1 Introduction

Increases in global energy demand have been caused by increases in population and industrialization. Demands for energy production and storage will only increase as time continues.[1] However, the use of non-renewables increasingly pollutes the air, and these non-renewables will eventually run out.[2,3] This has inspired the advancement of renewable and sustainable energy production and storage capabilities. One major issue with renewable energy is intermittent power generation due to natural changes such as wind speeds, nighttime, and ocean currents. Natural gas does have the advantage of being able to continuously provide an energy stream. Storage of electrical energy from sources such as wind and solar is expensive due to the large size and relatively inefficient nature of batteries.[4,5] While advancements have been made and electrical storage has improved over the years, solar in particular is still too expensive compared to other non-renewables. As a result, photovoltaic (PV) cells coupled with batteries are not an economically viable alternative to coal power at the present time. For this reason, concentrating solar power (CSP) has been popular for storing solar energy in the form of heat that can be used to run a steam engine.

Global energy consumption could potentially be supplied through sole use of the sun. This realization is limited by the cost of storage for nighttime use, distribution of collected energy, and total capital investment. Progress is being made on each of these fronts to make the utility of solar power realizable to the broader market around the world. Storage of solar-generated energy is done using CSP using thermal energy as opposed to chemical energy in batteries due to the higher cost of batteries. Additionally, no utility-level battery application currently exists in the market. While thermal storage is the medium of choice to store energy captured from the sun, development of cheaper and higher-efficiency batteries would nullify the need for thermal storage. Distribution of energy can be simplified by locating utility scale projects near major cities and smaller scale units in more remote locations. Capital investment is being reduced through the cost of semiconducting materials and the use of alternative materials. However, progress in each of these areas can be mutually exclusive.

2 Solar Energy Conversion

Conversion of solar energy into energy usable by humankind is done in the forms of electrical or thermal energy. Direct conversion of solar energy into electricity is primarily accomplished through the use of a PV cell. Such cells can operate under 1-sun conditions, where they are exposed to both direct and diffuse radiation as well as under concentration, but care must be taken to ensure that the cell is not damaged by operation at extreme temperatures. Thermal energy conversion is based on the absorption of incoming solar flux and subsequent conversion to thermal energy. Low temperatures can be achieved with flat plate systems, which collect both direct and diffuse radiation, whereas higher temperatures are capable