Continuity of Thermal Processing Power Through Energy Storage Materials

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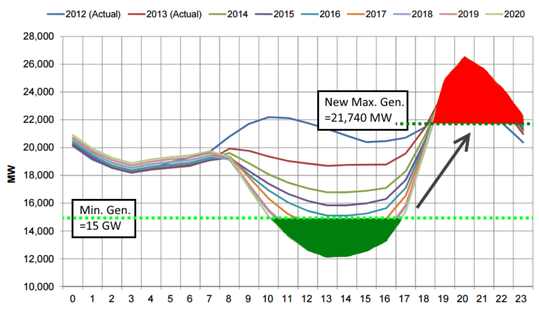
*Solar thermal driven solutions are restricted to applications that: **(1)** do not require continuous processing power and **(2)** do not require tight temperature control. The Woodall Research Group presents promising solutions via high and mid temperature heat storage.*

The Problem

Within the last decade, there has been an exponential growth in the energy sector around the world. With constant technological improvements, solar panels are only efficient and useful in the daytime.



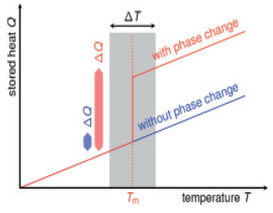
The graph above is known as the “Duck Curve”. The Duck Curve is a graph of power production over the course of a day that shows the timing imbalance between peak demands and renewable energy production. The green shaded region is the point of over-generation, where PG&E can no longer buy back the energy and the energy is lost. The red shaded region is the area of over-consumption, where the demand for energy is higher than what they can supply.

The Problem

Unfortunately, we also have the problem of power outages due to bad weather conditions and other factors. These power outages can last up to four days. Therefore, a battery system solution is needed.

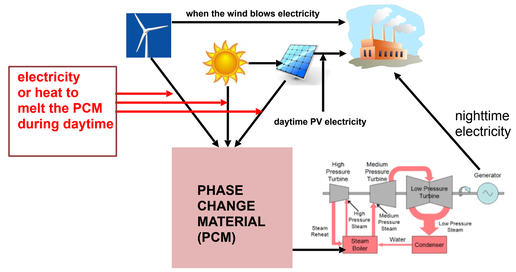
The Solution

With our Phase Change Material (PCM), our mission is “Continuity of Power” during utility power failures. The materials we use is an alloy made up of Aluminum and Silicon, two of the most abundant elements in our world. These elements have high latent heat, high thermal conductivity and low thermal expansion.



Metal / Alloy	Latent Heat of Fusion (kJ/kg)	Melting Point (°C)
Aluminum	396	660
Silicon	1665	1410
Al-12.2%Si	555	577

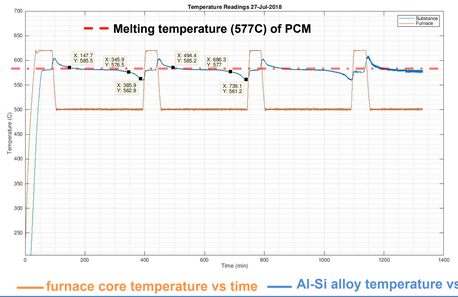
Mid Temperature



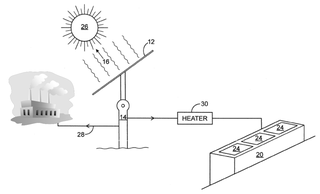
The battery will operate by having an electricity or heat to melt the PCM during daytime. The alloy will eventually reach 577°C where it will change from a solid to a liquid. Once the sun goes down or a power outage happens, the thermal energy will be converted into electricity to power your electronic’s.

The Results

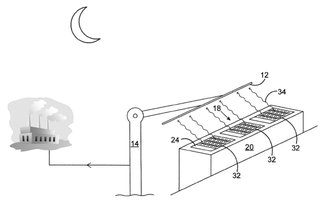
We collected the data for the Mid Temperature system and the results were promising. The 1.2 Kg substance stayed at 577°C for roughly 3 hours.



High Temperature



During the day, PV array with a mix of GaAs and Si cells (12) converts sun power (16) to electricity during the day. Some electricity (28) powers the factory, the rest (14) powers heater (30) to melt the silicon (24).



During the night, the same PV array (12) would be positioned over the meted silicon at 1414°C. PV (12) now receives radiation from the molten silicon (24) and generates electricity for the factory. The molten silicon stays at 1414°C releasing its latent heat until frozen.