LIFE-SIZE DEMONSTRATION OF BIFACIALITY ENERGETIC GAINS

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Context

Bifacial photovoltaic modules have come to increasing attention stimulated by the development of new solar cell structures. The potential of bifacial modules has been already shown in specific time intervals and for various ground albedos, but there are only a few global studies for full scale systems in different configurations. The study presented in this poster aims to fill part of this lack by monitoring 5 representative systems and analyzing main influencing factors.

15 kW_p Bifacial outdoor platform

For one year, the CEA-INES platform has been hosting photovoltaic systems incorporating Bifacial modules (see fig.1) in order to demonstrate the energy benefit and, above all, to quantify the production gain at system level, compared to monofacial reference system “R”.

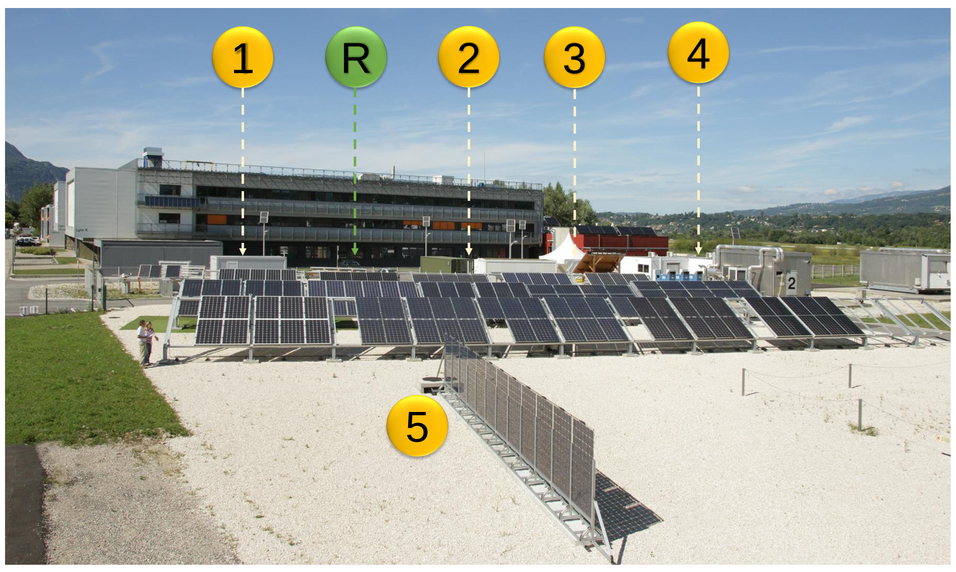

Figure 1: CEA-INES platform with 5 Bifacial systems

The objective is notably to highlight the factors influencing this gain such as the albedo of the soil, the orientation of the modules, the level of irradiation and the height of the modules (see fig.2).

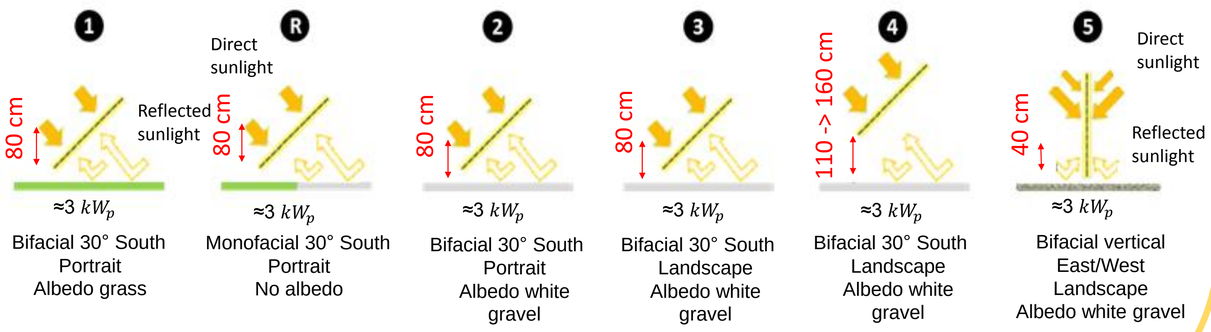

Figure 2: Six independent and continuously monitored systems

Conclusions and perspectives

- In similar conditions Bifacial outperforms monofacial annual production by 10 % to 13%,
- Bifacial vertical E/W system provides smoother daily production but 8% annual Energy loss,
- Efficiency depends on horizon line, in best locations it can reach more than 17% annual Energy Gain,
- Replacing synthetic grass (albedo ≈ 0.2) by white gravel (albedo ≈ 0.4) increases Gain by 3%,
- Raising the panels from 80 to 160 cm increases Gain by more than 5%,
- The landscape or the portrait orientation of the panels has no impact, if there is no shading of proximity, or snow on the bottom of the module,
- These promising conclusions suggest that bifacial allows a better network balance and is able to generate interesting gains, as soon as the PV plants studies are implemented with more adapted approaches and more advanced tools.

✓ **This study is supporting the current development of a modeling and simulation tool at CEA-INES.**

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Results and observations

- Bifacial Energy Gain is maximum during summer and minimum in winter (see fig.3).

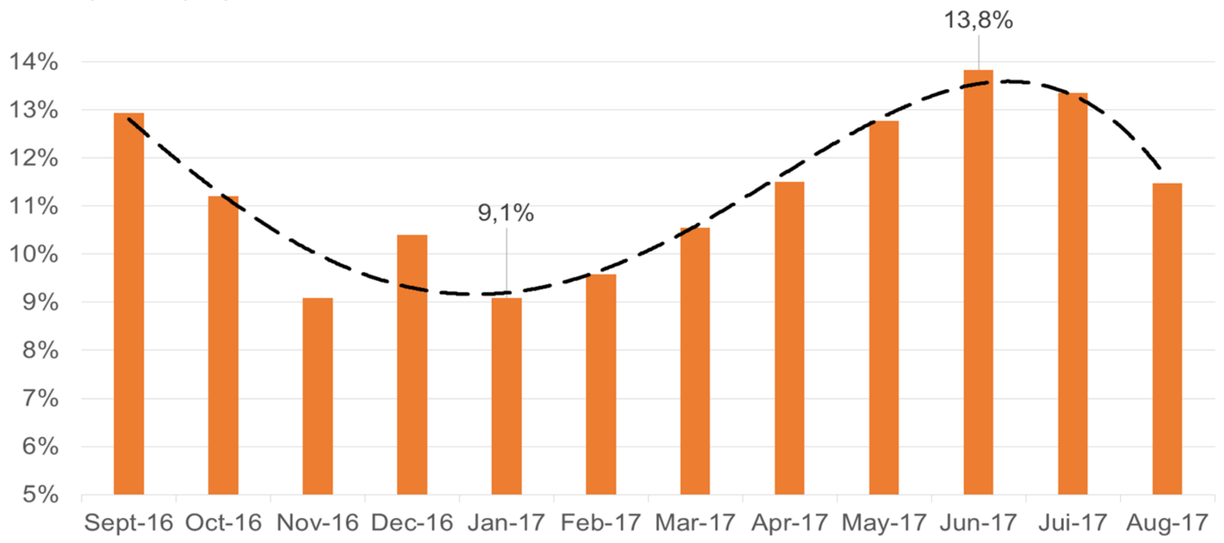

Figure 3: Monthly gain evolution over a year, Bifaciality vs reference “R”

- Bifacial Energy Gain is stronger when albedo is higher due to better reflection from the ground to the rear face of panels (see fig.4).

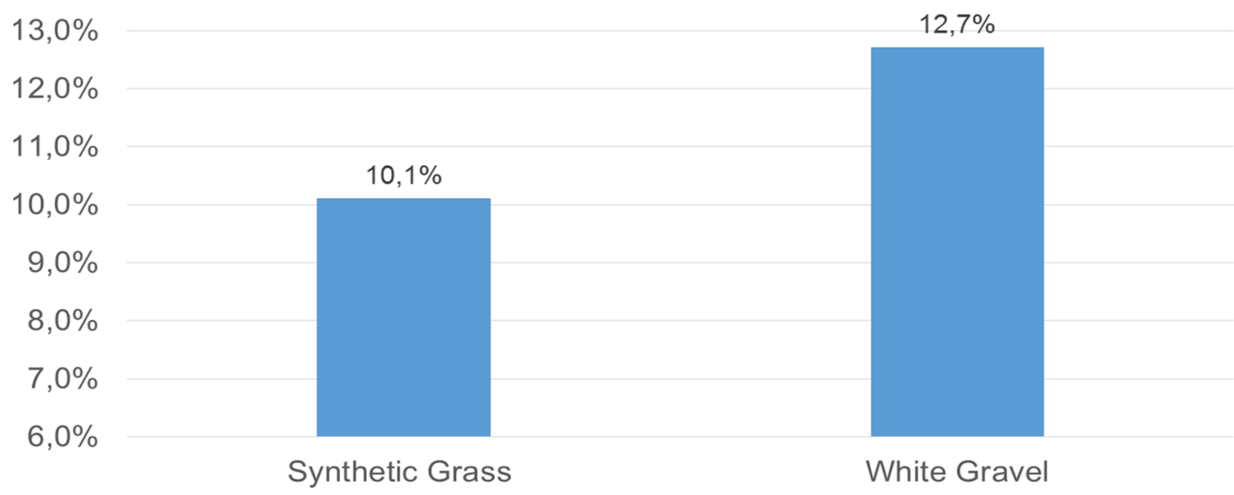

Figure 4: Bifacial Gain on the left grass (albedo ≈ 0,2 – system 1) and on the right white gravel (albedo ≈ 0,4 – system 2) vs reference system “R”

- Bifacial Energy Gain increases while modules are raised, opening one window between ground and bottom of systems (see fig.5).

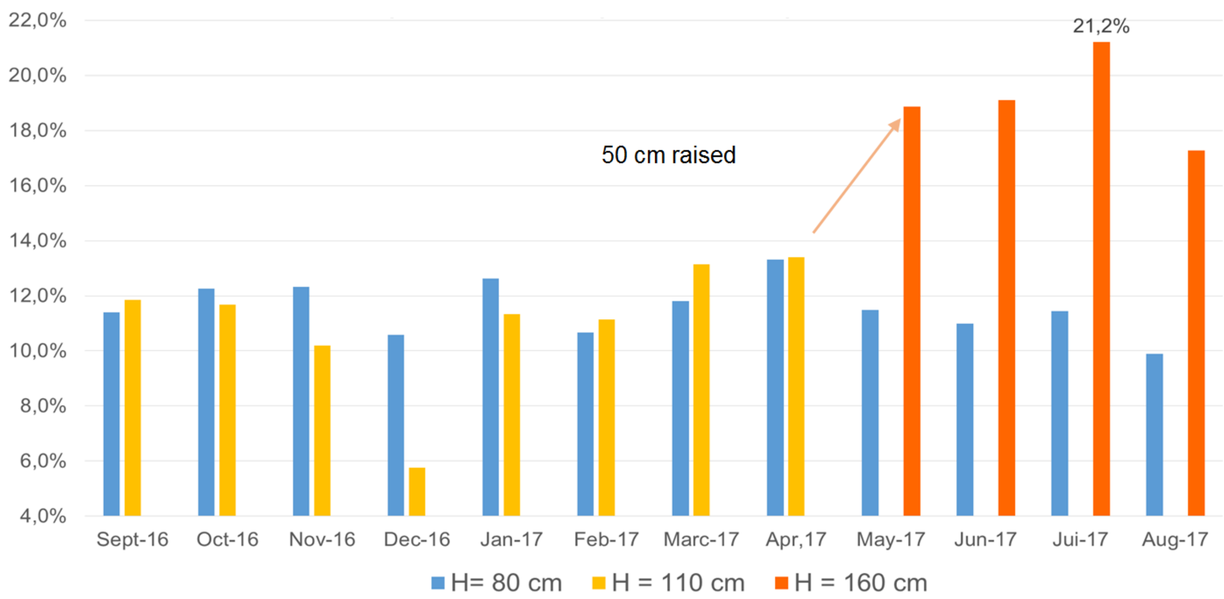

Figure 5: Bifacial Gain for different heights (system 4) vs reference system “R”

- Bifacial vertical E/W system is able to match with the average 30° tilted system only around the summer solstice (see fig.6).

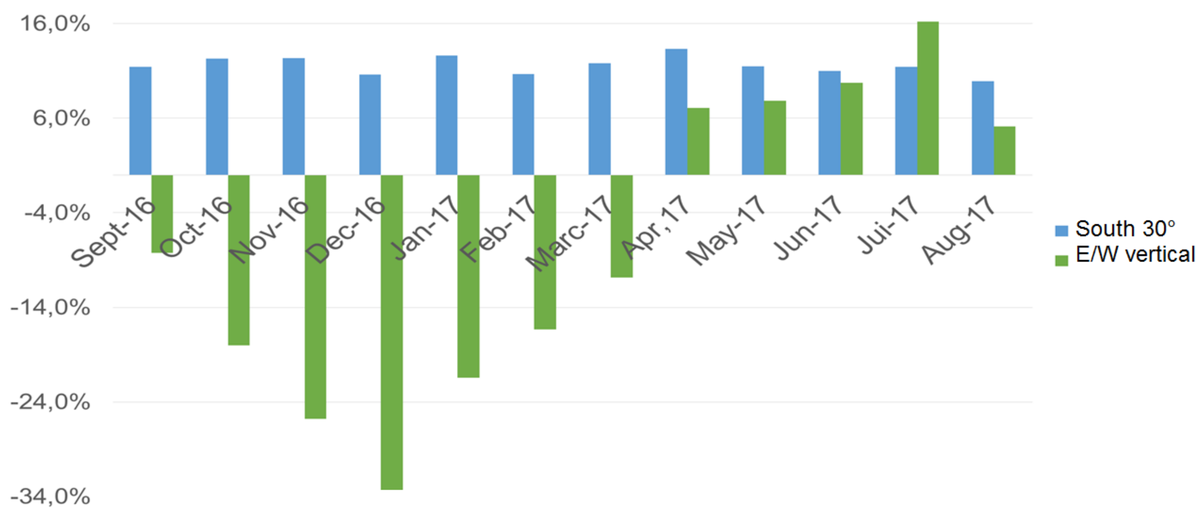

Figure 6: Bifacial Gain for the average of 30° tilted system and E/W vertical system vs reference system “R”