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C1Po3C-01: A study of the whole life cycle carbon emission of liquid air energy storage system

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Liquid air energy storage (LAES) is a cryogenic energy storage technology that stores electricity in the form of liquid air, with operating temperatures as low as 80 K. Currently, LAES is still in the stage of critical technological development and exploratory demonstration applications. Its quantified environmental impacts remain unclear, and research on the carbon accounting of LAES throughout its life cycle is significantly lacking, requiring further investigation. This study focuses on a 60 MW LAES system, developing a carbon emission accounting model that covers its entire life cycle, including production, construction, operation, maintenance, and decommissioning. A comparative analysis of system carbon emissions was conducted for the core cryogenic storage unit, considering both liquid-phase and solid-phase cold energy storage methods. Additionally, the research was conducted on the impact of key parameters such as the lifespan of the LAES system and the expander efficiency of the power generation unit on the carbon emissions of the system. Based on the carbon emission distribution of each unit in the system, the carbon reduction potential of each stage in the LAES system can be identified, which is essential for promoting the iterative optimization of the LAES system.

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