

ADVANCING ELECTRICITY STORAGE TECHNOLOGIES WITH A SYSTEM DYNAMICS APPROACH

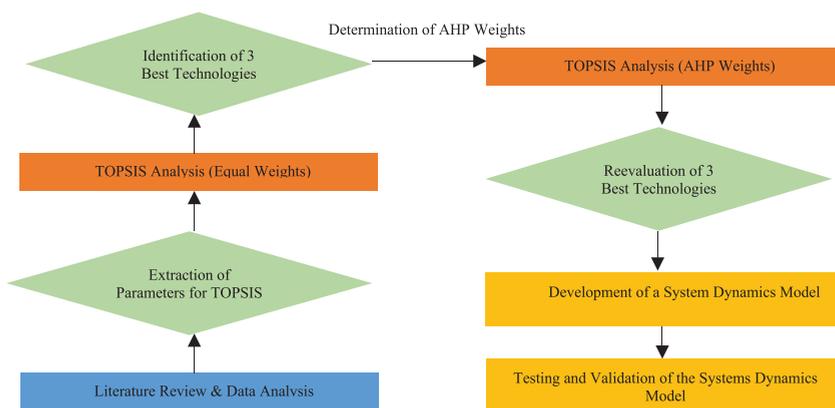
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Abstract – Climate neutrality targets and strategies show that the share of renewables in energy generation is set to increase, nevertheless their variability, seasonality and lack of reliability pose significant challenges. With the continued growth in energy consumption, demand for energy storage is becoming more evident. The integration of renewable energy and the reliability of the grid depend on the installed storage capacity. However, the overestimation of the amount of storage needed can result in wasted investment. Therefore, to enable proactive energy policy – making and efficient energy system planning, it is necessary to be able to predict how the installed capacity of specific energy storage applications will develop over time. This study conducts an electricity storage technology assessment to investigate feasibility and technological progress, compare available technologies and conclude the main drivers and barriers affecting the adoption rate. A multi-criteria analysis approach is applied to compare the different types of energy storage technologies available. TOPSIS analysis, a ranking method based on distance from the ideal solution, was used to identify the electricity storage technologies that are closest to the ideal solution, followed by a more in-depth analysis – a systems dynamics approach. The system dynamic model was built in Stella Architect to further assess the viability of these technologies, predict and compare installed capacities. The results reveal various critical factors that influence the rate of deployment of electricity storage technologies: capital and operating costs, storage installation time, market distribution constraints, storage outages, lifetime, etc. This paper concludes which technologies should be given more consideration for deployment and what are the key factors affecting their installed capacity over time. The findings of this study underline that energy storage is one of the key steppingstones towards the energy transition, providing insights into technology prioritization and driving factors identified.

Keywords – *Electricity storage technologies; energy storage comparison; energy storage systems (ESS), energy transition; system dynamics*



A flowchart of methodology