# Enhancing Energy Efficiency and Design Sustainability in Atmospheric Water Generators

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**Abstract:**

According to the World Health Organization, 4 out of 10 people worldwide are directly affected by water scarcity. The lack of access to a supply of clean water causes severe problems in multiple aspects of human life, including socioeconomic development, food production, and health and disease prevention. A promising solution lies in the large volume of water that exists within the atmosphere, which approximates the volume of 11 billion Olympic-sized swimming pools globally. As a result, atmospheric water generators (AWGs) have been proposed as a method of making use of this resource. Due to the necessity of water resources, the impact of AWG technology cannot be understated: a 2015 report from Grand View Research values the global market for AWGs at nearly 1 billion USD, projecting it to further grow by 20.1% through 2024.

However, many designs of atmospheric water generators are often large and unwieldy, and their usage requires multiple moving parts. Additionally, in many areas where water scarcity is a significant issue, the existing local infrastructure is frequently insufficient for supporting the energy load required for such a device. A prior design proposed and successfully implemented by Suryaningsih et al. (2016)[1] relies on using a 1-2 $m^2$ solar panel as a source of renewable source of energy to provide 12 volts DC to both a Peltier module array and a fan. Air enters through the fan and is heated by one side of the array, before being cooled into condensate on the other side. This design can generate up to 14.6 liters of water per day while using only 125 watts of power, and on average consumes just 739.7 kilojoules per liter of water produced.

While this design involves fewer mechanical parts and compares very favorably to other AWG designs currently on the market in terms of energy efficiency, further improvements can be made. Rather

[1] S. Suryaningsih and O. Nurhilal, "Optimal design of an atmospheric water generator (AWG) based on thermo-electric cooler (TEC) for drought in rural area", 2016, pp. 1-2.

than using a solar panel as the energy source, a series of multiple thermoelectric generator (TEG) modules could be used to produce the required amount of voltage based on external temperature differences, thereby greatly reducing both the weight and the amount of space required to properly set up the device. In turn, this enhances the device's portability and expands its potential range to even more remote locations. Solar energy would be concentrated onto the TEG modules via a parabolic reflector (similar to that used in solar cookers) in order to produce a large temperature differential between both sides of the TEGs. As this method would require the use of a battery to ensure a constant voltage is delivered to the system at all times, the voltage produced by the TEGs should be between 30-50% greater than the voltage delivered to the system to charge the battery, or a range of 15.6 to 18 volts DC. Based on preliminary data and analyses, this proposed new method can provide an average of approximately 16.5 volts DC over a 14-hour period while using just 0.0256 $m^2$ of area for the energy source. Future work would require exploring other possible types of batteries and energy storage, as well as adding built-in solar tracking features in order to capture the maximum amount of solar energy available at any given time.