**Mathematical Proof of Concept**

is the electrical energy generated from the solar module.

is the electrical efficiency of the solar module.

is the solar energy generated from the solar module.

is the solar irradiation or incident solar energy per unit surface area.

is the surface area of the solar module.

is the total irradiance acting upon the solar module surface.

is the direct irradiance.

is the diffuse irradiance.

is the reflected irradiance.

is the direct normal irradiance.

is the incidence angle between the normal of the solar module surface and the sun.

is the solar altitude angle.

is the solar module altitude angle or tilt angle.

is the solar azimuth angle.

is the solar module azimuth angle.

is the apparent solar irradiation.

is the ratio of diffuse radiation on a horizontal surface to direct normal irradiation.

is the relative atmospheric pressure.

is the atmospheric extinction coefficient.

is the ratio of unshaded surface area to total surface area of solar module.

Combining all equations:

Ignoring and , thus ;

Assuming the same PV module used and a fixed time, .

Similarly, assuming the same PV module, fixed time, and incident angle, ,

**The electrical energy generated from the solar module is directly proportional to the cosine of the incidence angle and the unshaded area of the solar module.**

Obtaining optimal value,

**The optimal module azimuth angle should be always equal to the solar azimuth angle to maximize electrical energy of the module.**

Obtaining optimal value with substituting ,

Using trigonometric identity ,

**The optimal module altitude angle should always be equal to the zenith angle of the sun which is 90 minus the solar altitude angle to maximize electrical energy of the module.**

**References**

Matius, M.E.; Ismail, M.A.; Farm, Y.Y.; Amaludin, A.E.; Radzali, M.A.; Fazlizan, A.; Muzammil, W.K. On the Optimal Tilt Angle and Orientation of an On-Site Solar Photovoltaic Energy Generation System for Sabah’s Rural Electrification. Sustainability 2021, 13, 5730. https://doi.org/10.3390/ su13105730