

# ***Small Modular Reactors for a Net Zero World***

Noura Y. Mansouri, KAPSARC, +966561174065, [noura.mansouri@kapsarc.org](mailto:noura.mansouri@kapsarc.org)

Adnan Shihab-Eldin, Charles McCombie, Holger Rogner, Robert Budnitz, and Robert Schock.

## **Overview**

This paper examines the potential of Small Modular Reactors (SMRs) to contribute to a net-zero world by enabling nuclear energy's role in the energy transition to mitigate climate change. The paper presents a summary of existing SMR technologies and their potential for deployment. While SMRs offer many benefits such as affordability, shorter construction time, and ease of integration with renewables, several barriers must be overcome to commercialize them, including safety improvements, competitive economics, enhanced regulatory systems, spent fuel management strategies, market demand, and government support. The paper calls on the global community to recognize the role of nuclear energy, support the acceleration and commercialization of SMR technologies, and establish a harmonized international regulatory system specifically for SMRs led by the IAEA. Such an initiative could be the first step towards realizing a comprehensive and empowered international regulatory and safety regime, saving time and money for developers and vendors of various new SMR designs.

## **Methods**

The paper employs qualitative research methods including literature review from secondary sources. Providing a summary of all existing SMR technologies and their potential for deployment. Specifically, the paper relies on a literature review from secondary sources, which involves analyzing and synthesizing information from existing publications, reports, and other relevant documents.

The literature review is used to provide a comprehensive summary of all existing SMR technologies, including their features, benefits, drawbacks, and potential for deployment. This summary is based on a critical analysis of the existing literature, which involves synthesizing the information from multiple sources, evaluating the quality and relevance of the sources, and identifying the gaps and limitations in the current knowledge.

By using a literature review, the paper is able to draw on the collective knowledge and expertise of a wide range of scholars, experts, and practitioners in the field of nuclear energy and SMR technologies. This allows the paper to provide a more nuanced and comprehensive understanding of the topic, and to identify the key issues, challenges, and opportunities associated with the deployment of SMRs in a net-zero world.

## **Results**

Small Modular Reactors (SMRs), although still unproven in terms of both their economics and their technical performance, can provide many benefits and can mitigate many of the inherent risks associated with large reactors, because of their prospect to provide better affordability, shorter construction time, wider applications, and ease of integration with renewables. Although their promise is also great in the developed countries, SMRs can be particularly useful for newcomer countries with smaller grids and less developed infrastructure, as well as, for remote off-grid areas, and non-power applications.

Many people, especially in the nuclear industry, think or hope that the commercialization of SMRs may be the path towards continued use and expansion of nuclear power. Numerous papers have been written on their potential advantages. However, there are several barriers that must be overcome to make this scenario a reality. The following key conditions need to be fulfilled.

1. A clear demonstration of the safety improvements offered by SMRs
2. A convincing case for competitive economics – both per MW installed and per kWh produced
3. An enhanced international regulatory system easing licensing and oversight
4. Credible spent fuel management strategies – including “take back” or “take away”
5. Sufficient market demand to support “production line” SMR factories
6. Governmental support of first of a kind (FOAK) SMRs – financial, regulatory and organizational

If all of these conditions can be satisfied, this may lead to public/political acceptance that SMRs do indeed represent a new approach to nuclear power and consequently to wider acceptance of a global increase in nuclear power.

**Key policy recommendations:**

1. recognize the role of nuclear energy for a just, reliable and clean energy transition
2. support the acceleration, adoption and commercialization of SMR technologies to enable nuclear energy's role for effective action to mitigate climate change.
3. it further recommends an initiative to establish a harmonized international regulatory system, specifically for SMRs, led by the IAEA, with support from and active participation of major national nuclear regulators around the world. Such an initiative could be the first step towards the realization of a comprehensive and empowered international regulatory and safety regime. It is also expected to be welcomed as well by the developers/vendors of various new SMRs designs, as it will save them time, effort and money in securing licensing globally.

## References

Hawkes, P. J., and R. J. Boardman. "Small modular reactors – key to future nuclear power generation in the UK?" *Nuclear Future* 4, no. 4 (2008): 191-199.

Panchal, P. R., and P. K. Tewari. "Small modular reactors for enhancing energy security in developing countries." *Renewable and Sustainable Energy Reviews* 71 (2017): 292-305.

Yildiz, M., and M. H. Gürbüz. "Small modular reactors: a comprehensive overview of their economics and strategic aspects." *Renewable and Sustainable Energy Reviews* 48 (2015): 371-376.

Storr, A., et al. "The potential for small modular reactors in the UK." *Energy Policy* 39, no. 12 (2011): 7520-7529.

Bruschi, M., and M. Locatelli. "Small modular reactors: Nuclear energy market potential for electricity generation." *Renewable and Sustainable Energy Reviews* 50 (2015): 42-48.

Ghorbanian, S. A. E., and A. Rineiski. "A review of small modular reactors designs and analyses." *Annals of Nuclear Energy* 68 (2014): 2-12.

Heidet, R., et al. "Small modular reactors – a review of current status." *Nuclear Engineering and Technology* 47, no. 2 (2015): 141-148.

Bruschi, M., and M. Locatelli. "Small modular reactors: Nuclear energy market potential for district heating." *Energy* 101 (2016): 423-431.

Escobar, J. F., et al. "Small modular reactors for electricity generation: An economic and environmental evaluation." *Applied Energy* 187 (2017): 508-518.

Yildiz, M., and M. H. Gürbüz. "Small modular reactors: a comparative study for Turkey." *Energy* 76 (2014): 286-293.