

Thermal Energy Storage for Homes

Balaji Venkatesh

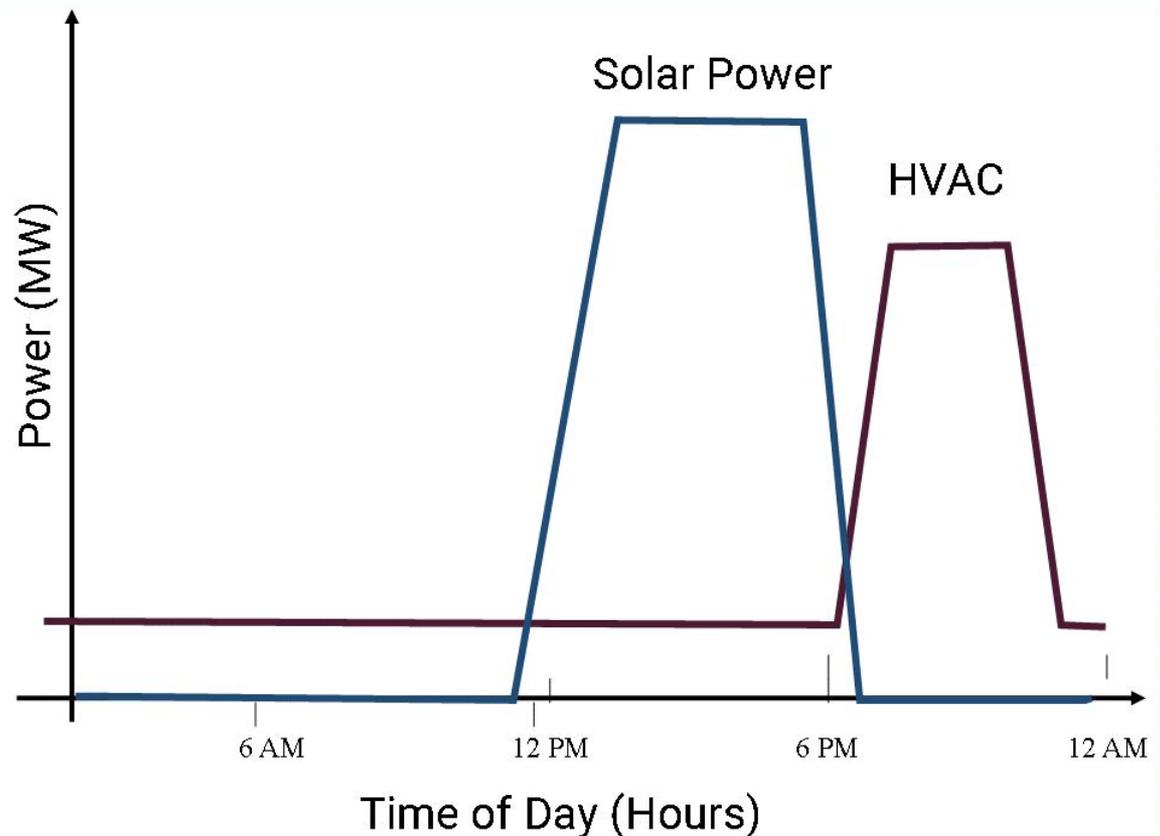
Introduction

- The sunlight striking Earth's surface in just one hour delivers enough energy to power the world economy for an entire year.
- One way to collect this energy and make it useful is the solar panel.
- These panels generate electricity whenever they receive light energy.
- Many homeowners are starting to install solar panels and generate their own electricity.

Problem

- A timing problem has arisen with the matching of the solar energy coming in and the home loads that use it.
- Solar energy is available only when sun shines, that is, during the day.

HVAC energy use on an average work day



Existing Solutions

Batteries

- Exist in both home and utility scale applications
- Create excessive pollution during production and after use



Existing Solutions

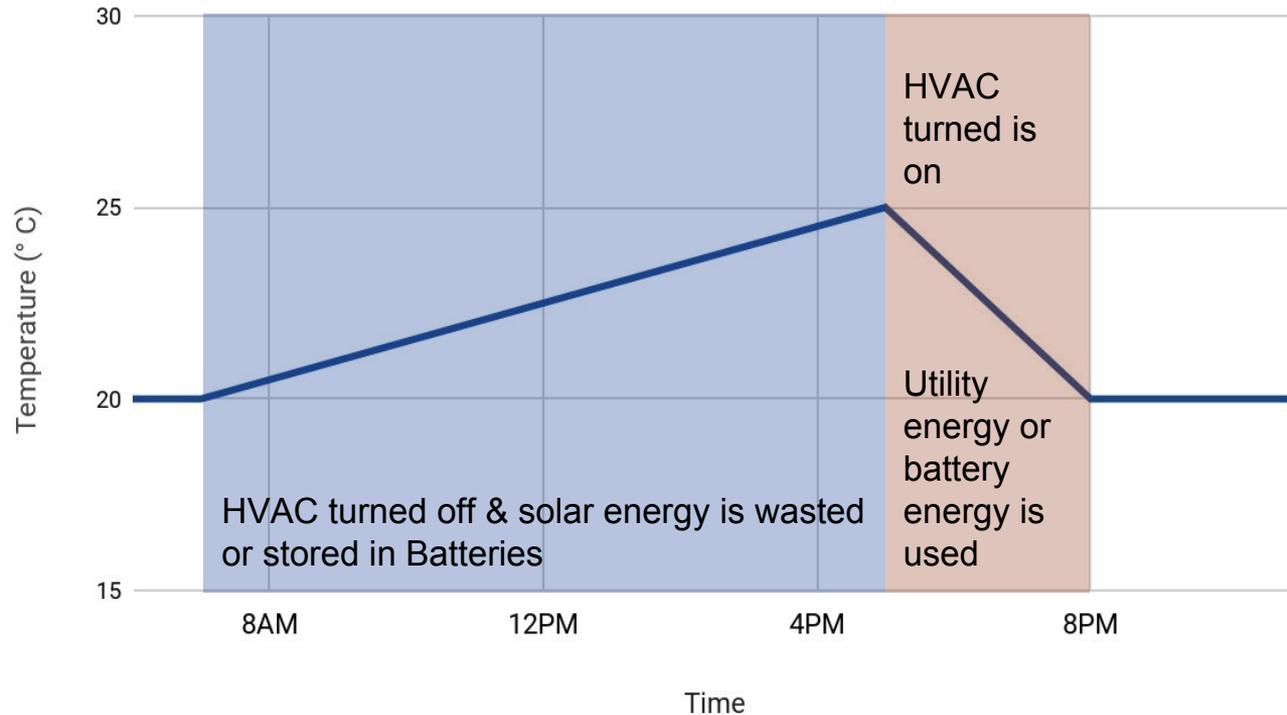
Occupancy sensing thermostats

- Help to reduce HVAC load
- Still do not solve the timing issue
- Actually function to worsen the problem



Typical operation of an intelligent thermostat

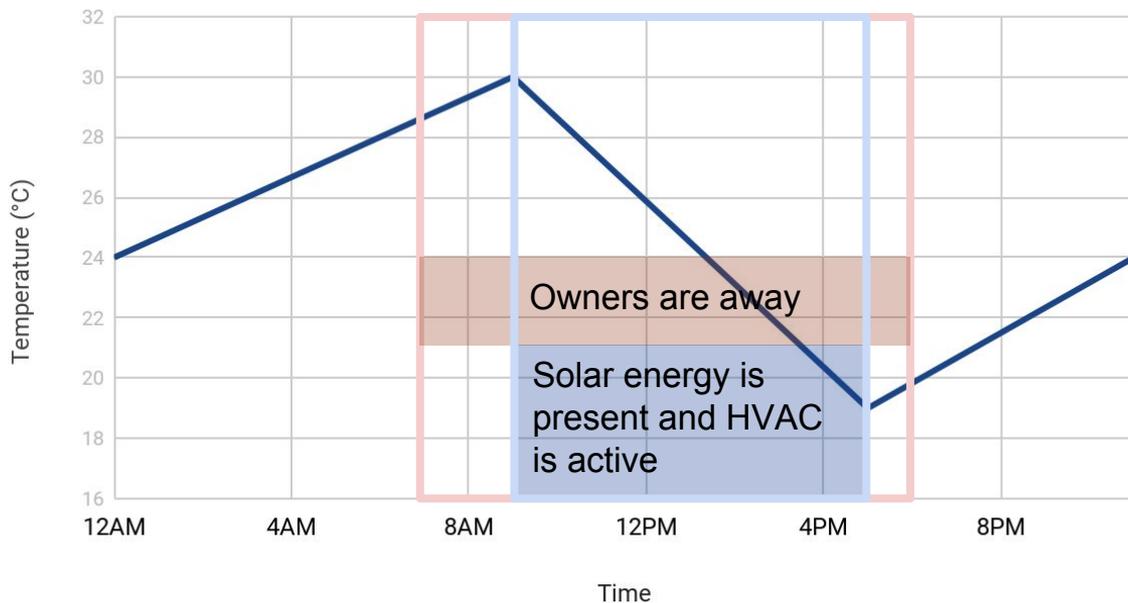
Temperature Over Time



Proposed Solution - Concept

- Lets the home warm up while occupants & solar power are not present
- When solar power is present, 'supercools' the home bringing the temperature below the required temperature
- Allows the temperature to rise within an acceptable range throughout the evening

Temperature V/S Time



Proposed Solution - Implementation

- Works very much like the thermostats we currently use in our homes.
- Only difference is the times that it turns the HVAC on and off.
- Therefore, the TESH system can be integrated into the existing thermostat interface in our homes.



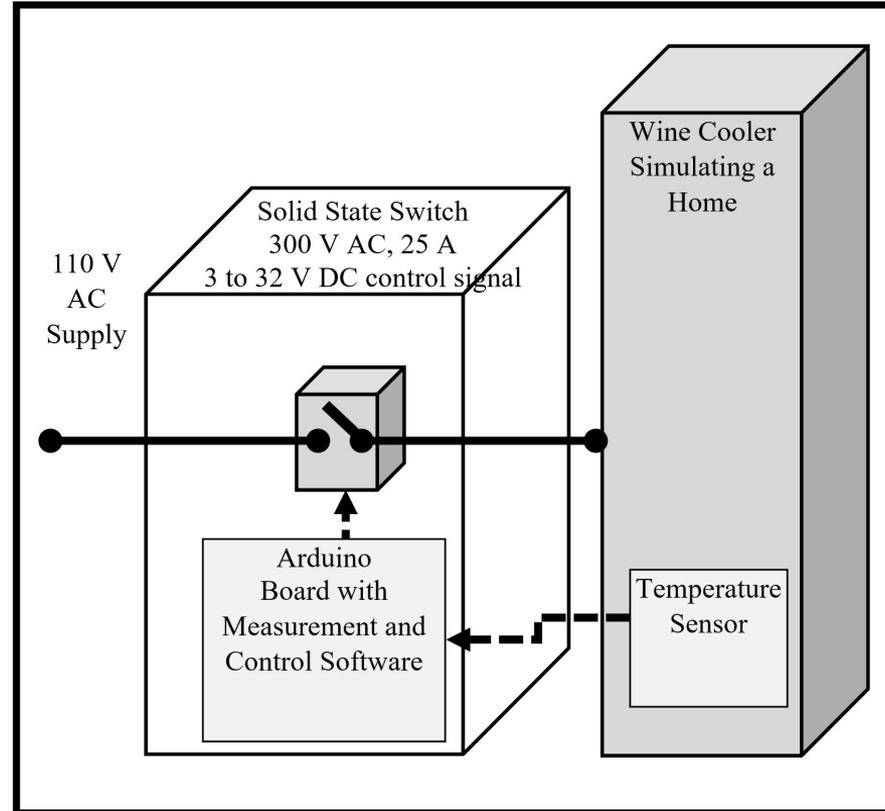
Proposed Solution - Feasibility

- Cooling a 2500 square foot home by 15 degrees Celsius would take around **3600 joules**
- This amount of energy can easily be generated by **100 square feet of solar panels** (wunderground.com/calculators/solar.html)
- Therefore, TESH should be feasible for most solar installations.



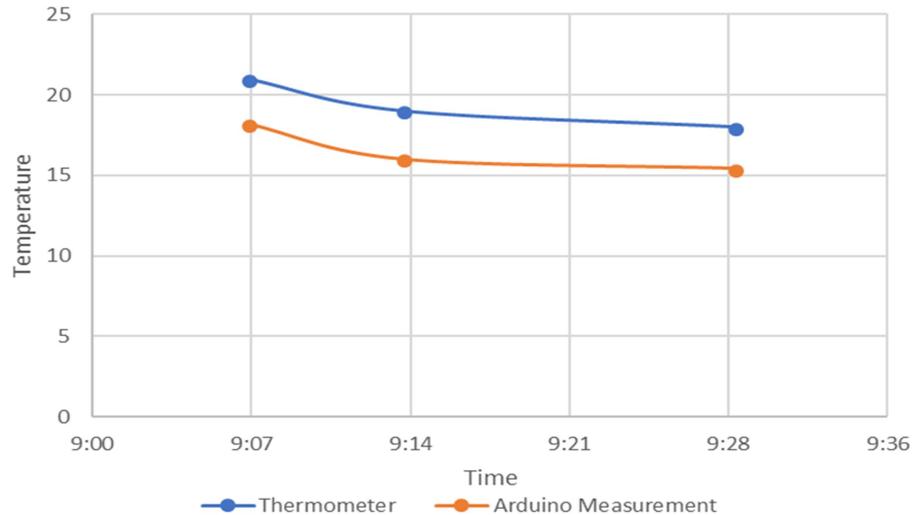
Proposed Solution - Experimentation

- Multiple tests were conducted on a model TESH system
- A wine cooler was used to simulate a home
- A solid state relay in conjunction with an Arduino was used to control the cooler

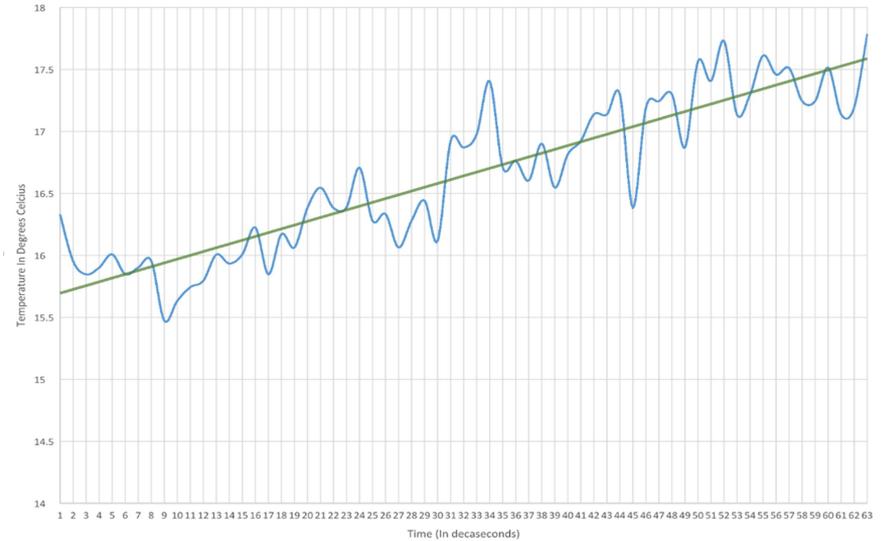


Proposed Solution - Experimentation

Thermometer VS Arduino Temp Measurement



Temperature (Heat Gain) Average Per Min



Proposed Solution - Commercialization

- The price breakdown was as follows:
 - Arduino Due - \$58
 - Temperature Sensor - \$2
 - Solid State Relay - \$63
 - Wiring - \$2
- This resulted in a cost of around \$125

A commercialized TESH system would not require a relay, and would most likely look and work similarly to the existing thermostat in many homes today. Through mass production, the costs would most likely be able to be brought below \$50 or even \$20.

Questions
