

Addendum - The Pinhole Effect on Layered Solar Panel Power Throughput

By Joseph Juma

In, "Are Recessed Coplanar Solar Panels Better than Monoplanar Panels?" I intuited that perhaps the pinhole effect might be beneficial in allowing for the layering of solar panels for increased land-to-power efficiency. However, a simple intuition foray into the mathematics of optics seems to discredit this approach. For example, if one were to consider a circular solar panel which had 8 tiny holes drilled equally far apart from one another, as if the points of an octagon embedded in the circle at $1/2$ its radius. These 8 holes, pinholes, would then allow light to pass through them and be projected, further-down, onto 8 more equally spaced circular solar panels of the same size as the first. This would allow such solar panels to receive light, and the distance would likely not be substantial so as to have meaningful energy reduction due to atmospheric phenomenon like fog, except perhaps on a *very* foggy day.

However, the exposure of more surface area in this way, if solar panels have a constant efficiency coefficient for all amounts of energy exposed to them via solar irradiance, would not mean higher throughput. The reason for this is that the amount of energy that would be propagating through each hole would be equal to the amount of energy that originally went through the hole. This amount of energy is proportional to the percentage of the first solar-panels surface area each hole takes up. Due to this, the net energy being exposed to the 9 (1 primary, 8 secondary) solar panels is still identical to the energy being exposed to only a single solar panel. This, combined with the fact the conversion to electrical energy is a linear coefficient of irradiant energy, means that the amount of energy will be produced regardless of whether the 9-panel approach is taken, or the 1-panel approach.

Given 1 panel is much less expensive than 9 panels of nearly equal surface-area to the singular panel, thereby costing 9 times as much material to produce the same power-output, it is easy to suggest that 1 panel is the preferable approach. All of this does however beg a question of the biomimetic inspiration of plants: what evolutionary

phenomenon creates the layerings of leaves which do not play into solar-panels?
Clearly the efficiency of leaves is subject to a different dynamic, and as such this is not a projectable phenomenon onto solar panels.