

Bifacial Photovoltaics: the Roof That Produces Twice — and Loses Less to Heat

Reflecting radiation does more than increase the light available to the panel: it also limits the overheating that penalises it.

The effect of albedo on bifacial output is well known. A third mechanism, documented by other studies, joins the picture: heat itself makes the panel lose efficiency, independently of the light it receives.

By Joël Kohli, Founder & Director



On a light, reflective roof, a bifacial panel captures the sun twice: directly on the front face, and by reflection on the rear face. And because the surface heats up less, the modules also lose less efficiency. (AI-generated image)

On a roof fitted with photovoltaic panels, one usually thinks of a single energy source: the direct radiation striking the front face of the modules. Three independent studies — a field trial in the Vendée, a university experiment in the United Arab Emirates and a technical « [White Paper](#) » by SolarWorld/ISFH — show that part of this radiation can be harnessed a second time, provided the surface beneath the panels is reflective. This is precisely the ground on which a thermo-reflective coating meets photovoltaics.

A Cool-Roof Inspiration, a Thermo-Reflective Execution

The three studies cited here rely on setups belonging to the cool-roof field: high-reflectance paints or membranes tested in the laboratory or on pilot installations. This is the vocabulary of the international research on the subject, and we refer to it for that reason.

It is not, however, the vocabulary of our offering. A THERM'Reflectis thermo-reflective coating is not limited to surface reflectance: it combines that reflectance with work on emissivity, insulation and long-term durability, for the roof as well as for façades and glazing. The physical principle measured by these studies

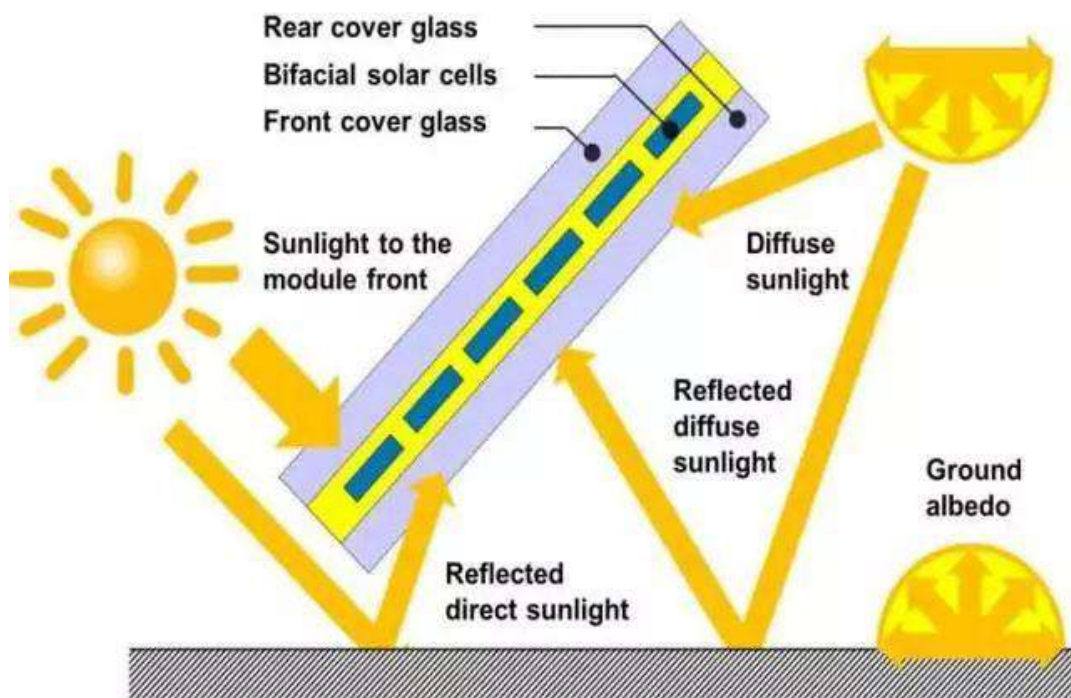
— more reflected radiation available to a photovoltaic system — remains valid for our technology; the level of performance and durability aimed for is different.

Two Mechanisms That Complement Each Other

A thermo-reflective coating and a bifacial photovoltaic panel do not act on the same thing:

- The coating reflects a large part of the solar radiation instead of letting the roof absorb it and heat up.
- The bifacial panel captures part of this reflected radiation on its rear face, in addition to the direct radiation captured by its front face.

The coating reflects what the bifacial panel can then turn into electricity. It is this relationship between the two technologies that the three studies make it possible to substantiate.



Working principle: the reflective roof returns part of the incident radiation to the rear face of the bifacial module, in addition to the direct radiation captured by the front face.

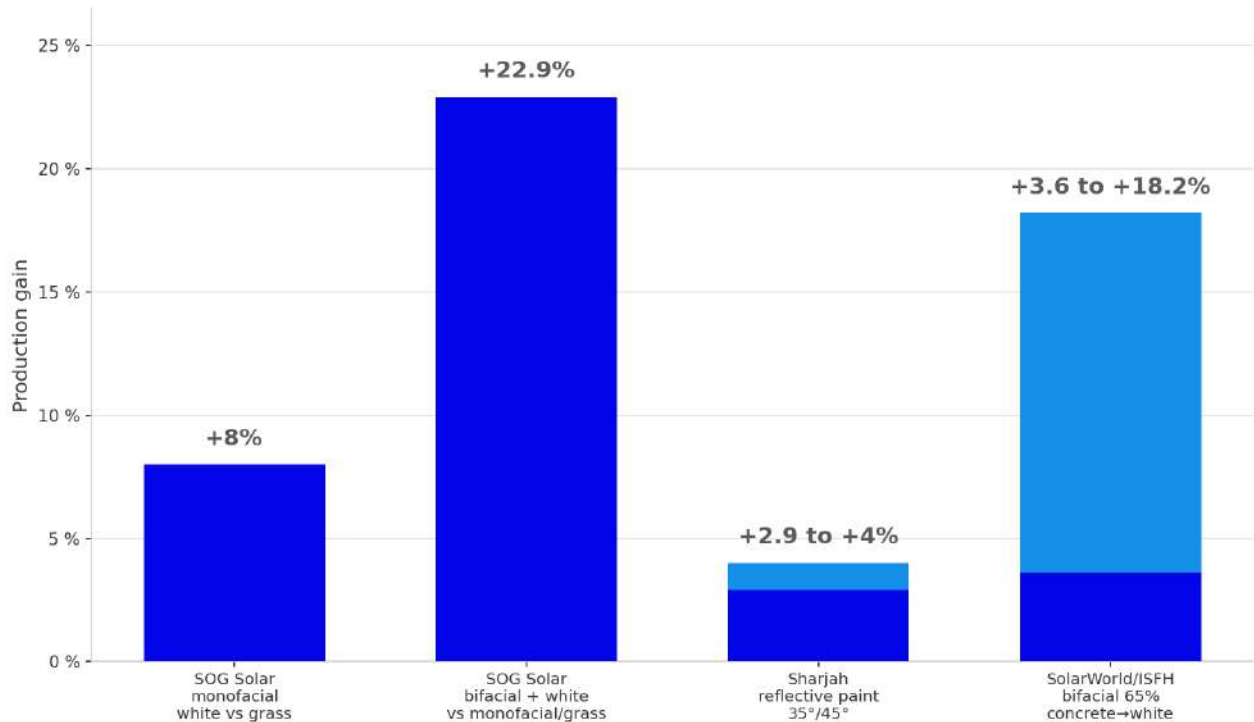
What the Measurements Show

The three sources do not measure exactly the same thing (surface, climate, tilt, module type), but they converge on the existence and order of magnitude of the phenomenon:

Reference study	Configuration testée	Gain de production
SOG Solar (Vendée, 2021)	Monofacial module, white surface vs grass	+ 8 %
SOG Solar (Vendée, 2021)	Bifacial module + white surface, vs monofacial on grass	+ 22,9 %
Université de Sharjah (2019)	Reflective paint tested by the researchers vs standard roof, 35°/45°	+ 2,9 à 4 %
SolarWorld / ISFH	Bifacial 65%, concrete (16%) vs white surface (80%), 0.3 m	+ 3,6 % → + 18,2 %

The values above come from three different protocols and do not add up together; they illustrate one and the same lever — the albedo of the surface beneath the modules — in distinct configurations.

Production gains measured in the three reference studies



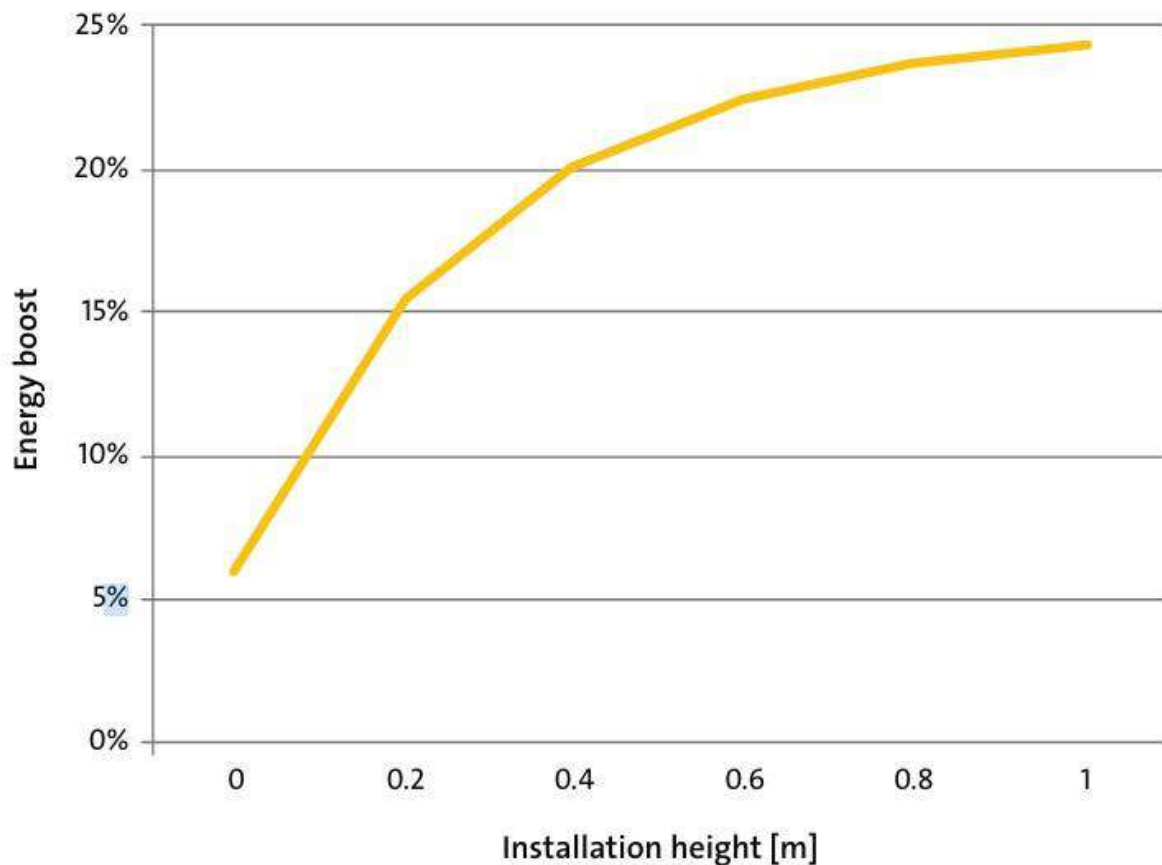
Comparison of the production gains measured by SOG Solar, the University of Sharjah and SolarWorld/ISFH. The two-tone bars indicate a range of results depending on the configuration tested.

The trial conducted by SOG Solar in the Vendée is the most telling: by replacing grass with a white surface beneath bifacial panels, the bifacial's overproduction relative to the monofacial rose from + 9.3% to + 13.8% on the same day — proof that albedo and bifaciality add up rather than substitute for one another.

The Yield Climbs Higher Still with Bifacial

The « White Paper » SolarWorld/ISFH quantifies this same principle on a theoretical model: for a bifacial module at 65% bifaciality, installed 0.3 m above a surface with only 16% albedo (an ordinary concrete), the production gain is only 3.6%. **On a white surface with 80% albedo**, under the same conditions, **it climbs to 18.2%**. The mounting height also matters: **gains stay modest below 0.3 m and level off beyond 1 m**.

A bifacial panel installed on a dark roof therefore taps only a small part of its potential. The same panel, placed on a high-reflectance surface, comes much closer to it.

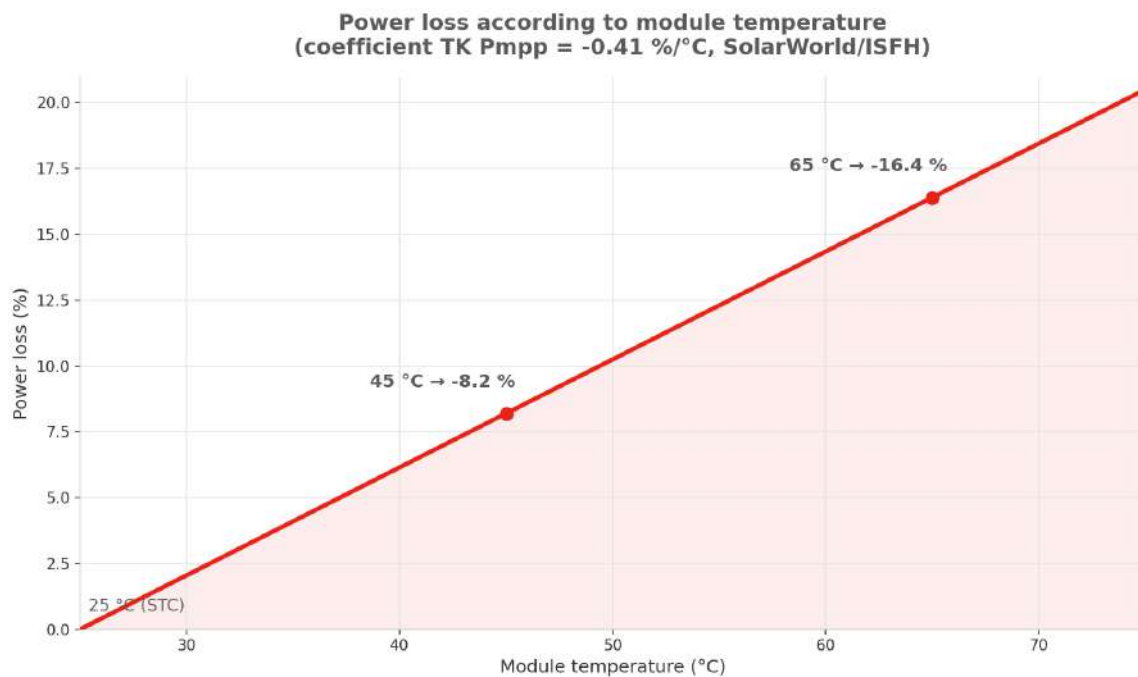


Energy gain of a bifacial photovoltaic installation with a landscape-mounted module, south-facing, tilted at 30° and with a row spacing of 2.5 metres, for an albedo of 80%.

A Third Lever: Heat Also Costs Efficiency

The three previous studies measure a light effect, not a temperature effect: none measured the temperature of the modules themselves. A distinct phenomenon, documented by an abundant technical literature, nevertheless deserves to be added to the picture: **beyond 25 °C, each additional degree reduces the power of a crystalline-silicon photovoltaic module by about 0.35 to 0.45% — sometimes summarised as “about 0.5%” in practice.**

This is known as the temperature coefficient (TK P_{mpp}), a normative figure present on every module data sheet, measured under standard test conditions (STC: 1000 W/m², 25 °C, AM 1.5 spectrum). The « White Paper » SolarWorld/ISFH, already cited, gives a concrete example: for the Sunmodule Bisun, bifacial as well as monofacial, this coefficient is -0.41 %/°C. **A module that reaches 65 °C on a roof — a common temperature in strong heat — thus loses on the order of 15 to 18% of its instantaneous power** compared with its test conditions, solely because of temperature.



Power loss as a function of module temperature, calculated from the coefficient TK Pmpp = -0.41 %/°C published by SolarWorld/ISFH for the Sunmodule Bisun.

This loss is no trifle: it occurs precisely at the hours when radiation is strongest, and therefore when output would be highest. A module that heats up less retains part of the potential lost by modules that heat up more.

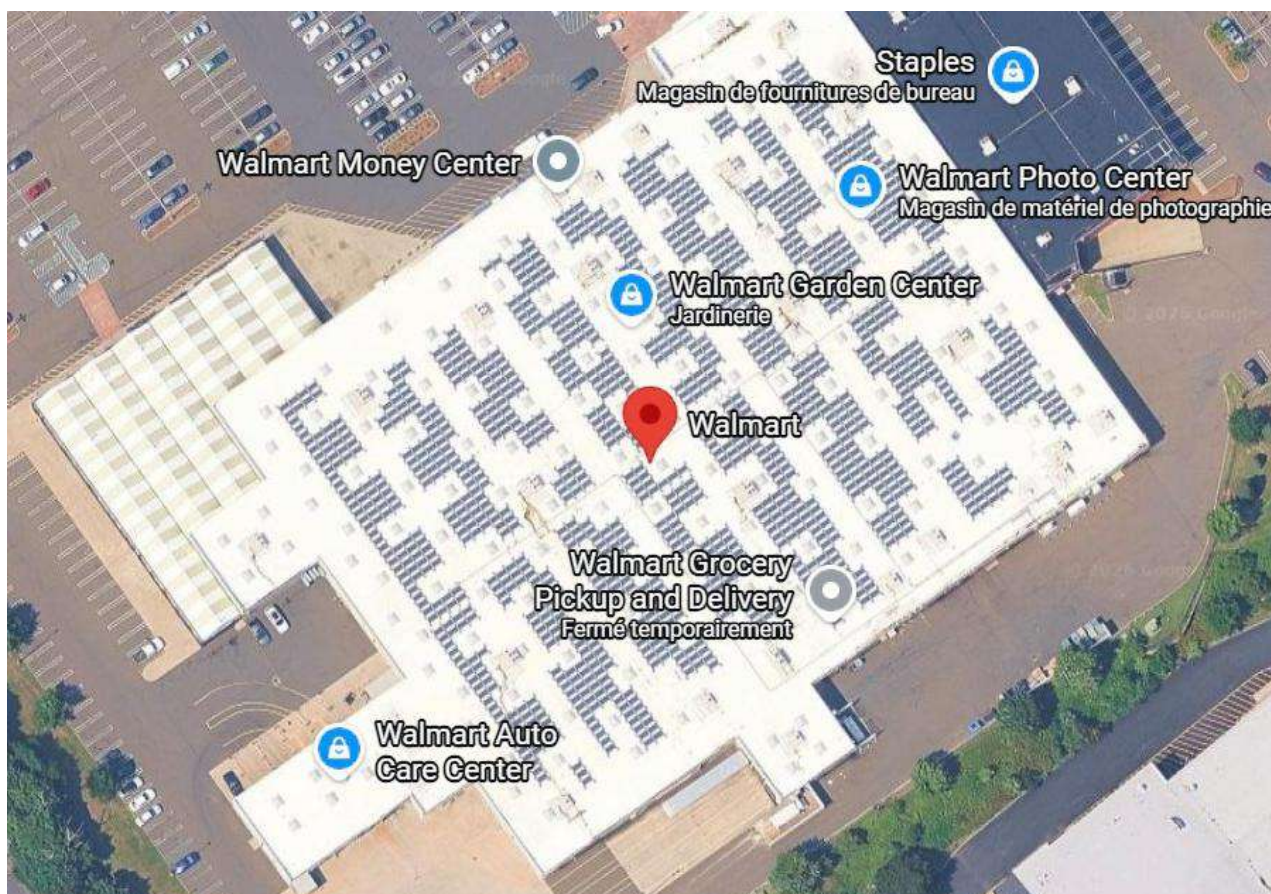
An Added Benefit — Without Overstating It

It would be excessive to present this third lever as direct evidence tested on our coatings: the three production studies cited above measured neither the temperature of the modules nor a cause-and-effect link between roof albedo and panel temperature. What is known, distinctly and well established elsewhere, is that heat penalises a module's efficiency — and that a darker roof heats up more, commonly reaching between 70 °C and 80 °C in full sun according to the cool-roof literature. Limiting this heating with a high-reflectance surface is therefore a coherent physical line of reasoning, to be distinguished from a direct measurement on a PV installation.

For a site already equipped or planning to install photovoltaics, this opens a three-level reading of the thermo-reflective coating: more radiation available to the rear face of a bifacial module, a roof that heats up less, and — through a distinct and well-documented physical mechanism — a module that, in theory, heats up less and produces better.

Where This Combination Makes the Most Sense

Large flat roofs — warehouses, industrial buildings, farms, greenhouses — are best placed to benefit: available surface, controllable mounting height, and a direct interest in combining a cooler roof with optimised electricity production. On these surfaces, the same intervention addresses two challenges at once — the thermal protection of the building and the performance of the photovoltaic installation.



A large flat roof (warehouse, industrial or agricultural building) fitted with photovoltaic panels, representative of the type of site most relevant for this combination. (Source : Google Maps — Walmart, Milford, Connecticut, United States)

Sources : SOG Solar — « Mini REX Bifacial », 7 mai 2021 · Université de Sharjah — Altan et al., « An experimental study of the impact of cool roof on solar PV electricity generations », International Journal of Low-Carbon Technologies, 2019 · SolarWorld AG / Institut für Solarenergieforschung Hameln (ISFH) — « Calculating the Additional Energy Yield of Bifacial Solar Modules », white paper (coefficient TK Pmpp du Sunmodule Bisun) · photovoltaïque.info (HESPUL) — « Puissance et rendement des modules photovoltaïques » (définition STC) · Littérature technique généraliste sur le coefficient de température des modules en silicium cristallin (ordre de grandeur : -0,35 à -0,45 %/°C)

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