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IMPLICATIONS OF CLIMATE CHANGE ON PV GENERATION IN SEMI-ARID ZONES

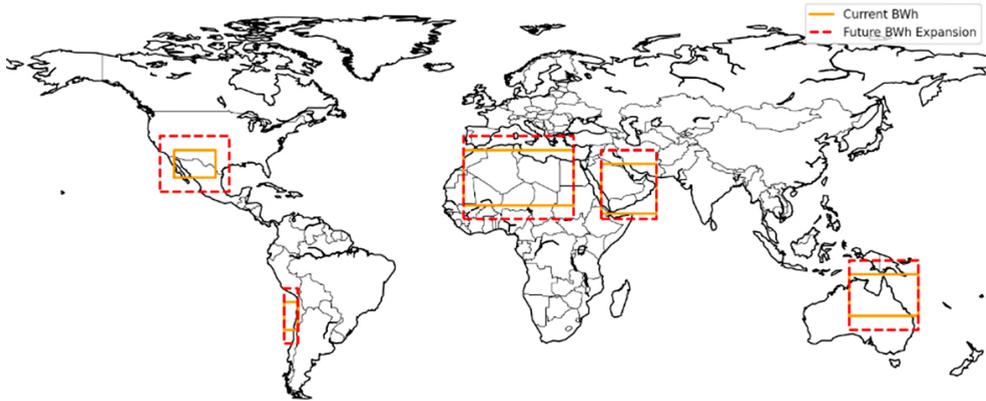
Aiman ALBATAYNEH*

*Energy Engineering Department, School of Natural Resources Engineering and Management,
German Jordanian University, P.O.Box: 35247, Amman 11180, Jordan*

* **Corresponding author.** Email address: Aiman.albatayneh@gju.edu.jo

Abstract – Adopting photovoltaic (PV) solar energy in regions with abundant sunshine offers a promising pathway for transitioning towards renewable energy sources. However, deploying PV solar energy faces challenges posed by climate change, which can potentially undermine its effectiveness and reliability. One significant concern is the impact of rising temperatures on the efficiency of PV panels, which can lead to reduced electricity production. This paper investigates the potential effects of climate change on PV production in the Cold Desert (BWk) Climate Zone through comprehensive PV performance simulations. Utilizing PVSyst software, we conducted an in-depth analysis of 1MW PV systems under current climate conditions and projected future scenarios in 2060. Our assessment focused on understanding how rising temperatures may affect PV performance in the BWk Climate Zone, characterized by cold winters and hot summers with low precipitation. Figure shows a world map illustrating the current arid, desert, hot (BWh) climate zones and their projected expansion into adjacent areas, potentially turning cold desert (BWk) zones into hotter, arid regions. Orange regions: represent the current BWh climate zones. Red dashed regions: indicate the hypothetical future expansion areas of BWh zones. The simulation results revealed a slight decrease in global horizontal irradiation (GlobHor) from 2230.4 kWh/m² to 2154.8 kWh/m² and a corresponding increase in horizontal diffuse irradiation (DiffHor) from 488.51 kWh/m² to 553.15 kWh/m². The ambient temperature (T_Amb) rose from an annual average of 18.51 °C to 20.07 °C. Despite these climatic changes, the global incident irradiation on the collector plane (GlobInc) and the effective global irradiation corrected for IAM and shadings (GlobEff) showed only minor reductions. Consequently, the energy injected into the grid (E_Grid) experienced a marginal decrease, from 33928.701 kWh to 33856.461 kWh annually. These findings indicate that PV production is expected to decrease, but the reduction is relatively minor, amounting to an insignificant value of 0.021 %. This finding suggests that while climate change may impact PV efficiency due to increased temperatures, the overall effect on PV production in the BWk Climate Zone remains minimal.

Keywords – *Climate change; cold desert (BWk) climate zone; energy sustainability; Jordan; Ma'an; PV performance; PVSyst simulation; renewable energy*



Projected Arid Desert Hot (BWh) Climate Zones expansion into Cold Desert (BWk) Zones

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