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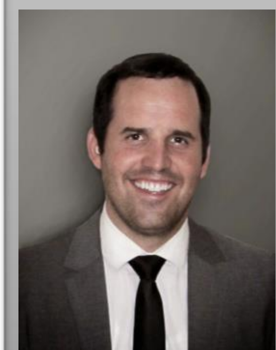

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HIGH TEMPERATURE THERMAL ENERGY STORAGE FOR INCREASED DISPATCHABILITY OF SOLAR ENERGY

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World energy demand has increased dramatically over the past century. Predictions of global energy consumption expect an increase of 48% from 2012 to 2040 (U.S. Energy Information Administration, http://www.eia.gov/outlooks/ieo/world.cfm). Compounding this issue, emissions output from fossil fuel power plants have caused many "clean air" policies to be implemented. These policies require power plants to reduce the output volume of certain emissions. Hybridizing power generation technology with renewable energy sources (solar, wind, geothermal, etc.) is a viable method for meeting the requirements of these policies and reducing emissions, as well as reducing total fossil fuel consumption. Solar energy, in particular, has great potential for hybridization with fossil fuel power generation. The sun delivers enormous amounts of energy to the surface of the earth each day. Unfortunately, the intermittency of solar energy poses a major obstacle to large-scale power generation as it is only available when the sun is shining, which creates the need for large-scale and low cost energy storage technologies. These energy storage technologies must be capable of storing energy in the 500°C – 1000°C range in order to achieve a high percentage of solar usage in the plant, and make the implementation economical. In this this work, a novel high temperature thermal energy storage system is developed to increase the dispatchability of solar energy in hybrid solar/gas combined cycle power plants using solid and phase change materials in a high temperature packed bed. The process includes heating an air stream by concentrated solar power (CSP) heating technology (CSP was not performed experimentally, but simulated in the model) to ~800°C. This hot air stream is used to thermally charge the packed bed. The charged packed bed is then used as a heat source when direct solar energy is not readily available. This study characterizes the ability of different materials to store and transfer thermal energy in a packed bed setting. By means of experimental and simulation methods, results are presented demonstrating the effectiveness of this technology.