

## Sustainable Ionized Gas Thermoelectric Generator: Comparative Theoretical Evaluation and Efficiency Estimation

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**Abstract :** This extensive theoretical study on a novel Ionized Gas Thermoelectric Generator (IG-TEG) system has shown the ability of continuous energy extracting from the thermal energy of ambient air around standard room temperature and even below. This system does not need a temperature gradient in order to work, unlike the other TEGs that use the Seebeck effect, and therefore this new system can be utilized in sustainable energy systems, as well as in green cooling solutions, by extracting energy instead of wasting energy in compressing the gas for cooling. This novel system was designed based on Static Ratchet Potential (SRP), which is known as a spatially asymmetric electric potential produced by an array of positive and negative electrodes. The ratchet potential produces an electrical current from the random Brownian Motion of charged particles that are driven by thermal energy. The key parameter of the system is particle transportation, and it was studied under the condition of flashing ratchet potentials utilizing several methods and examined experimentally, ensuring its functionality. In this study, a different approach is pursued to estimate particle transportation by evaluating the charged particle distribution and applying the other conditions of the SRP, and showing continued energy harvesting potency from the particles' transportation. Ultimately, power levels of 10 Watt proved to be achievable from a 1 m long system tube of 10 cm radius.

**Keywords :** thermoelectric generator, ratchet potential, Brownian ratchet, energy harvesting, sustainable energy, green technology

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