# Fire to Wire: A Stove-Powered Charger

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**Abstract:**

This work aims to develop a thermoelectric power generator system for harvesting waste heat from cooking stoves and barbecues, intended to power small electronic devices or LED lights in off-grid or outdoor environments. Central to this objective is optimizing the system's efficiency by employing effective cooling techniques, which are crucial for sustaining a temperature gradient across thermoelectric modules and maximizing power output. This paper specifically addresses the cooling aspect, analyzing and comparing various methods to enhance thermoelectric generator performance. The study evaluates passive cooling, active cooling, and liquid cooling systems to identify their potential and limitations for use in portable thermoelectric applications. Passive cooling, which relies on natural convection, is found to be a low-cost, low-maintenance option but struggles to maintain a substantial temperature differential under high heat conditions. Active cooling, employing fans, offers better thermal regulation but introduces additional power consumption, potentially lowering system's efficiency in off-grid contexts. Liquid cooling provides the highest cooling efficiency, particularly under heavy thermal loads, though portability and potential leakage pose challenges for its application in mobile setups. Results indicate that each cooling technique offers unique benefits and trade-offs, underscoring the importance of matching cooling methods to the specific operational environment and energy needs of the thermoelectric system. The insights gained from this investigation will guide future phases of the project, focusing on the design and integration of thermoelectric systems for reliable waste heat recovery in compact, sustainable energy applications.