GEOTHERMAL THERMOELECTRIC GENERATORS: A PROMISING ALTERNATIVE FOR HOT DRY ROCK FIELDS

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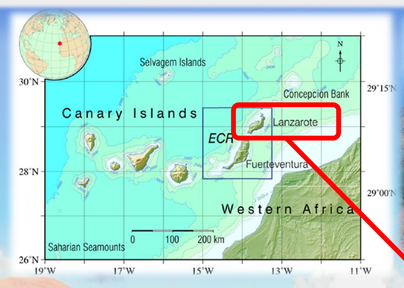
INTRODUCTION

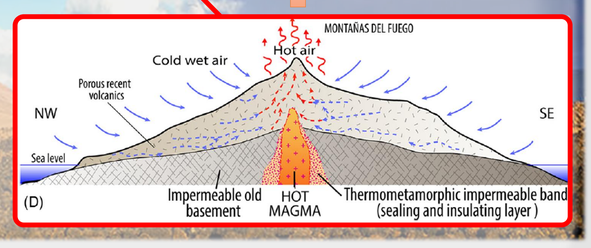
Geothermal energy contributed in 2021 with les tan 3.4% to the worldwide primary energy due to the implicit drawbacks in the existing geothermal power plants. That makes necessary to develop disruptive technologies that allow its use, for example, in *Hot Dry Rock Fields*, one of the most abundant geothermal reservoirs in the world.

Thermoelectric generators are an ideal alternative to conventional geothermal power plants because of their robustness and reliability, scalability and ease of installation with minimal environmental impact.

The most suitable heat exchangers for this application, due to the absence of moving parts, are those that operate by phase change, avoiding auxiliary consumption and maintenance.

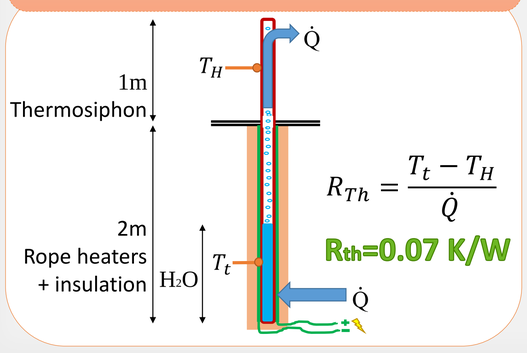
Thus, this work develops a thermoelectric generator for Timanfaya National Park in Lanzarote (Spain), the perfect environment to test his device because it has one of the most important surface geothermal anomalies in the world and because of the need for a boost in the use of renewable energies in the Canary Islands.





PASSIVE HEAT EXCHANGERS CHARACTERIZATION

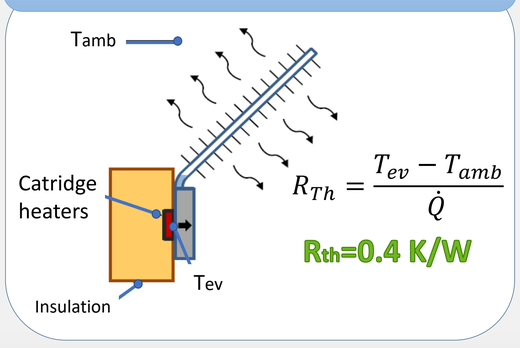
HOT SIDE HEAT EXCHANGER (HHE)



$$R_{Th} = \frac{T_t - T_H}{\dot{Q}}$$

Rth=0.07 K/W

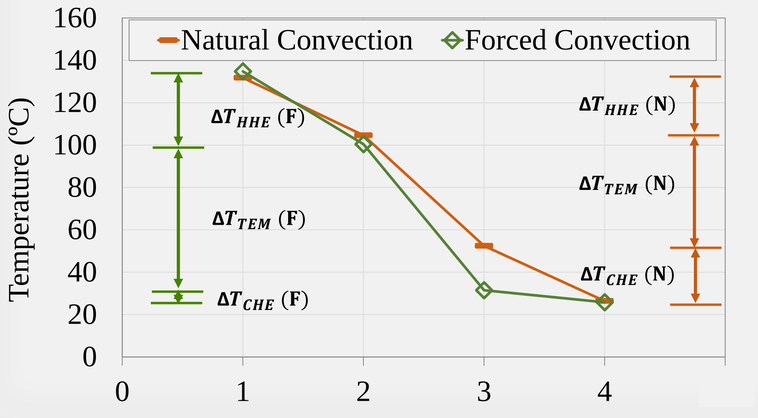
COLD SIDE HEAT EXCHANGER (CHE)

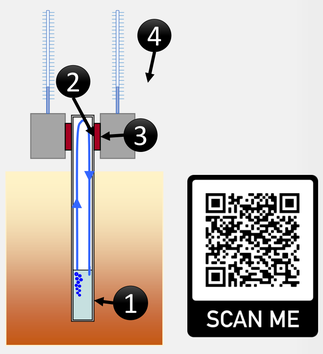


$$R_{Th} = \frac{T_{ev} - T_{amb}}{\dot{Q}}$$

Rth=0.4 K/W

GTEG LABORATORY TESTS



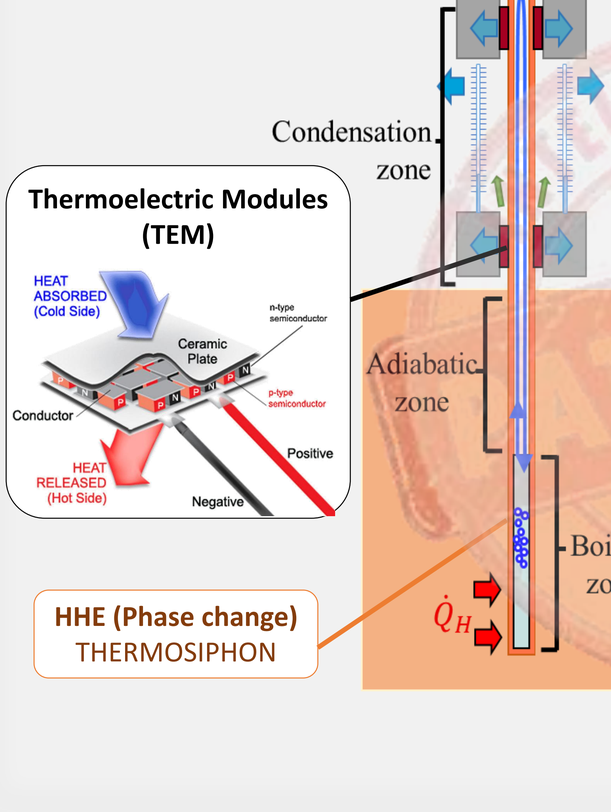


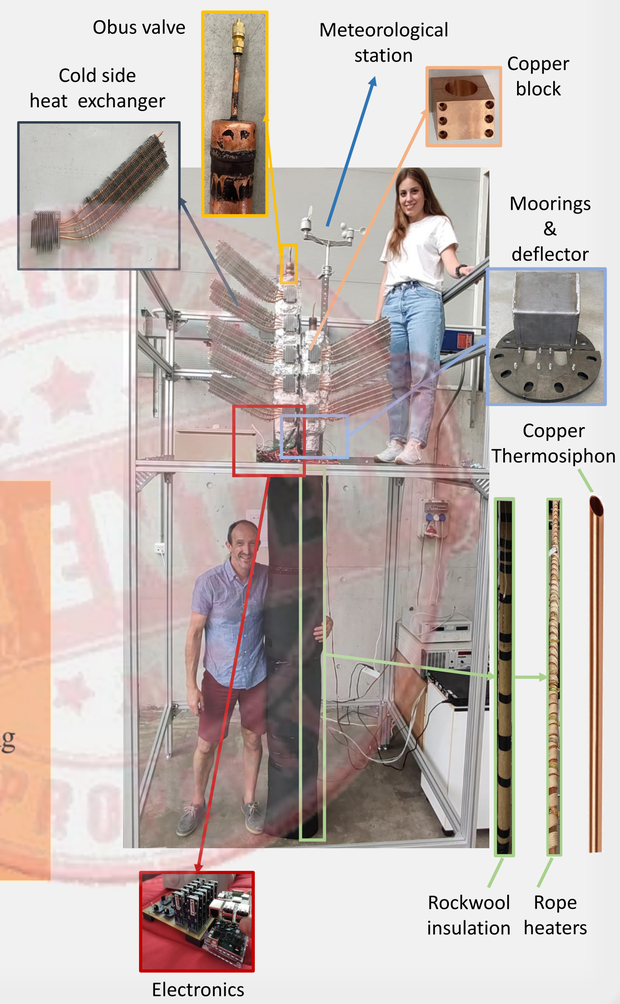
SCAN ME

GEOTHERMAL THERMOELECTRIC GENERATOR (GTEG)

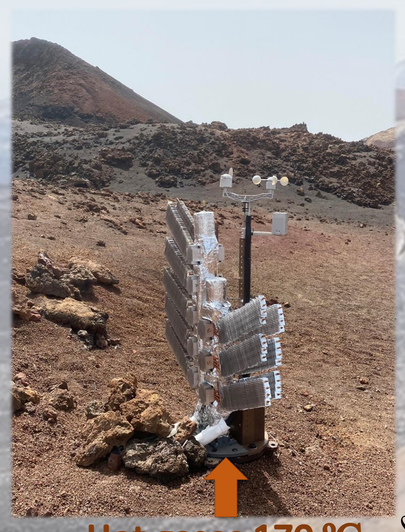
CHE (Phase change)
DISSIPATER + HEAT PIPES

HHE (Phase change)
THERMOSIPHON

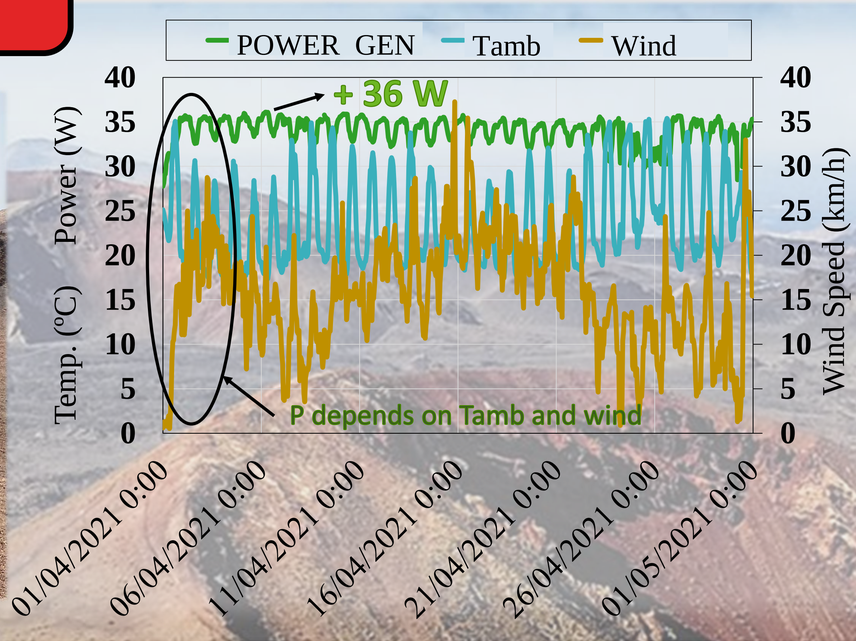


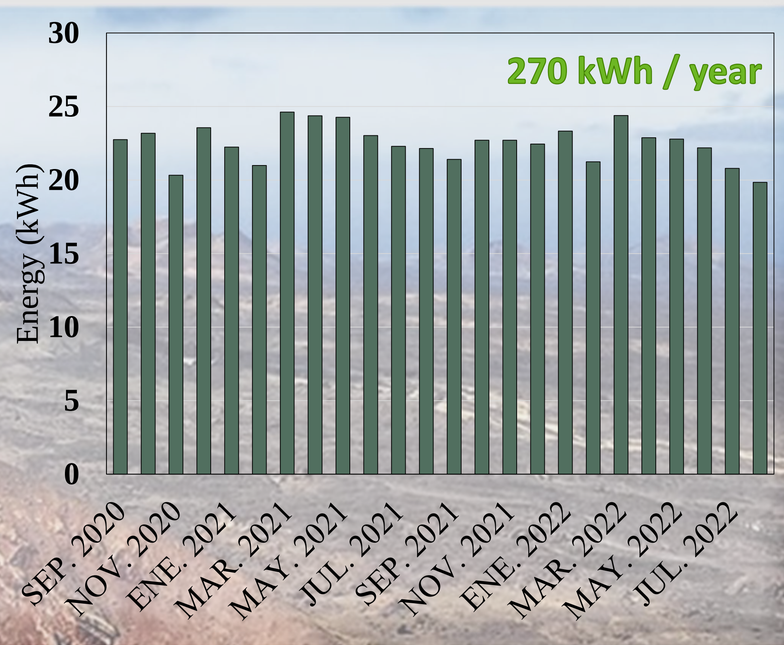


FIELD INSTALLATION & OPERATION



Hot gases 170 ºC





CONCLUSIONS

- ✓ A **geothermal thermoelectric generator** (GTEG) **without moving parts** has been succesfully developed and installed for **the first time worldwide**.
- ✓ It has heat exchangers that work by phase change, with low termal resistances (0.07 K/W in the hot side and 0.4 K/W per thermoelectric module in the cold side).
- ✓ **Good efficience of the heat exchangers** demonstrated by the thermal drop from the heat source to the hot side of the TEMs of 30 ºC and from the cold side of the TEMs to the ambient of 7 ºC with forced convection in the laboratory.
- ✓ **Succesfully installed in Timanfaya National Park** (Lanzarote, Spain) and identified by the Government as the only feasible solution **to harness its high enthalpy geothermal anomalies**.
- ✓ The developed GTEG has been operating for **+2 years**, generating more than **270 kWh per year**, without maintenance and with a **low environmental impact** compared to the conventional geothermal power plants.

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