Sometimes Less is More! The Case for a Vertical Bifacial Solar Farm (PV-4)

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Scientific Achievement:

Bifacial solar modules, which accept light from both faces, are an exciting photovoltaic (PV) technology for vertical integration with buildings and bridges. This first report establishes the design principle of vertical bifacial solar farms (BVFs) across the globe.

Significance and Impact:

By conventional wisdom, solar cells should face directly into the sun. However, building-integrated PV cannot face the sun directly; soiling of nearly horizontal monofacial farms in deserts erode energy output and require frequent cleaning; and PV output declines in the afternoon when the demand is the highest. Therefore, a VBF (Fig. 1) could be a transformative technology that addresses these issues.

Research Details:

- We integrated the global satellite-derived insolation data from NASA with the clear-sky model from Sandia to estimate hourly insolation information. Accounted for direct, diffuse, and albedo light.
- We analyzed the effect of nonuniform illumination on the electrical energy output of the solar farm.
- Global optimization of the VBF demonstrates that although VBF produces lower energy (see figure), the uniformity of energy production and reduced cleaning cost make the technology economically viable for many locations in the world.

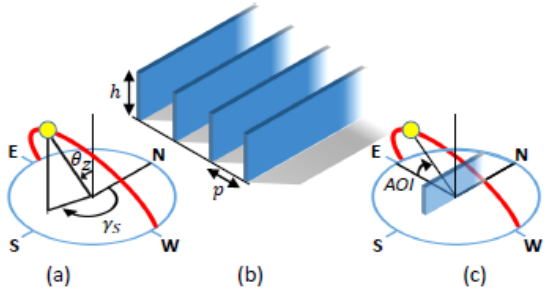

Fig. 1: BVFs must account for complex interplay of direct, diffuse, and albedo light.

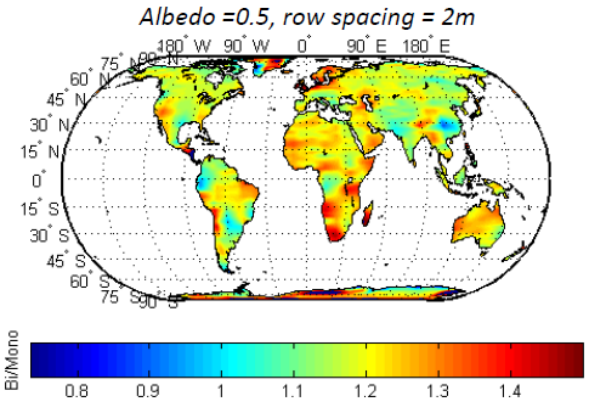

Fig. 2: Practical vertical bifacial farms outperform monofacial farms in many locations of the world.

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