The 2-layer thermoelectric generator structure application for photovoltaics cells cooling and energy recovery

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The series of experiments was carried out in three stages with the purpose of each being the following:

STAGE 1

Obtaining the real power/voltage characteristics of the tested photovoltaics cells for the selected temperature range.

STAGE 2

Determining the temperature characteristics of the multilayer TEGs structure with TEGs connected both in series and in parallel.

STAGE 3

The practical testing of the proposed hybrid PV-TEGs system under both the laboratory artificial light source and in the sun irradiation environment.

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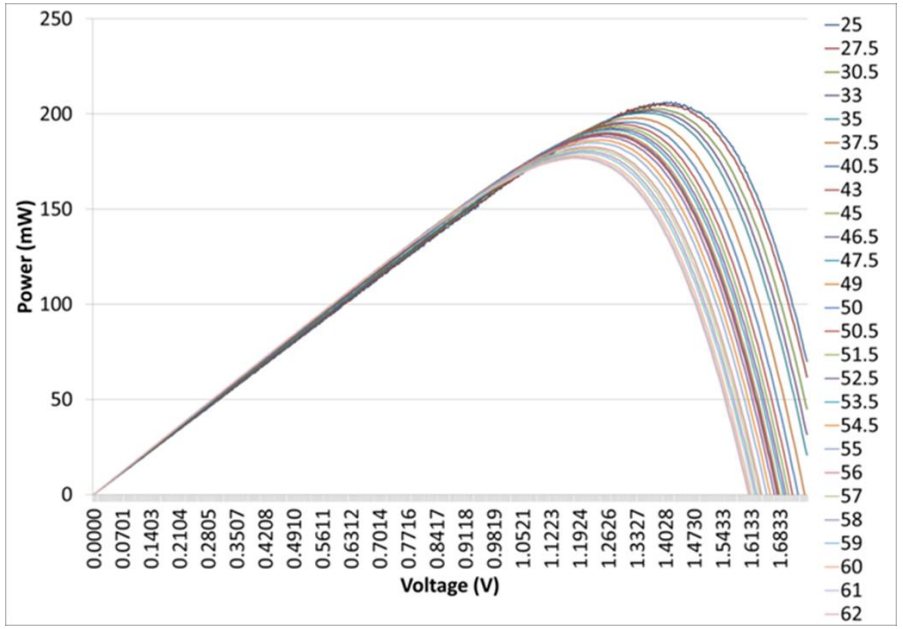
The real characteristics of the silicone polycrystalline photovoltaics cells tested was obtained in laboratory conditions using the toolkit consisting of: the artificial solar light simulator the Sol3A series being the irradiation source , true RMS digital multi tester with USB Mercury MTTR0 and the Keithley 2440 digital source meter.



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The temperature characteristics for the investigated multilayer TEG structure was obtained applying the TEC as an energy source.

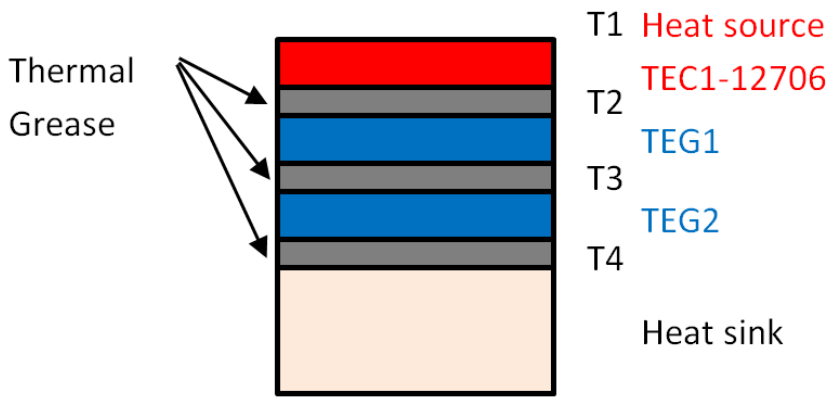
Where:

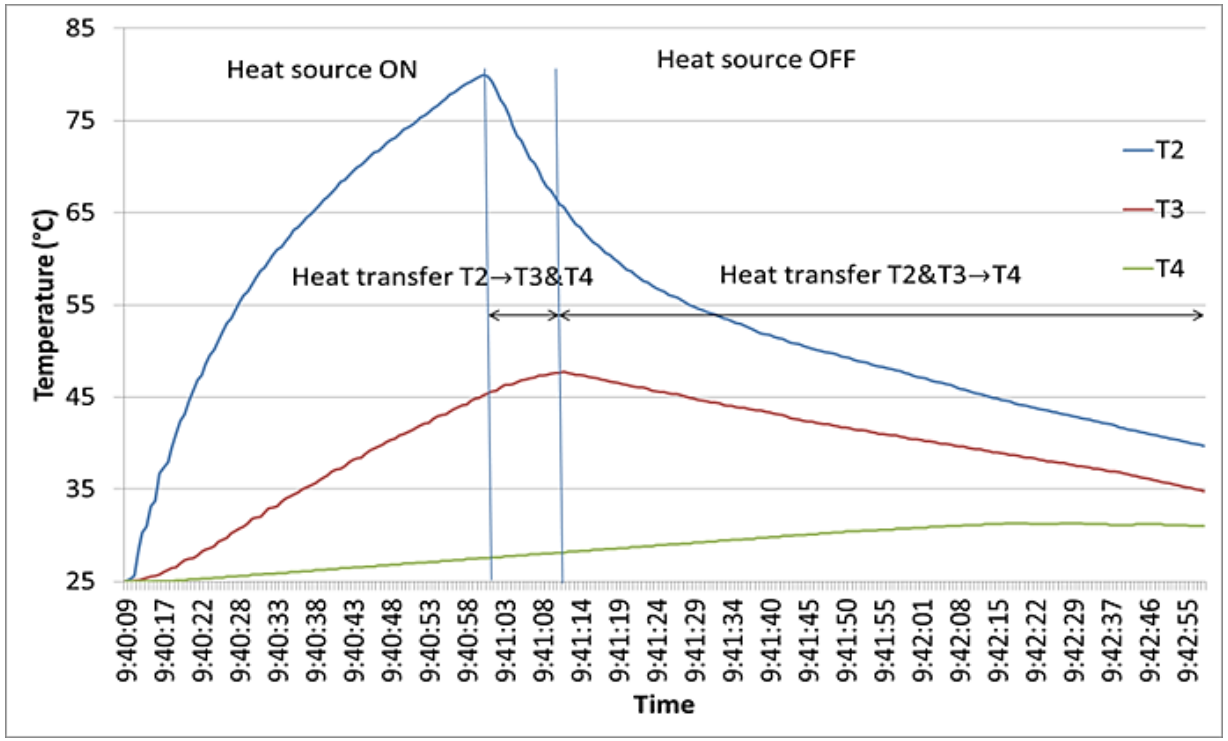
T1 – heat source (cold side);

T2 – connection area of the heat source (hot side) and the TEG1 (hot side);

T3 – connection area of the TEG1 (cold side) and the TEG2 (hot side);

T4 – connection area of the TEG2 (cold side) and the heat sink





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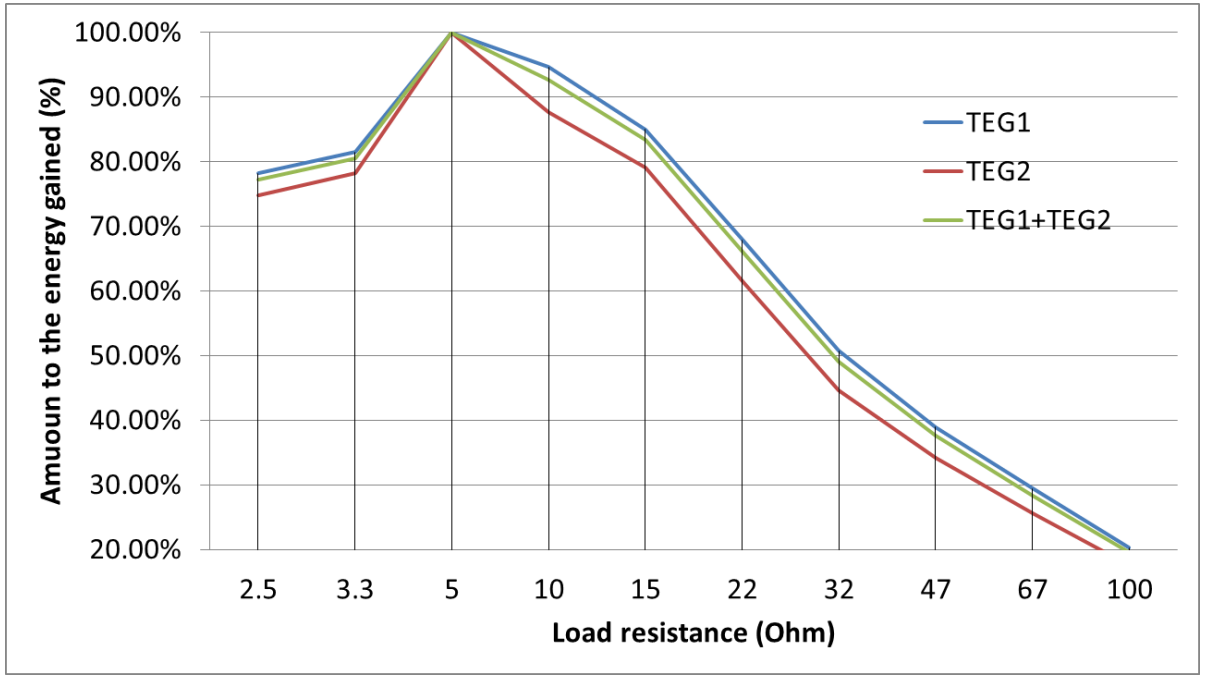
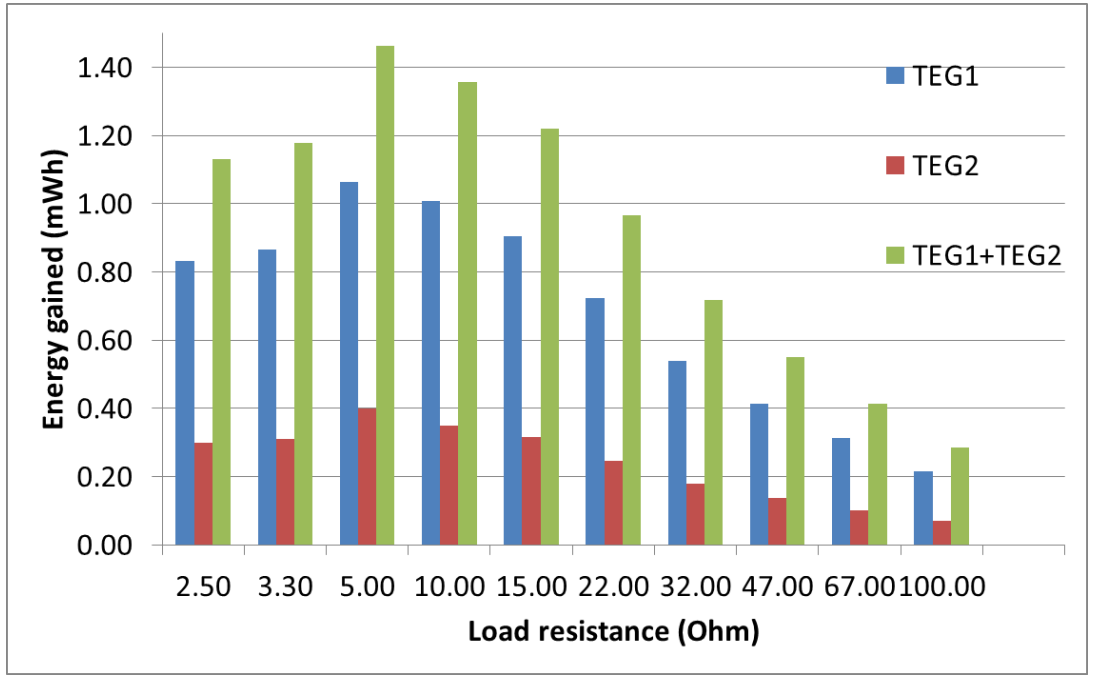
Subsequently, the influence of TEG's load resistance on energy output was tested and the most efficient load size found:





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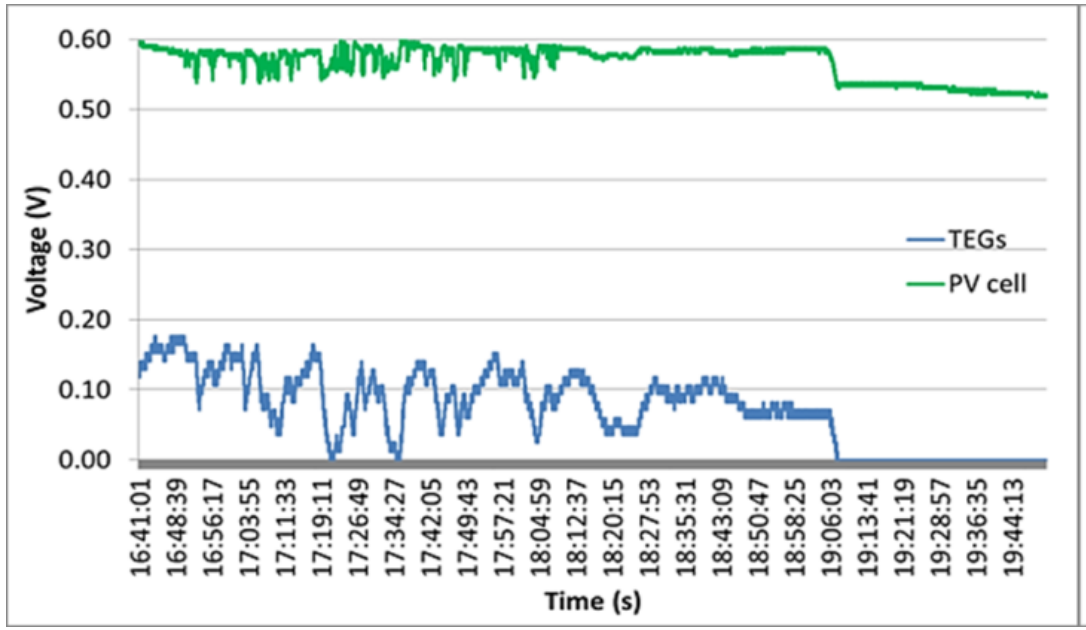
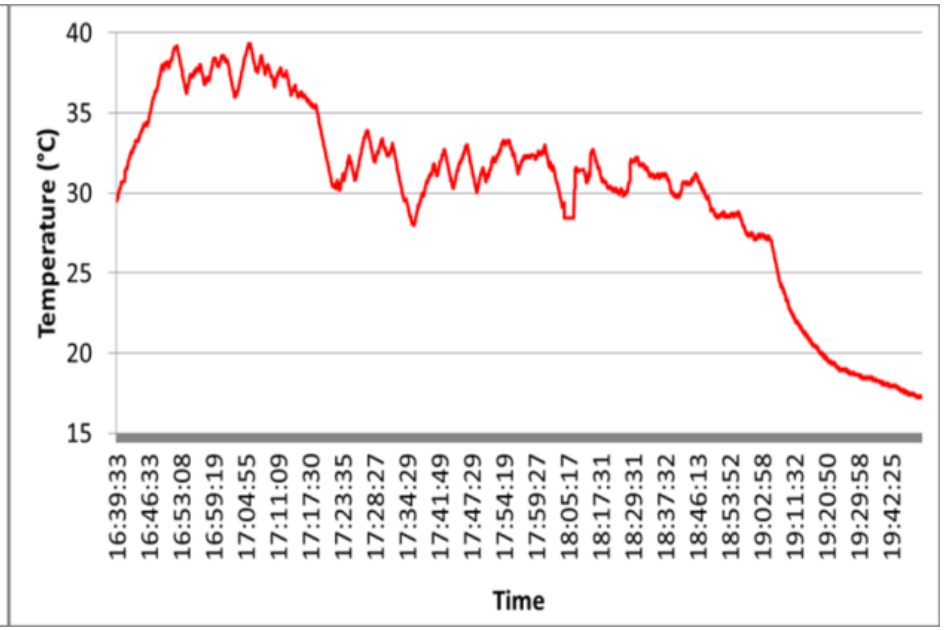
The practical voltage open circuit and 5 Ohm load tests of the proposed multilayer hybrid structure was performed in the North Glasgow area in April and May, 2020.





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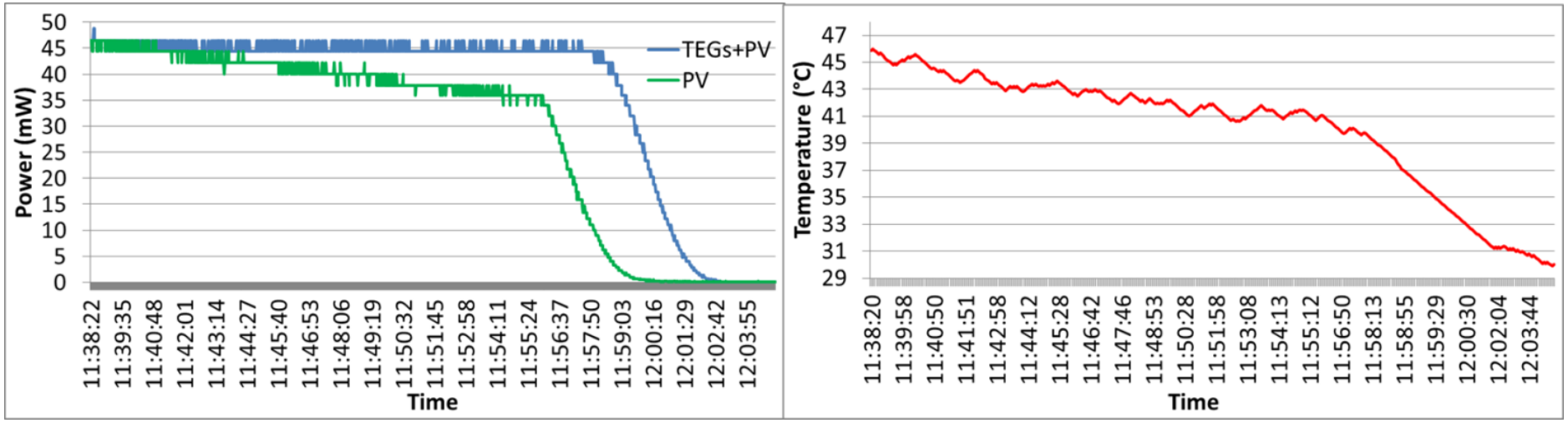

The investigations confirmed:

1. Influence of the PV cells temperature increase on to their efficiency (-0.58%/°C);
2. Utility of the thermo-electrical generators for cooling and PV cells energy recovery;
3. Energy boost provided by the multilayer TEG's structure to the hybrid PV-TEG system.