

Endurans™ Solar

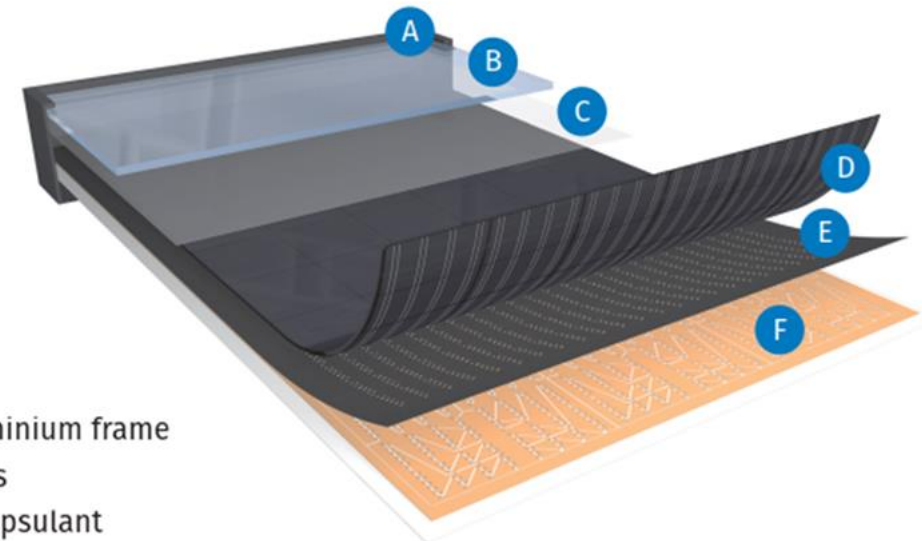
Advanced materials for back-contact (BC) modules
Value creation for IBC modules: CBS vs ribbon
interconnection

Hugo Schoot
BC Workshop 12 May 2022



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1. Introduction to Endurans™ Solar
2. Endurans™ Solar materials for BC modules
3. Value creation by using CBS vs ribbon cell interconnection for IBC modules
4. Building the BC ecosystem



- A Aluminium frame
- B Glass
- C Encapsulant
- D IBC or MWT cells
- E Rear perforated insulator sheet
- F Conductive backsheet

For more information on market and technology developments of BC technologies, please watch the webinars we organized with PVTech and our partners Silfab Solar, ISC Konstanz, Eurotron and Apricum :

<https://www.pv-magazine.com/webinars/competitive-and-sustainable-the-future-of-back-contact-technology/>

<https://www.pv-magazine.com/webinars/back-contacts-move-to-the-front/>

Also accessible via the Endurans™ Solar website: [FAQ | www.endurans-solar.com](https://www.endurans-solar.com)



Welcome to Endurans™ Solar!

DSM Advanced Solar is now Endurans™ Solar

Per 01.06.2021



100% subsidiary of **Worthen Industries**



Endurans™ Solar in a nutshell

Innovative backsheet solutions for solar panel manufacturers

Experts
in polymer
science, co-
extrusion, solar
technology

Production
facilities across
Asia, Europe &
America

Market leader
in co-extruded
backsheets.
Endurans™ HP
*All-purpose
Sustainable*

Market leader
in conductive
backsheets.
Endurans™ CB
*For high-end
aesthetics &
output*

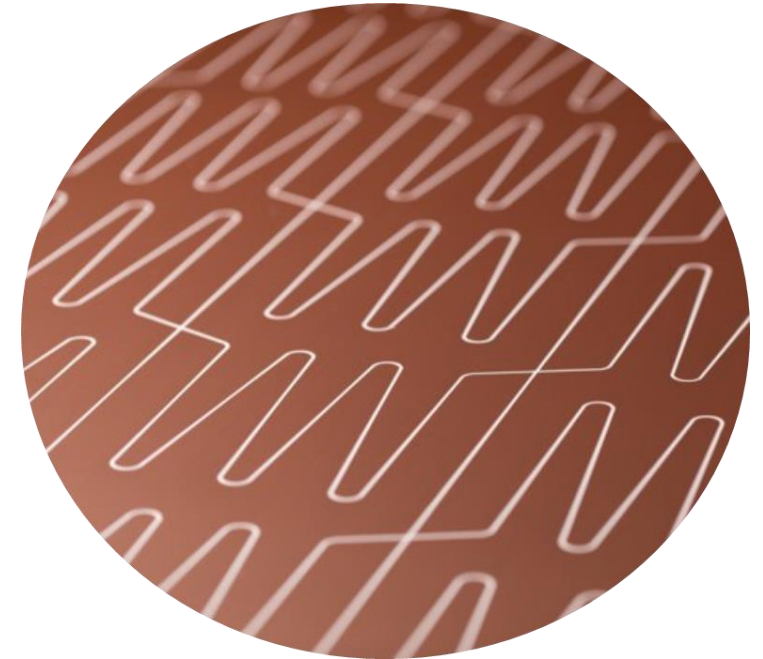
Pipeline of new
products:
Insulator sheets
Specialty encapsulants
EPE patches



CBS development at Endurans™ Solar

Drive for cost reduction, higher performance and sustainability

- Development of a CBS with a high-performance polyolefin based backsheet (Endurans™ HP technology)
- Development of a CBS with a lower cost metal foil, without compromising on conductivity
- Process improvements to optimize cost and increase production capacity to meet growing customer demand
- Optimizing the supplier base to improve quality, lead times and minimize transport costs
- Customer support: optimization of module design and CBS pattern to maximize module output using advanced modelling tools



Rear Perforated Insulator (RPI) development at Endurans™ Solar

Drive for cost reduction, higher performance and sustainability

- Unique material concept based on the Endurans™ Solar proprietary HPO technology
 - Polyolefin based – fully recyclable
 - Dimensionally stable
 - Excellent flatness
 - Unparalleled adhesion to cells, metal foil and backsheet
- Unique perforation technology
 - High speed
 - High accuracy
 - No risk of chads or ridges

Value creation study IBC cell interconnection

Comparing ribbon interconnection of half-cut cells with conductive backsheet interconnection of half-cut and full cells

	Zebra IBC HC – 6 ribbons	Zebra IBC HC - CBS	Zebra IBC FC - CBS
Cell efficiency*	24%	24%	24%
# Cells	6x20 HC M6	6x20 HC M6	6x10 FC M6
Module area (m ²)**	1.80	1.77	1.76
CTM loss (abs.)***	3.24%	2.65%	2.77%
Module efficiency	20.6%	21.2%	21.2%
Module power (Wp)	371	375	374

* non-cut cell efficiency. Half cut efficiency reduces to 23.8%

** Horizontal and vertical cell spacing 1mm for all module designs. Bussing area 30mm for HC-IBC/ 6 ribbons.

*** CTM loss includes geometrical, optical and resistive losses, excludes cell cutting losses.

For more information on cost of ownership studies comparing MWT and IBC BC with PERC modules, contact us or watch our webinars:

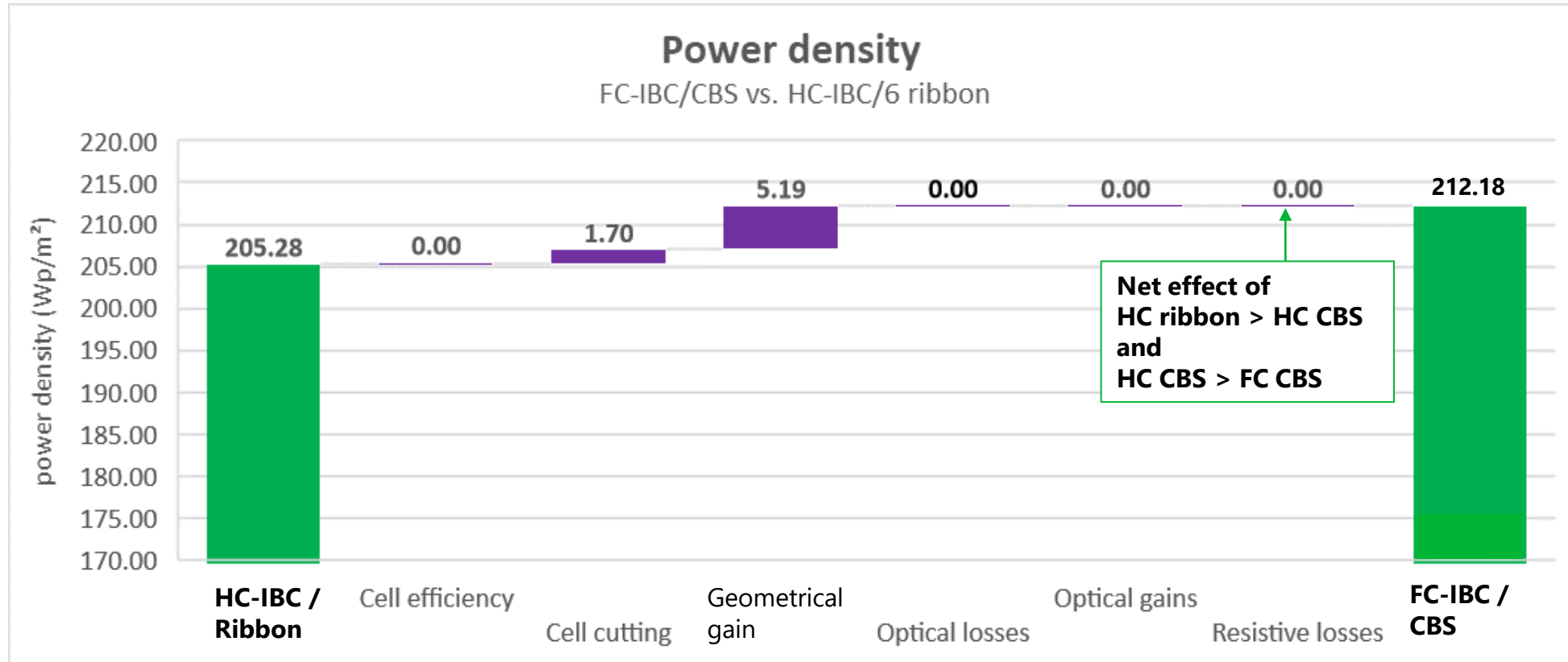
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Enhanced power density with CBS vs. ribbon

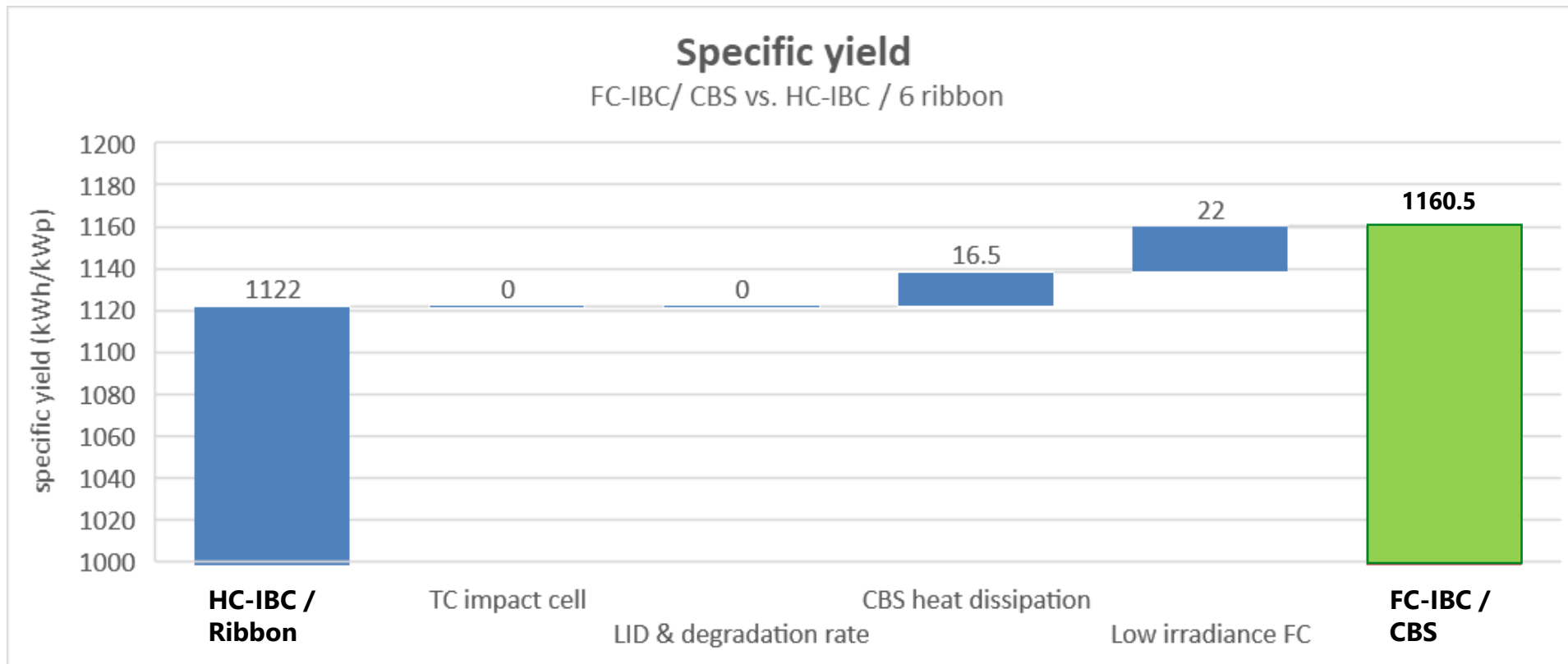
Resistive losses for full cell CBS equal those of half cell ribbons. Elimination of bussing area and higher full cell efficiency provide higher CBS module efficiency.



Remark: Resistive gain for HC-IBC / CBS vs FC-IBC / CBS equals 2.5Wp/m²

Enhanced specific yield with CBS vs ribbon

Due to a heat sink effect, modules with CBS cell interconnection run at lower temperatures. Full cells also provide a low irradiance yield advantage vs half cells.

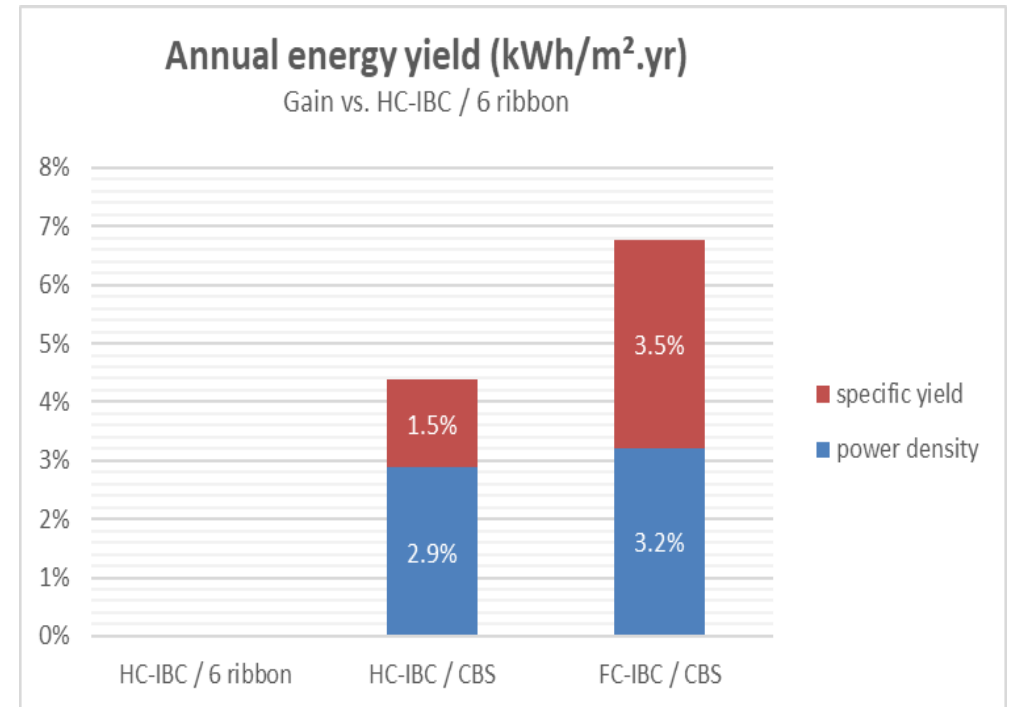
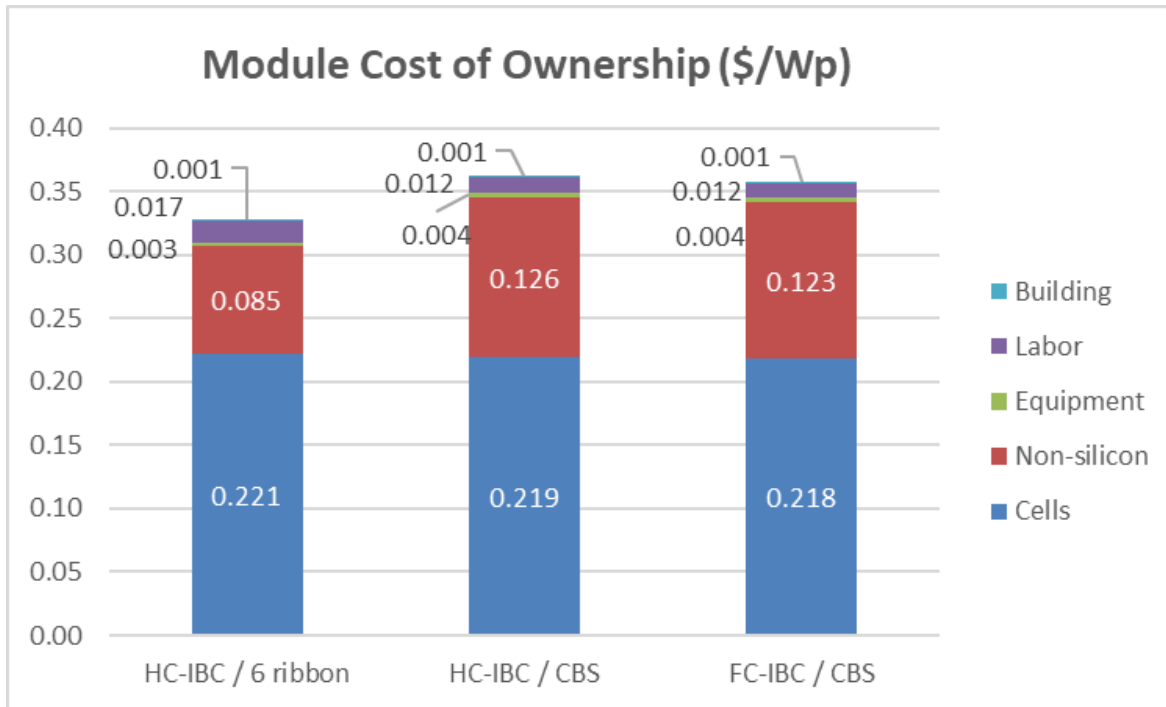


Remark: reference HC-PERC / 12MBB module design specific yield at 1100 kWh/kWp



Module cost and annual additional energy yield

Higher power density and specific yield add 4% for HC CBS up to 7% higher annual yield for FC CBS vs HC ribbon interconnection.



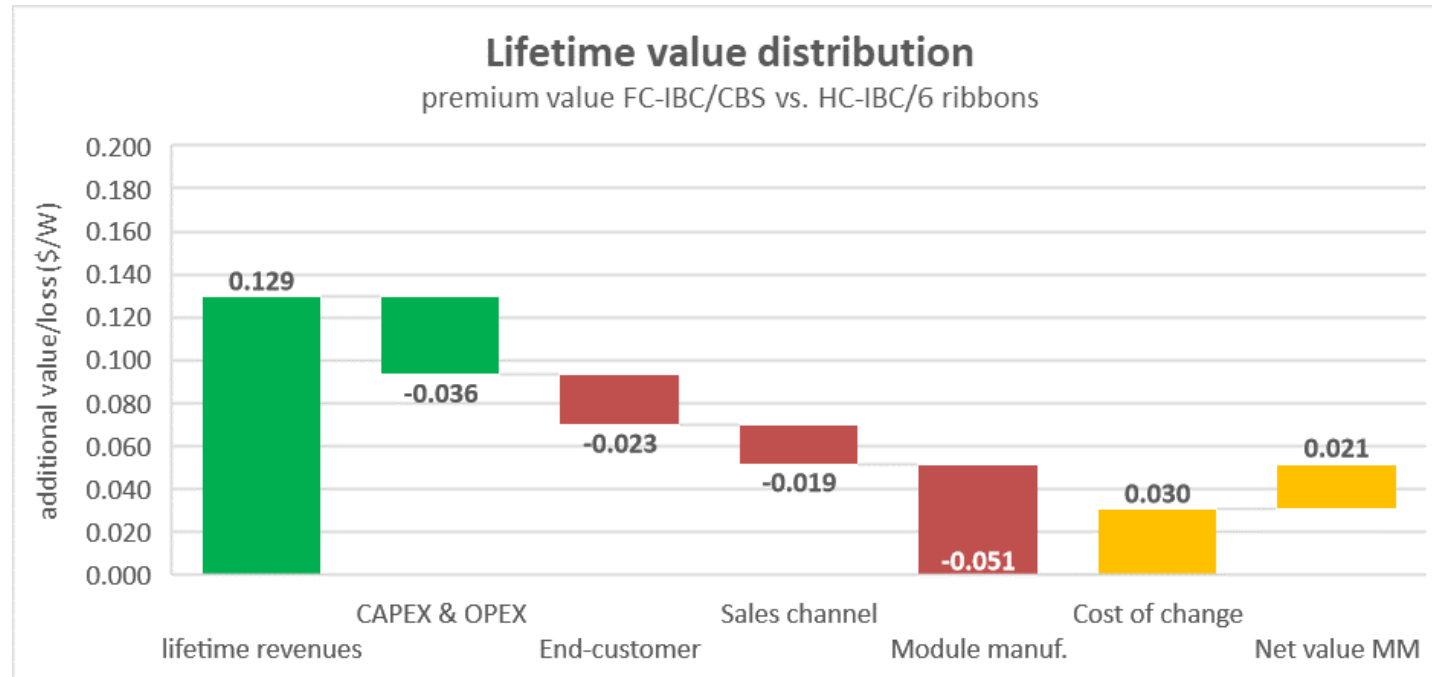
Gross line speed 100 modules /hr (260-280MW annual capacity)
 Depreciation 5%/yr (building) and 20%/yr (equipment), interest rate 5%.
 Labor cost 36-48k€/yr

Specific yield 1100 kWh/kWp (~Munich)
 Gain will be even higher for locations with higher irradiation and operating temperature



Value creation and distribution in the chain

Additional value created at the end customer is divided over the value chain, resulting in ~0.02 \$/WP additional profit for the module maker.



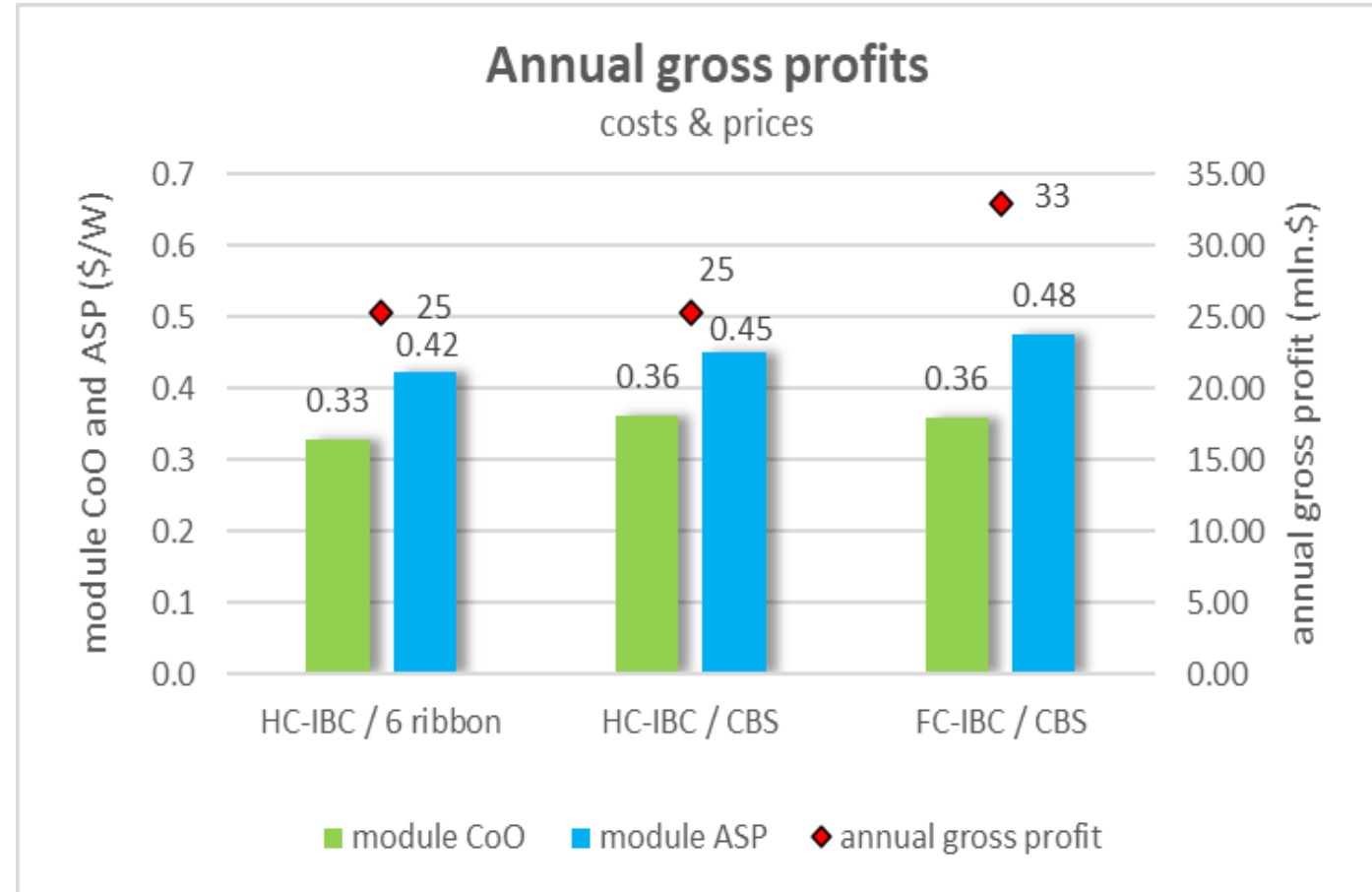
Assumptions: Electricity price 0.13\$/kWh
25yr system lifetime, WACC 5%
End-customer captures 25% of value added
Sales channel captures 20% of value added

Special thanks to Apricum, ISC Konstanz and Eurotron for their support in developing the model



Additional value and profit for the module maker

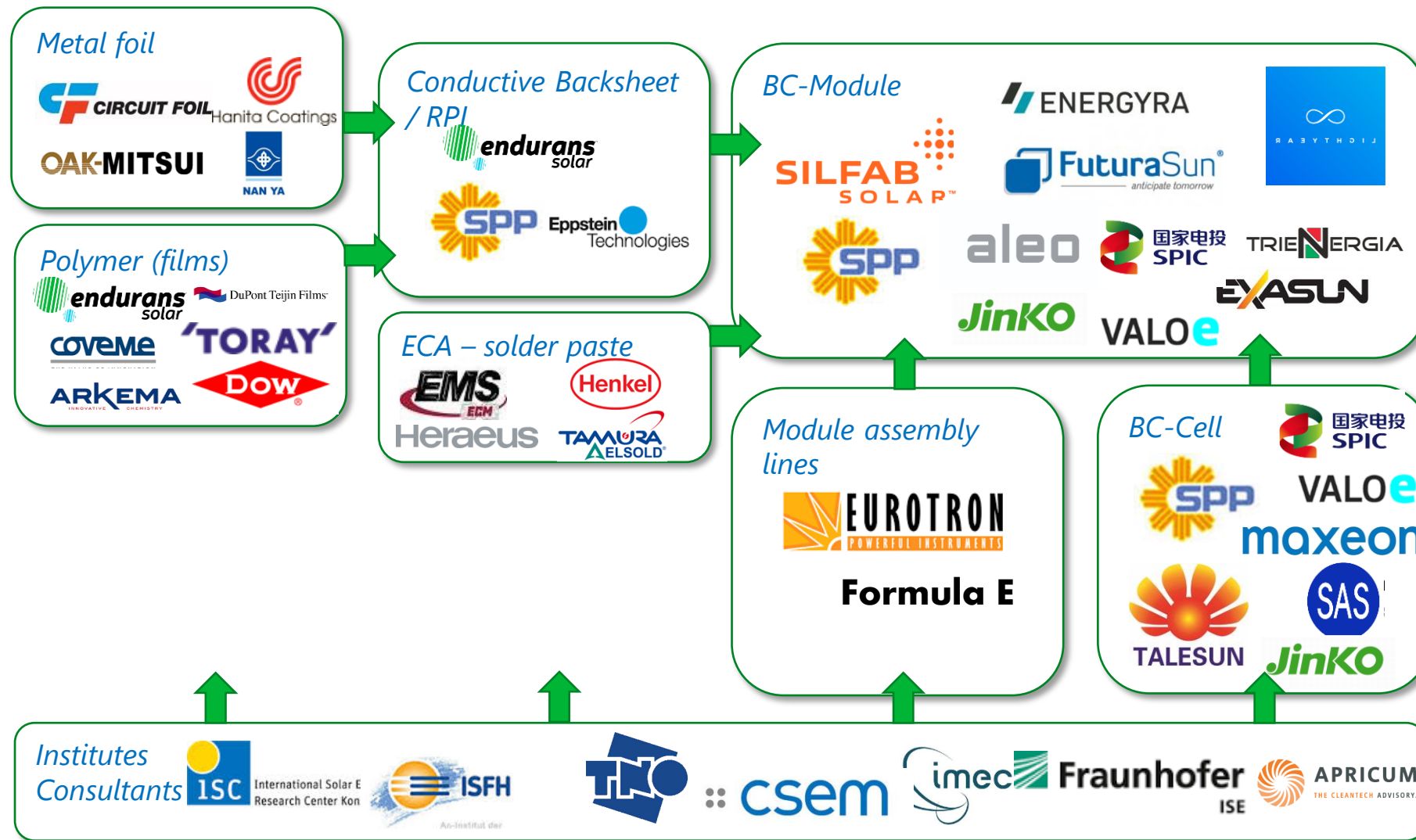
Slightly higher \$/Wp CoO for CBS-based modules is more than offset by higher value creation - delivering higher sales price and more profit for the module maker.



Let us make a simulation for your specific case!



A close collaboration across the BC ecosystem is the key to making BC technology a success for us all!



Same sun. More power.TM

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