Why switch from PERC modules to TOPCon modules?

WINAICO®

Hey! There is knowledge here!

Three technologies for greater efficiency and service life

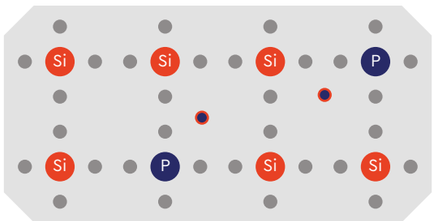
The new WINAICO NGX solar modules combine three technologies, which work together to increase efficiency and service life:

In this white paper, we explain the features and advantages of the individual technologies.

The features of TOPCon technology

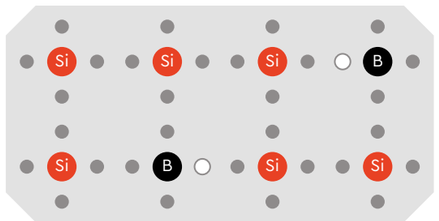
Solar cells are made from a silicon wafer. It is doped with chemicals to improve electricity generation. The difference between n-type and p-type results from the material with which it is doped.
TOPCon technology is based on n-type cells. This means that the base of the solar cell is negatively conductive. If the solar cell base is positively conductive, these are p-type solar cells.
In p-type cells, the base layer is doped with boron. Boron has one electron less than silicon. This creates an electron hole and the positive charge carriers predominate. This deficiency is called a „boron-oxygen defect" and causes a cell to lose efficiency over time.
In n-type cells, the base layer is doped with phosphorus. As phosphorus has one more electron than silicon, the doping generates free electrons and therefore does not suffer from this defect.
For decades, p-type cells have dominated the market, mainly for cost reasons. In the meantime, high-performance solar modules such as NGX modules from WINAICO are based on modern n-type cells, as these are more efficient, generate more power and have a longer service life.

N-TYPE solar cell



Free electrons

P-TYPE solar cell

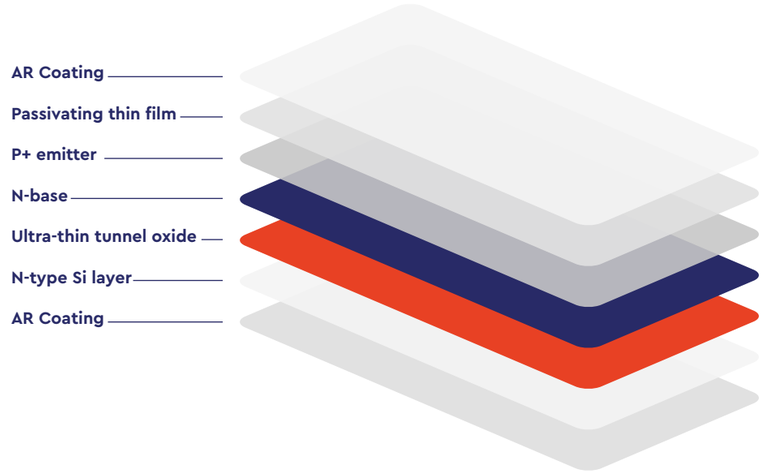


Electron hole

Further development of PERC technology

The efficiency of photovoltaics is limited: Part of the sunlight always penetrates the solar cell without generating electricity. PERC technology (Passivated Emitter and Rear Cell) increases the efficiency of photovoltaic modules by reflecting part of the light that reaches the rear of the cell without having generated electricity back into the cell. This is achieved by a special layer applied to the rear of the module, also known as rear passivation.
TOPCon (Tunnel Oxide Passivated Contact) is a further development of PERC(T) technology with an additional tunnel oxide layer.

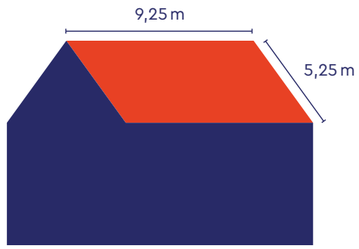
Structure TOPCon solar cell



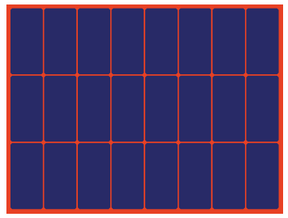
The advantages of TOPCon technology

Higher efficiency

TOPCon cells convert more sunlight than p-type cells, resulting in a higher module efficiency and yield. With over 220 watts of power per square metre, you get almost 5 % more system output on the roof and achieve 3 to 4 % more yield.



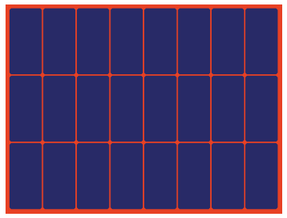
PERC Module 410 Watt



410 Watt
24 pieces
Total: 9,84 kW

Power generation 10.824 kWh*

WINAICO 430 NGX Module



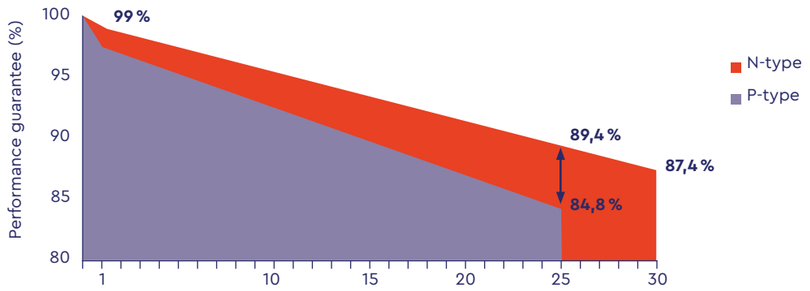
430 Watt
24 pieces
Total: 10,32 kW

Power generation 11.352 kWh*

*Spez. Jahresertrag 1.100 kWh/kWp

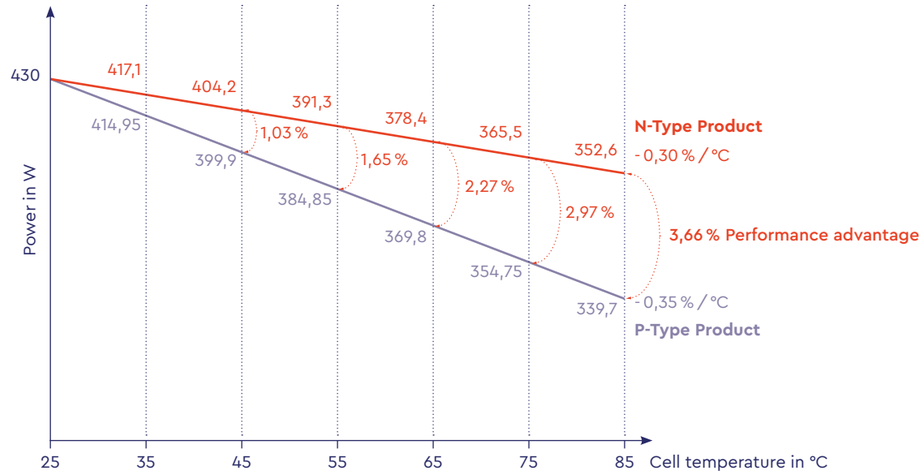
Less degradation

The lack of a boron-oxygen defect in n-type cells stabilises the performance of a module considerably. Degradation in the first year is ≤ 1% and is only reduced by a further 0.4% per year from the 2nd to the 30th year. The power yield of these modules is correspondingly higher – the WINAICO TOPCon modules are still at least 87.4 % after 30 years.



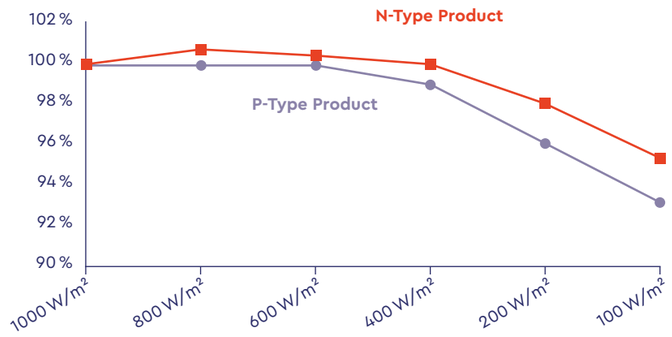
Lower temperature coefficient

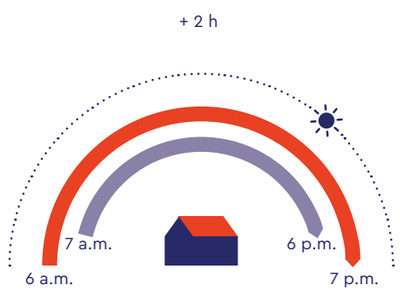
The temperature coefficient is the percentage of power output that a solar module loses for each degree increase in temperature. It affects the power generation of PV modules under hot conditions. TOPCon cells have better resistance to high temperatures: their efficiency in hot climates is higher compared to PERC modules – in view of climate change, this is also becoming increasingly relevant in our latitudes. Switching from PERC to TOPCon improves the temperature coefficient by a further 15 % – from 0.35 %/°C to 0.30 %/°C. Based on a standardised wattage of 430 watts, TOPCon modules deliver over 3 % more power.



Performance in low light conditions

n-type cells have more free electrons than p-type cells and therefore have better low-light behaviour. In direct comparison to PERC modules, n-type TOPCon modules have a better response in low light (below 600 W/m²). This is reflected in an extended power generation time of around 1 hour in the morning and evening.

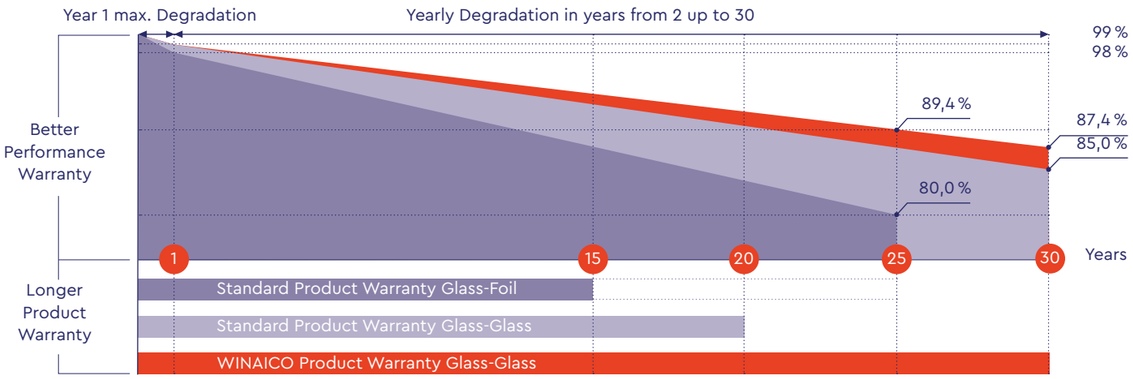




Longer warranty

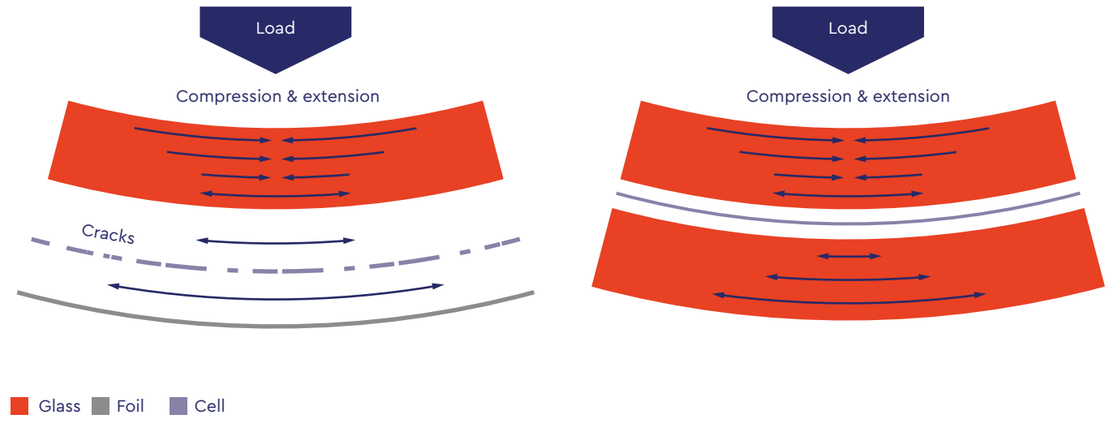
WINAICO's TOPCon modules are characterised by outstanding quality in the glass-glass design, a significantly longer service life and greater safety. Sufficient reasons why the new module series comes with a 30-year product guarantee.

Solar modules with a double glass composite and TOPCon solar cells have significantly better long-term stability than conventional solar modules. This is usually reflected in a longer manufacturer's guarantee. In the case of NGX modules, WINAICO guarantees a decrease in output of max. 1% in the first year of operation and max. 0.4% per year up to the 30th year of operation – a significant improvement compared to conventional modules.



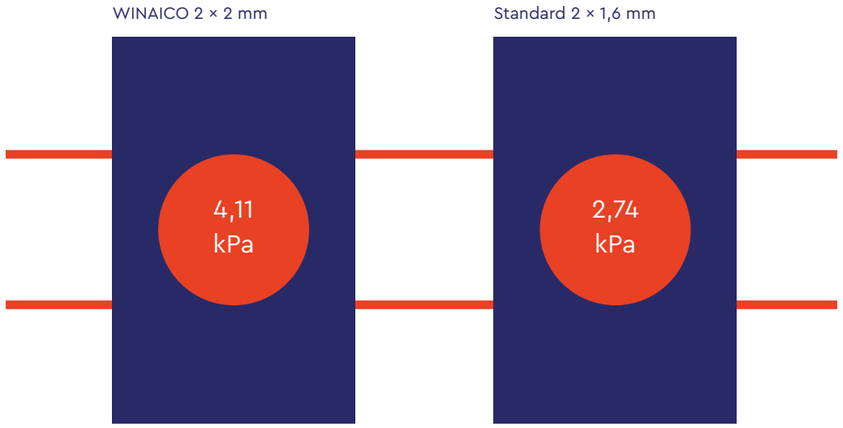
The features of glass-glass modules

The difference between glass-glass modules and glass-foil modules lies in the material used for the rear side, the rest of the structure is identical. In glass-foil modules, the rear side is sealed by a layer of foil, whereas in glass-glass solar modules this task is performed by a second pane of glass.
In glass-foil modules, the front glass pane is slightly thicker to ensure the stability of the module. High-quality double-glass modules such as those from WINAICO, on the other hand, use thermal glass that is only 2 mm thick on both sides but is extremely robust, durable and weather-resistant.
Pressure and tensile loads, for example from snow and wind, put mechanical stress on solar modules. In glass-glass modules, the glass has the same material thickness on the front and back. This means that the cell composite is located in the „neutral fibre". Very low tensile and compressive loads act in this layer. The risk of microcracks in the cells or connectors is therefore virtually zero.



The advantages of glass-glass modules

In addition to the purely mechanical protection provided by an additional pane of glass on the back, two other effects have a positive impact on the durability of the glass-glass module. Firstly, the back glass prevents water, chemicals or other potentially harmful environmental influences from attacking the cell composite better than a film.
Secondly, the symmetrical structure with a glass pane on the top and a glass pane on the underside of the module also ensures a higher mechanical load-bearing capacity.
This is also significantly increased by the use of 2 mm thick glass. Tests have shown that the 2×2 mm glass-glass module from WINAICO was able to withstand over 30% more load compared to a standard glass-glass module with only 2×1.6 mm.



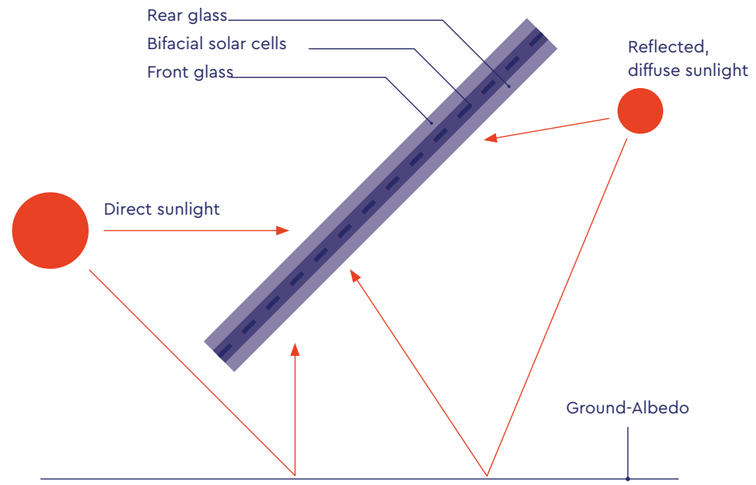
The test procedure

To simulate a real situation, the modules were mounted face up and allowed to bend freely.
The load was applied by an airbag on the back of the panel and by slowly inflating the airbags the load was increased. The average deflection was monitored at 1 kPa intervals during the tests.

The features of bifacial solar modules

Bifacial solar modules utilise not only the sunlight that shines directly on the front of the solar cell to generate electricity, but also indirect light on the back of the solar cell. This is made possible by a glass pane on the rear side of the module – it captures both unused light that passes through the module and reflected light from the surroundings.

In a bifacial solar cell, the full-surface aluminium back surface field is replaced by an aluminium grid. This grid provides a high level of transparency on the back of the module. Indirect light can therefore be absorbed by the solar cell on both sides.



The advantages of bifacial solar modules

Depending on the nature of the reflective surfaces and the installation height of the module, the additional yield on the back of bifacial modules can be up to 25 % higher. As a general rule, the higher the albedo* and the greater the distance between the module and the surface, the higher the additional yield.

* Measure for the reflectivity/reflective radiation

#iamyourmodule

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