# Solara: A Self-Sustaining, Solar-Powered Heating System Utilizing Parabolic Reflection, Thermal Conductivity, and Automated Airflow Regulation for Energy-Efficient and Electricity-Free Climate Control

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The increasing reliance on electricity and fossil fuels for heating has led to rising energy costs, environmental degradation, and accessibility challenges in off-grid regions. To address these issues, Solara introduces an autonomous, solar-powered heating system that operates entirely without electricity, utilizing parabolic solar concentration, high-efficiency thermal conductivity, and automated airflow regulation to maximize heat retention and distribution. Solara's design features a cylindrical parabolic reflector, which concentrates sunlight onto 14 black copper pipes, placed at different heights on the focal axes created by the reflective surface, thus creating a pressure-induced temperature gradient, allowing the overall efficiency to reach 92.8%. To ensure this efficiency, we connected and tested Solara to a (3x3x4 )m room, in which the temperature of the room increased by 10 degrees Celsius in less than 40 minutes. To retain the high temperatures in the system 2 water tanks were placed and the top connected to a V-shaped copper heat pipe covered in a cone-shaped structure, which aids in the forced air flow. An Arduino-controlled actuator system dynamically regulates airflow using smart sensors and servomotors, ensuring optimal heat transfer based on real-time temperature and pressure differentials. Additionally, mimicking a solar-tracking mechanism through a rotating base enhances energy efficiency by continuously adjusting the system's orientation for maximum solar exposure throughout the day. By integrating passive solar heating, automated climate control, and intelligent energy management, Solara presents a scalable, cost-effective alternative to conventional heating methods.

**Awards Won:**