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Design and optimization of a novel system for cold and power storage and cogeneration

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Subcooled compressed air energy storage (SCAES) is a system cogenerating heat, cooling, and power at a high coefficient of performance. In this study, hybridization of a SCAES system with a large-scale solar-powered absorption chiller (SPAC) is proposed. The hybrid system sustainably provides cooling and power at high efficiency. The combined SPAC-SCAES system is appropriate for locations with large cooling demand and grid-connected renewable power plants. Employing this system, the renewable power plant may efficiently operate in the power market, maximizing the financial benefits by storing its surplus power and reclaiming the stored energy for balancing the demand and the production. In addition, a massive amount of cold is produced, increasing the profitability of the system. This combined system is designed and simulated for a typical wind farm plus an absorption chiller of a hospital. Non-linear programming (NLP) is used to optimize the operation strategy of the SCAES and based on the given results; the components of the hybrid system are sized. The results show that by the combined system a massive amount of balancing power can be produced for the grid, a reliable integration between the cold and electricity sectors is made, and the levelized cost of energy (LCOE) decreases remarkably.

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