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Determining the effect of the solar cell band gap on power yield in southern African irradiance conditions

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Abstract content
   (Max 300 words)
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Solar panel yield is determined both by the local available solar irradiance and the detector characteristics. The Shockley-Queisser limit is the theoretical limit of maximum efficiency of any single junction solar cell. It is based on the maximum possible yield for the band gap of the junction in question and not on any practical or manufacturing limits. To a first approximation this limit is calculated for the irradiance at the top of the atmosphere. A more accurate calculation requires considerations of the solar ray attenuation at the specific site of measurement. The contributions to the irradiance are not proportionally the same on the surface of the earth as at the top of the atmosphere, as different wavelengths of incident light are scattered and absorbed differently. As such the optimal band gap on the surface of the Earth will slightly differ from that obtained from the first order approximation. Due to the variability of atmospheric conditions with time and geographical position, this optimal band gap will also vary with time, location and orientation. This paper calculates the optimum band gap for site specific parameters, such as latitude, altitude and aerosol types, descriptive of southern African sites identified for solar power generation. The paper highlights the key factors that influence the band gap optimisation, which would assist in the research and development of more efficient solar cells, under southern African atmospheric conditions and allow for more accurate predictions to be made for local solar power yield.

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