Kronos Solar Projects

Photovoltaics und Reflection

A snapshot analysis on the effects of Solar Rays on solar panels

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Glint and Glare Study by Power Engineers, provided with information eg.by the University of Minnesota

This Document provides an overview over reflection caused by solar panels. It displays different aspects like the appearance, impacts, mitigation as well as comparison to other reflecting objects.

Definition:

- Photovoltaic Panel – Photovoltaic panels, also known as PV panels, are designed to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity.
- Glint – Also known as a specular reflection, produced as a direct reflection of the sun in the surface of the PV solar panel. This is the potential source of the visual issues regarding viewer distraction (Figure 1).
- Glare – A continuous source of brightness, relative to diffused lighting. This is not a direct reflection of the sun, but rather a reflection of the bright sky around the sun. Glare is significantly less intense than glint (Figure 2).

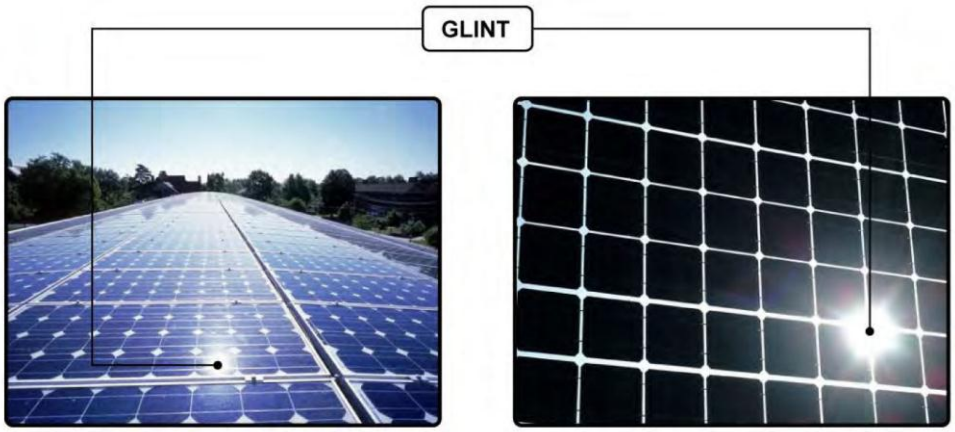

Figure 1

Figure 2

Figures 1 and 2 show the two different types of reflection on solar panels. In this document herafter, these will be combined in the term “reflection”.

Reflection means, throwing rays or waves back from an object. In this specific case sun rays are reflected by the modules surface. This can lead to the demonstrated Effect shown in Figure 1 and 2.

Essential in the study of solar modules is their structure. Their aim is to use the energy of each ray of the sun to convert it into electrical energy. Therefore each reflected ray is a loss of produced power and is thereby reducing the efficiency of the module. For this reason, the entire structure of the modules is designed to absorb as much radiation as possible to maximize the efficiency. Thus the reflection is not a desired effect but rather a result of the construction that leads to an unwanted side effect.

This unwanted side effect, however, occurs not only on solar modules, this phenomenon also occurs on glass windows, greenhouses and other reflective materials (as steel, plastic etc.). Even in the environment on surfaces like on water or snow this reflection is visible. In contrast to the above mentioned reflectors the solar panels return within the least amount of energy (compare Figure 3).

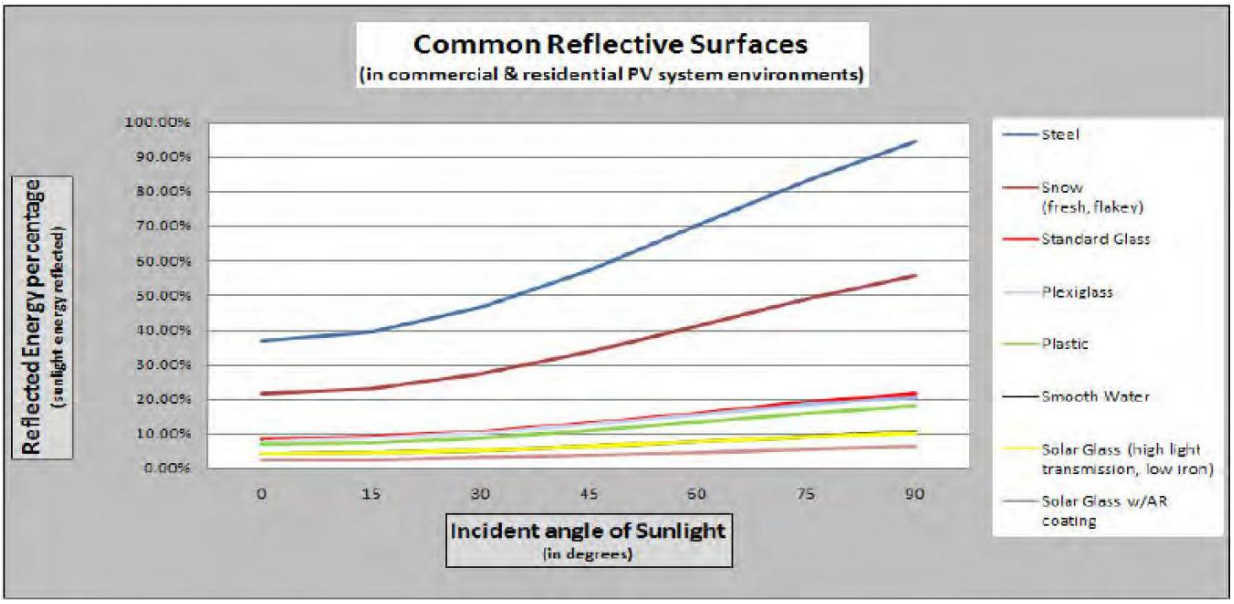

Figure 3

Figure 3 shows the reflection intensity of several materials as a function of the incident angle. It shows as already has been described, the solar panels, respectively the protective glass, reflect with the least radiation. A detailed view of Figure 3 is shown again in Figure 4.

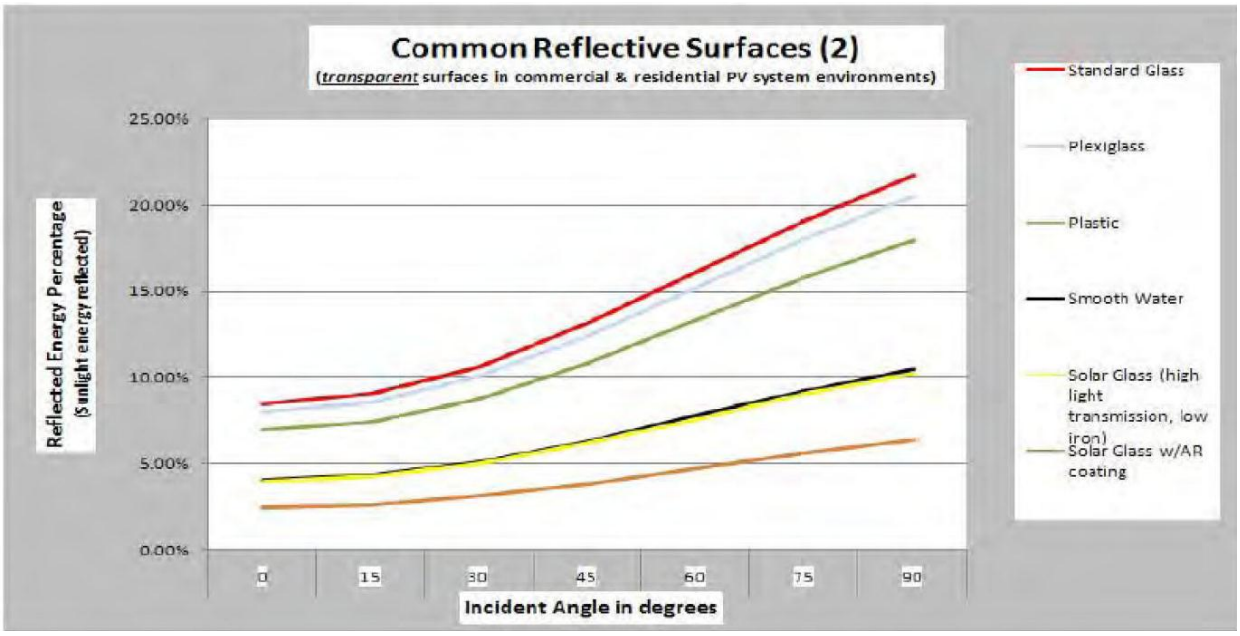

Figure 4

It should be noted that the reflected energy percentage of solar glass is far below of a standard glass and more on the level of smooth water. In addition to this, there are other ways to reduce the impact of this already low reflectance values even more or intercept the rays.

This includes:

- Special surfaces that increase the absorption and minimize the reflection
- The installation angle of the modules
- Absorption of the rays by plantings

That the reflection of all the solar farms will not cause major problems is further supported by the fact that solar farms can be found at airports and right beside highways.

Furthermore, the effect of reflection is not a permanent phenomenon. It depends very much on both, the weather conditions and angle of incidence. Simply by the last point the period of reflection is limited to few hours a day, but only by good weather conditions.

Summarized, it has to be expected that from the construction of the modules, significantly less light is reflected than in conventional glass facades of office buildings. Additional options exists to further eliminate any reflection.

This is also provided by the statement of a Glare study that was provided with information for example by the University of Minnesota. Therein it is stated as follows:

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“The studies prove that solar glass has less glare and reflectance than standard glass. The figures also make it clear that the difference is very decisive between solar glass and other common residential/commercial glasses.”

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