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Nuclear-Renewable Hybrid Energy Systems: Considerations for Future Deployment in Ghana

Nuclear and renewable energy offer the potential for significant long-term supplies of heat and power at relatively stable prices, and for producing lower GHG emissions than alternative fossil-fuel sources. Owing to their large capital costs and low fuel costs, nuclear power plants require a high load or capacity factor to be economically viable. Renewable energy sources on the other hand have the benefits of strong societal acceptance and the potential for smaller-scale, distributed installations. The integration of nuclear energy and renewable energy into a single nuclear-renewable hybrid energy system (NHES), using various coupling schemes, would enable a nuclear power plant to run at high capacity while also addressing the need for flexibility of generation rates and producing energy services, ancillary services, and low-carbon co-products. Small Modular Reactors (SMRs) are designed with safety as a top priority, incorporating advanced features and inherent safety mechanisms. These characteristics, coupled with their modular nature, make SMRs an attractive choice for newcomer countries such as Ghana. The opportunities in harnessing the benefits of both nuclear energy and renewable energy systems through the deployment of an integrated hybrid energy system are enormous. Despite the several benefits, however, several factors need to be considered before making an informed decision for the deployment of NHES. Some of these considerations include techno-economic analysis, regulatory aspects, stakeholder engagement, system interconnections as well as policy and governmental considerations. In this paper, these considerations will be discussed in detail and the current needs analyzed in the Ghanaian context. Suggestions and recommendations that are expected to facilitate the deployment of NHES will also be discussed.

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