Performance benefits and end-user value of conductive backsheets for back-contacted solar modules

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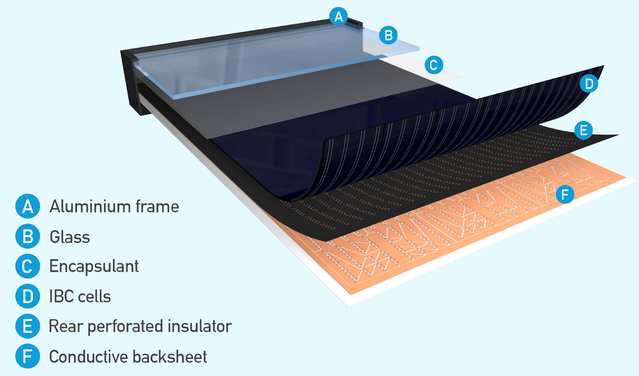
IBC and CBS: the ideal combination!

Interdigitated back-contacted (IBC) solar cells and conductive backsheets (CBS) are the ideal combination to enable high-efficiency solar modules and are of great value to both the module maker and end-user.

Simulation results which substantiate some of the key advantages of using a CBS for interconnection are presented and the value created for the module maker and end-user is demonstrated by a detailed cost calculation.



About Endurans™ CB

Endurans™ Solar (formerly DSM Advanced Solar, acquired by Worthen Industries Inc. in 2021), is a leading supplier of science-based material solutions for PV modules:

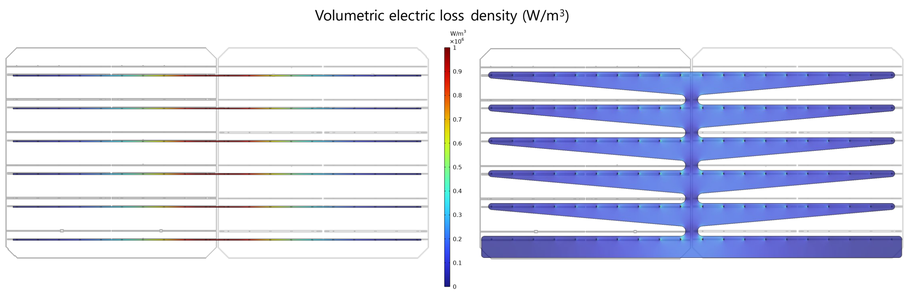
- **Endurans™ HP, high-performance polyolefin backsheet which is fully recyclable**
- **Endurans™ CB, a conductive backsheet for high-efficiency, aesthetically pleasing back-contact solar modules, based on metal wrap-through (MWT) or interdigitated back-contact (IBC) technology.**

Key advantages of back-contact technology with CBS interconnection

- Higher cell efficiency of back-contacted cells → less (MWT) or no (IBC) front metallization on cell
- Highly automated manufacturing and less risk of cell damage → each cell is only picked and placed once; down to 90 µm thick cells has been proven
- Smaller module area = higher efficiency → no bussing area required (integrated in CBS with flexible pattern design)
- Higher energy output → reduced operating temperature (CBS helps heat spreading) and improved low-irradiance performance (with full cells)
- Reduced electrical losses → shown by Comsol simulations:

Full-cell IBC interconnection: ribbon vs CBS

Isc = 11.24 A

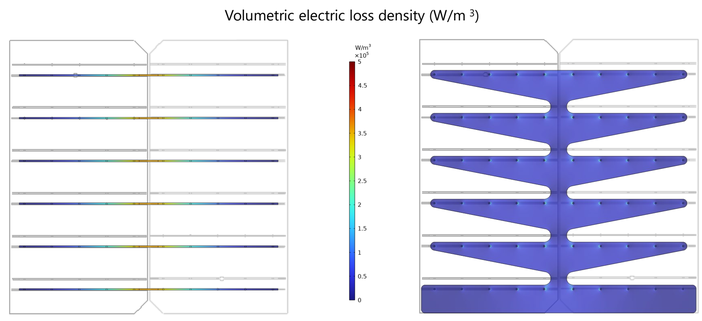


R = 1.60 mΩ
P_{loss} = 202 mW

R = 0.69 mΩ
P_{loss} = 88 mW

Half-cell IBC interconnection: ribbon vs CBS

Isc = 5.62 A



R = 0.83 mΩ
P_{loss} = 26 mW

R = 0.36 mΩ
P_{loss} = 11 mW

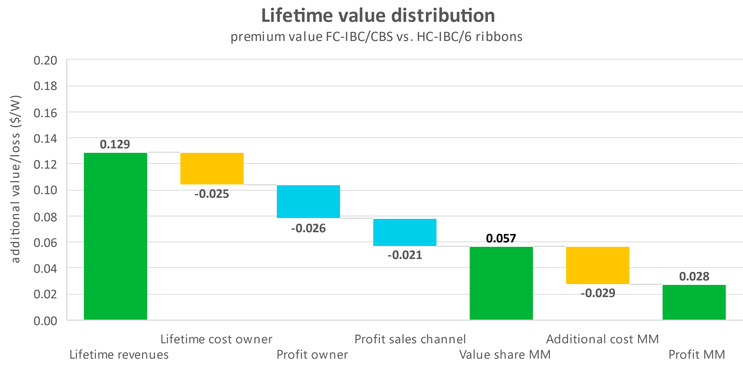
Assumptions: M6 cell size with 6 busbars / polarity; ribbon cross-section: 1.0 x 0.2 mm; CBS thickness: 35 µm; losses in solder paste not included in above simulations.

Value creation for module maker and end user

- A detailed cost-analysis for different IBC interconnection options has been performed using optical and electrical simulation results as input.
- The table below shows the performance difference between modules using 6 busbar Zebra IBC cells for ribbon vs CBS interconnection.
- The power density is ~2.9% (for HC) or ~3.4% (for FC) higher when using a CBS compared to ribbon interconnection of half cells.
- The specific yield is ~1.5-3.5% higher due to thermal and low-irradiance benefits (see EU PVSEC, 2020, 4AV.1.18)
- The total increase of 4-7% in energy yield with CBS allows for an increased module price vs. ribbon module design.
- The added value of the module across the value chain is presented in the graph below.

	ZEBRA IBC Half cell + 6 Ribbons	Zebra IBC Half cell + CBS	Zebra IBC Full cell + CBS
Cell efficiency	24%	24%	24.2%
# Cells	6x20 HC M6	6x20 HC M6	6x10 FC M6
Module area (m^2)*	1.80	1.77	1.76
CTM loss (abs.)**	3.26%	2.66%	2.78%
Module efficiency	20.7%	21.3%	21.4%
Module energy density (Wp/m2)	207	213	214
Module power (Wp)	374	378	378

** Horizontal and vertical cell spacing 1mm for all module designs. Bussing area 30 mm for PERC.*
*** CTM loss includes geometrical, optical and resistive losses, excludes cell cutting losses.*



Conclusions

The results presented in this work demonstrate that using conductive backsheets for interconnection of IBC cells, compared to ribbon interconnection, can improve module efficiency by ~0.6-0.7% (absolute) due to reduced resistive losses and reduced module area. An additional value of ~0.03 €/Wp can be created for both the end-user and the module maker.