UTILIZE CLIPPED ENERGY TO CREATE WATER WITH THERMOELECTRIC DEVICES

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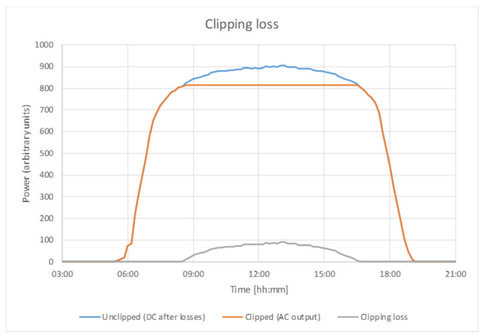
This innovative approach to repurposing clipped energy for sustainable benefits contributes to ecological restoration and conservation efforts.

What is Clipped Energy?

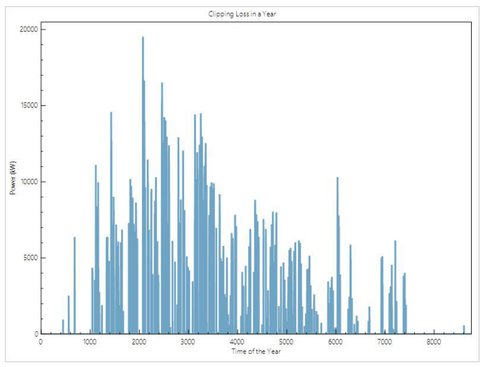
Solar clipping refers to the situation where the AC power output of an inverter is limited due to the peak rating of the inverter. During the best sunlight hours, additional power may be available from the solar panels, but it can not convert to AC power. This situation results in Clipped Energy. This energy generally gets wasted unless solar PV power plants are coupled with battery energy storage systems.



Clipped Energy Availability

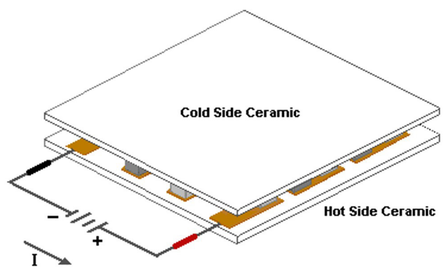
If you look at the recent data, most of the PV projects get designed with 1.4 DC/AC ratio in the United States. This can result in 4,546,800 kWh of clipping losses for a 100 MWac solar project in any given year. These numbers can decline as PV modules start degrading over the years.

A clipping loss chart for Galveston, TX.



What Are Thermoelectric Devices?

Thermoelectric devices are made of an array of alternating n-type and p-type semiconductors. This array is soldered between two ceramic plates. Once the voltage is applied to these devices, current flows through the junctions of two conductors. This results in heat removal from one side, which turns cold, and the heat gets deposited at the other junction, which becomes hot.



This temperature gradient can range anywhere between 35C to 70C depending on the Peltier coefficient, current, and time

Water Condensate Creation Setup

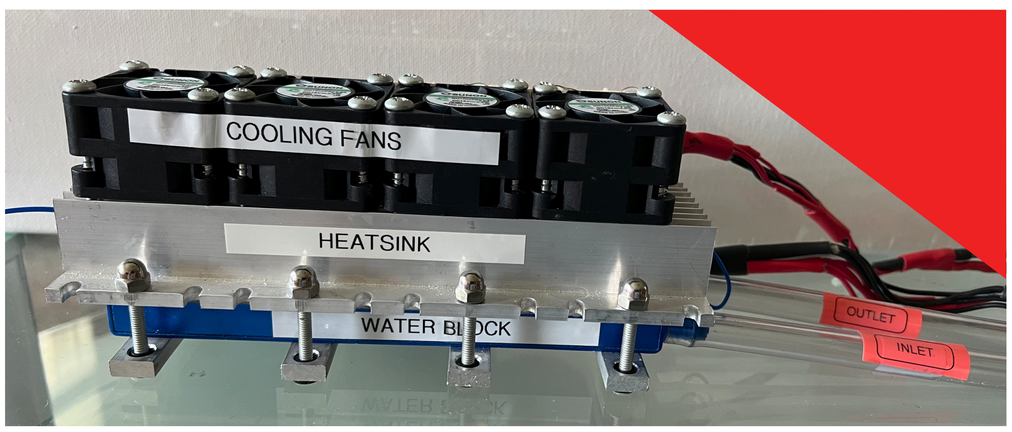
This setup consists of four critical components -

1. Thermoelectric modules – 12 V dc power supply is connected to four modules. These modules are sandwiched between the heat sink plate and the water block. Once the power is supplied, one side of the module gets hot and the other side gets cold.
2. Heat sink – The heat sink helps the system's thermal management. It helps reduce the temperature of the module's hot side based on the principles of conduction.
3. Cooling fans – The heat generated by the hot side is absorbed by the heat sink, and cooling fans transfer that heat to the surrounding atmosphere by continuously blowing ambient air over the fins of the heat sink. In this case heat transfer happens based on the principles of convection.
4. Water block – Cold side of the thermoelectric module is connected to the water block. This water block has an air inlet, where ambient air enters and gets in contact with the cold inner walls of the water block. Here again, conduction and convection heat transfer principles come into play. Humid ambient air starts condensation inside and outside the water block. As this condensate increases in volume, we can capture the fresh water out of air. The power consumption for this smaller setup is approximately 600 W per hour. The experiment generated 2 ml of water after an hour of operation in Houston, TX.

If you scale that up to utilize all the clipped energy from the typical 100 MWac solar project, we could generate 15,156 liters of water annually.

Conclusions

1. This setup will work best where ambient air is highly humid. Coastal cities like Houston, Miami, San Diego, etc could be a great locations for this experiment.
2. Air coming out from the water block outlet can be used for cooling purposes if the setup is scaled up.
3. Clipped energy which was treated as system inefficiency, could be used to create valuable resource and make solar projects even greener.
4. This could reduce the underground water extraction at the site. As water is needed everyday for routine maintenance activities.



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