is proposed in this study. It is just a proposal for carbon usage methodologies.*

**v. There is no competition for water desalination and Thermolysis. While traditional fossil fuel based technologies may be included, only SMRs are taken into consideration for Thermolysis and water desalination [Fig. 1].**

***Author response:*** *Indeed, the study should include the competition between modern and traditional systems. But the goal is to reduce emissions from thermal power plants. Therefore, the research provides a proposed and applicable model for countries to confront the climate change crisis. Also, this research highlights the focus on the advantages of small modular reactors. These ideas are in Fig.2.*

**vi. The MESSAGE results in Section 4.1's Figures 4, and 5 are irrational.**

**— Solar power supplies the system's whole requirement beyond 2045, in Fig. 3(b). However, in the event of a low CO2 tax (Fig. 4(a)), solar and SMR would not be able to compete with CCGT and beyond 2030, CCGT would provide the whole demand for electricity. Solar cannot compete for the whole period in the high CO2 tax scenario (Fig. 4(b)), but SMR receives a portion of the energy mix. Furthermore, mentioning low and high carbon taxes in milestone years will be a useful for the readers.**

**— Solar power supplies the system's whole requirement beyond 2045, in Fig. 3(b). However, when CO2 emissions are limited, solar energy is not able to find a place in the optimal solution (Fig. 5). It will be helpful to readers if CO2 emission restrictions are mentioned in milestone years.**

***Author response:*** *I apologize for this confusion. The manuscript and results are updated and modified*

**References**

1. **References have not been listed in accordance with the template provided.**

***Author response:*** *The references are updated and modified*

**ii. Reference at serial number 7 has not been cited in the text.**

***Author response:*** *The reference is added. I apologize for this mistake.*

Based on your valuable suggestions and insightful questions, I have tried to improve the paper and revise the manuscript. These changes will not influence the content and framework of the paper. Appreciate the Editors/Reviewers’ warm work earnestly and hope that the revision will meet with approval. Hope that these revisions are satisfactory and will be acceptable for publication in your respected journal. Once again, thank you very much for your comments and suggestions.

Wish you all the best.

Sincerely yours,

Ahmed E. Salman

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