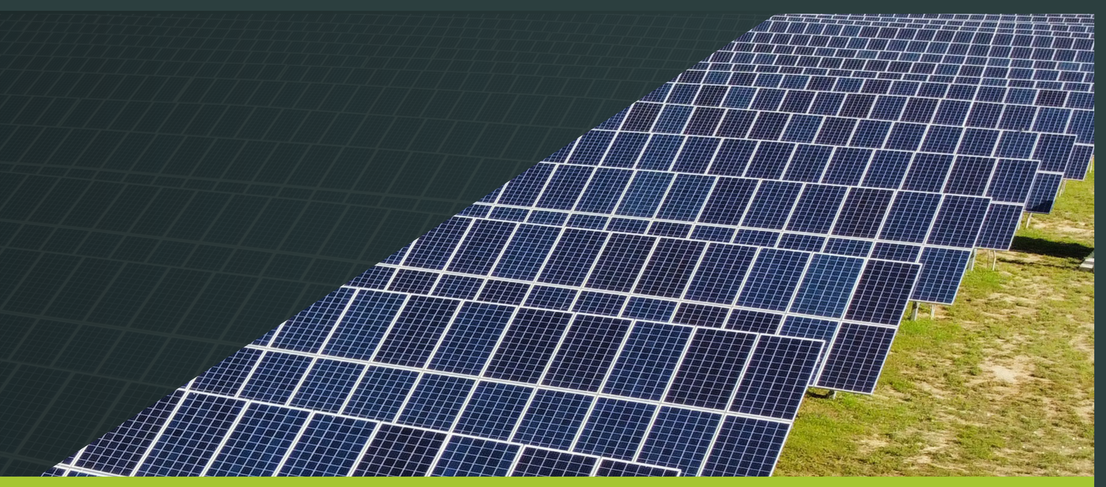
Bifacial Modules:
Better Than Predicted?



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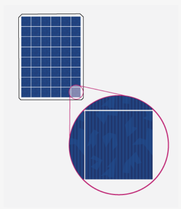
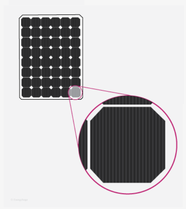
As the solar industry continues to evolve, we have seen a rapid growth within the bifacial module category. The versatility of bifacial modules can be used in a number of different applications like ballasted systems, fixed tilt ground mounts, and single-axis trackers. Bifacial modules can increase production by around 5-15% just from the rear side of the module. Due to the glass covering both sides of these modules they tend to be much stronger and durable than a conventional module. Additionally the cost gap between bifacial and conventional modules continues to drop making them an even more attractive option. After years of experience using bifacial modules and comparing them to traditional modules we have gained real world data on the actual benefits. Learn about the best practices when designing a system with bafacial modules and what we have seen with past bifacial projects.

Bifacial Modules

Bifacial modules have contacts and bus-bars on either side of each cell. This allows the module to produce energy from both sides, giving them a great advantage over traditional modules. There are several designs of bifacial modules; **the most popular use monocrystalline cells.**



Polycrystalline
- Single silicon crystals
- Higher efficiencies
- Sleeker aesthetics



Monocrystalline
- Multiple silicon fragments
- More affordable
- Less efficient

Advantages

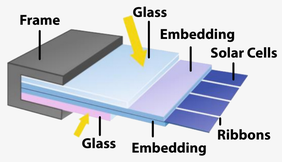
High Efficiency
Although the rear side efficiency of a bifacial module is less than the front. The combined production gain **increases by over 5-15%** when compared to a traditional module.

Decrease Amount of Panels
The increase production gains achieved from bifacial modules allow you to **use fewer modules to produce the same amount of energy.** This allows for a smaller overall footprint. For example, If we used monofacial modules on a 2.1MW system, we would need to add an additional 200 modules.

Bifacial Gain (BG)
Bifacial gain is directly related to the amount of direct, scattered and reflected light that is received by the rear side of the module. **Bifacial gain is affected by: albedo, height, shading, module quality.**

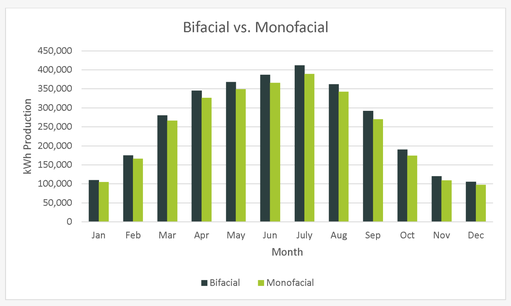
Bifacial gain is calculated by dividing energy production from the rear side by the energy production from the front side. This ratio determines the additional kWh production. **BG= (Energy Rear) / (Energy Front)**

Durability
Due to the tampered glass used in the manufacturing of these modules, they tend to be more resilient toward winds and other factors that may compromise the integrity.



Bifacial vs. Monofacial

Modeling the additional production gain for bifacial modules can pose a few challenges. Several variables like ground albedo, module tilt, shading and the time of year will impact the additional production.



System Specification

Single Axis Tracker

System Size: **2.1 MW**

Modules: **4176 / 1368 : 395W/ 330W**

Inverters: **40**

DC/AC Ratio: **1.05**

- A case study done on one of our past projects in Illinois found an **8.5% production gain when using bifacial modules.** The annual production with bifacial modules came to **3.34 GWh.**

- When modeling that system with **monofacial modules,** it was found to only produce 3.06 GWh annually. Assuming a 10¢ per kWh, the additional production equates to **an extra $28,424 per year!**

Albedo
Defined as the fraction of the incident sunlight which a surface reflects. A surface will NOT have a constant Albedo due to the angular distribution of light. Think of different weather/ time of day. Albedo= (Reflected/ Incident)

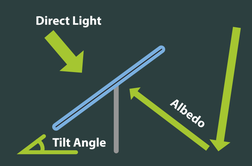
Surface Type	Albedo
Concrete	16%
Green Grass	23%
Light Gravel	27%
White Painted Concrete	60%
White Roof Membrance	80%

Design Considerations

Module Placement
Placing modules too close to the ground/ roof surface will block any of the albedo light. **It is recommended that modules are placed 2 feet above the surface** (not realistic for roof mounted systems). As that distance is increased you will see an increase in additional production from bifacial gain.

Tilt
Fixed Tilt
In the Midwest a system should face due south with a 25° - 30° tilt.

Single Axis Tracker
To maximize production use an east to west tracking system.

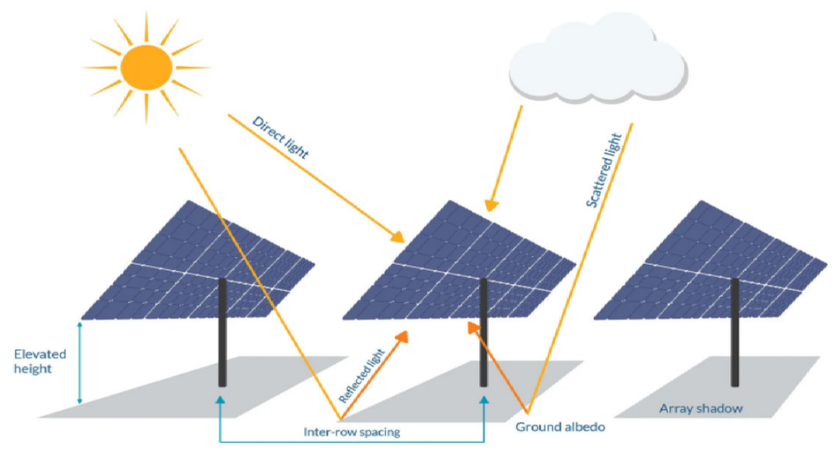


Geographic Region
The optimal tilt will vary depending on the location in which you are building the solar array.

Albedo
The material type which you are planning to install over is important to consider when calculating bifacial production. The more reflective a surface the greater production you can expect.

Shading
Shading produced from the mounting structure or racking can greatly decrease bifacial gain. The shading loss will vary on the rail thickness & location, number of rails below the modules and thehe modules distance from the ground.

Additionally, take into consideration the surrounding area; trees, buildings and other structures can produce shade which will greatly affect the production.



Source: PurePower Engineering -Engineering Supervision For Bifacial PV Systems

Summary

Accurately modeling the bifacial gain and understanding the key design aspects of a bifacial system will allow you to use fewer modules and achieve a greater ROI for each solar asset.

Our findings found an 8.5% production gain when using bifacial modules. This allows you to pass along a greater savings to the end customer.