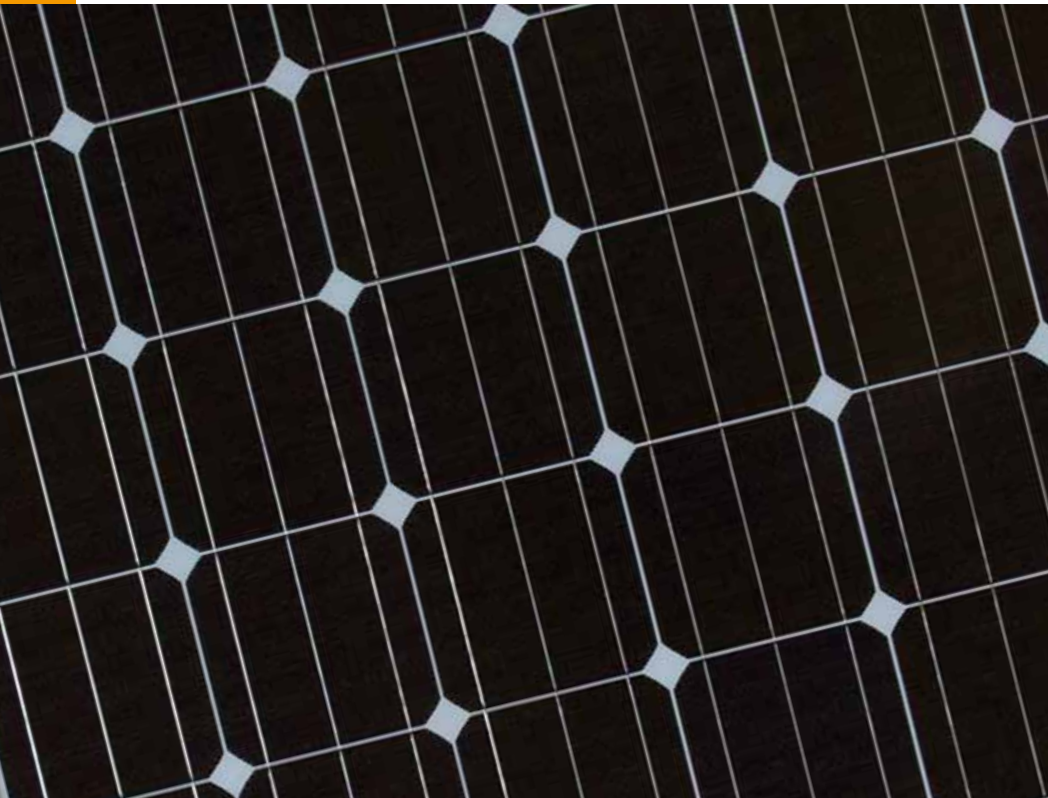


# PACKING MORE SOLAR CAPACITY ON YOUR ROOF WHILST DELIVERING HIGHER CASH FLOWS: PANDA TECHNOLOGY GIVES YOU MORE

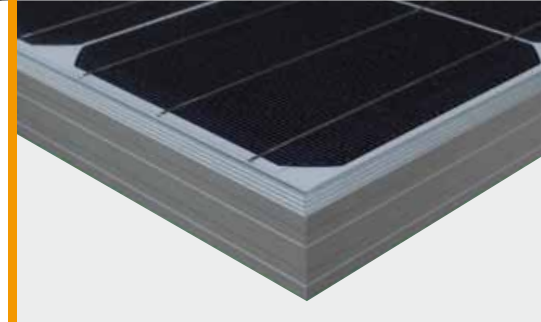


## PANDA at a glance

- PANDA technology delivers high power density PV modules with high efficiency solar cells based on n-type silicon.
- PANDA technology is the first fundamentally new crystalline silicon cell architecture in volume production in one decade and is compatible with standard manufacturing processes.
- PANDA cells have efficiencies of 20.1%

## TAKING EFFICIENCY AND ENERGY YIELD RELIABILITY TO A NEW LEVEL

- With the development of the Yingli Solar's PANDA modules, we are proving ourselves at the forefront of technological innovation.
- By using n-doped silicon instead of the industry's standard p-type silicon, we have created our best performing module family yet.
- PANDA was first realized through an in-house collaboration between the Energy Research Centre of the Netherlands (ECN) and Amtech Systems, Inc., two of the world's leaders in solar power technology. Today's average cell efficiency on commercial production lines achieves 20.1% with up to 18.5% module efficiency.
- Yingli PANDA is ideal for commercial or residential projects where energy output is essential.



# PANDA Technology – Main Advantages

## HIGH EFFICIENCY AND POWER DENSITY

- PANDA module efficiencies are higher than those of conventional p-type monocrystalline modules:
  - Metal impurities in n-type silicon are mostly inactive.
  - The special rear side passivation improves harvest of infrared light.

	Units	Conventional p-type	PANDA (n-type)	Advantage
Module Efficiency (η <sub>m</sub> )	%	16	17.9	12%
Power (60 cell module)	W	260	290	

## ADVANTAGE FOR THE END USER

- More energy production per unit area
- Lower overall system cost per unit energy production
- Equates to higher cash flows over system lifetime

## SUPERIOR HIGH TEMPERATURE PERFORMANCE

- PANDA modules have temperature coefficients for power and voltage that are 6%-10% lower in magnitude than those for conventional p-type silicon PV modules

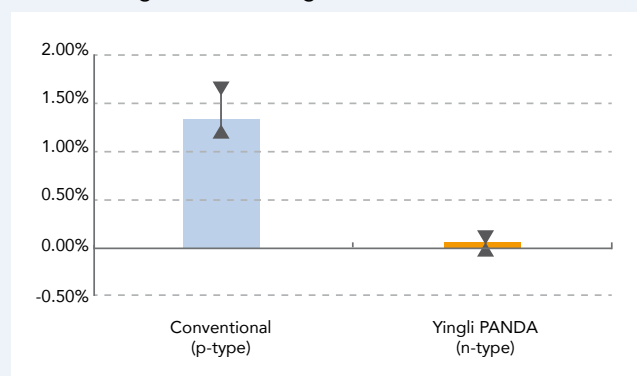
Temperature coefficient for	Units	Conventional p-type	PANDA (n-type)
Maximum Power (P <sub>max</sub> )	%/K	-0.42	-0.38
Open-Circuit Voltage (V <sub>oc</sub> )	%/K	-0.32	-0.30
Voltage at Pmax (V <sub>mpp</sub> )	%/K	-0.42	-0.40

## ADVANTAGE FOR THE END USER

- Makes your investment work harder with higher energy production and therefore improved cash flows on warm and sunny days

## NEAR ZERO INITIAL LIGHT INDUCED DEGRADATION

Due to the lack of boron-oxygen pairs as recombination centre in the n-type cell bulk, PANDA modules have near zero initial light induced degradation.

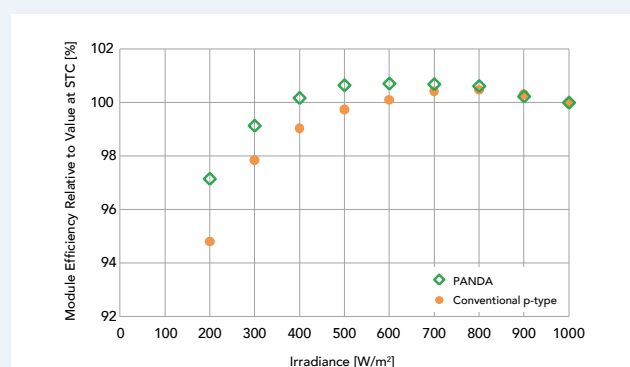


## ADVANTAGE FOR THE END USER

- No significant power degradation during the first weeks

## EXCELLENT EFFICIENCY AT LOW IRRADIANCE

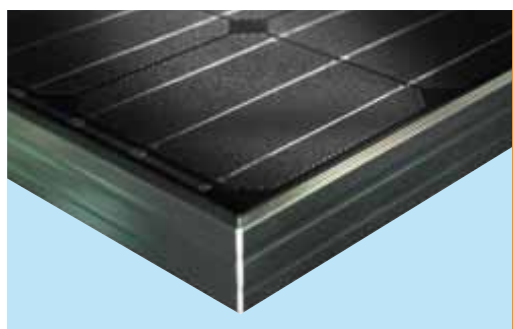
Even at low solar irradiance the efficiency of PANDA modules barely decreases.



	Conventional p-type	PANDA(n-type)
Module efficiency at 200 W/m <sup>2</sup> (relative to STC)	<95%	>97%

## ADVANTAGE FOR THE END USER

- Higher energy production during winter half-year
- Higher energy production mornings and evenings



## PANDA VARIANTS

### PANDA Black&Black:

Combines a black frame and black back sheet for an elegant, homogeneous appearance.

### PANDA Glass on Glass

Uniquely, the transparent rear allows more energy to be produced by collecting light through the backside of the module.