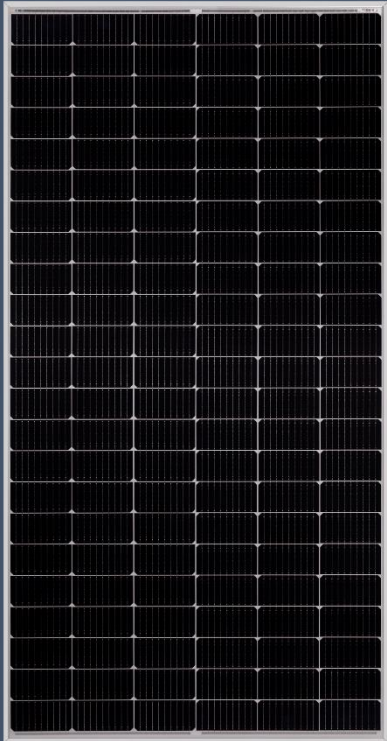


Cutting out the cracks:

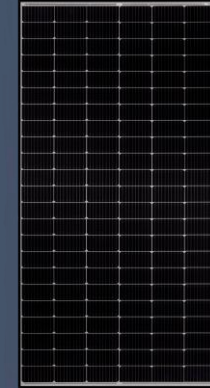
Advantages of thermal stress cutting

Thomas Regrettier
pv magazine webinar | June 3, 2021



VOLTEC
solar

Company overview: Strub Family owned business



**Wooden-based furniture
production**
4 factories in France
Turnover 2019 : € 243 Mio



PV Module Production
200MW
400.000 modules delivered in France in 2020
Turnover 2020 : € 54 Mio

Technologies - Production - Investments



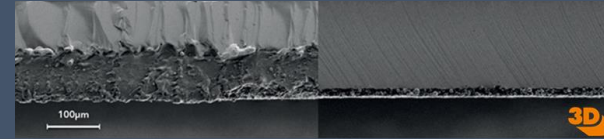
1M€ Investment



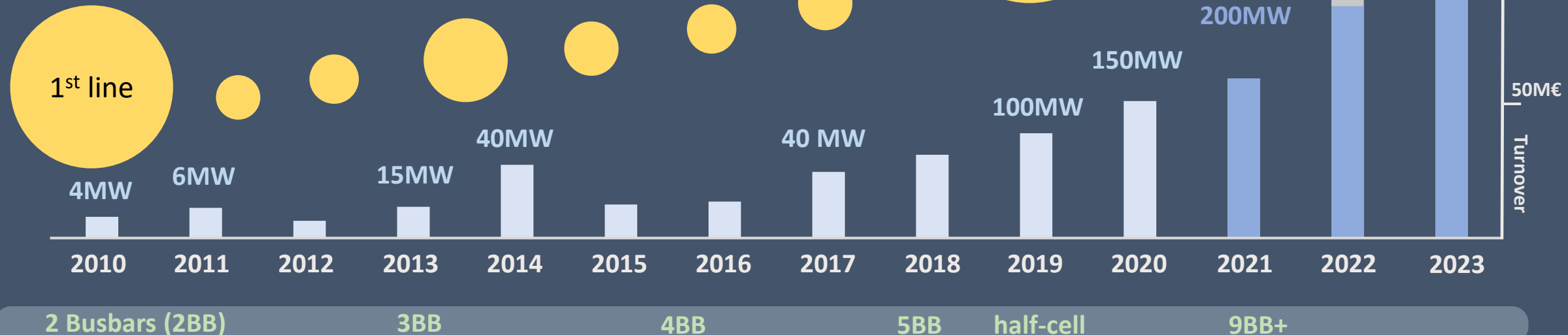
Glass-glass laminator

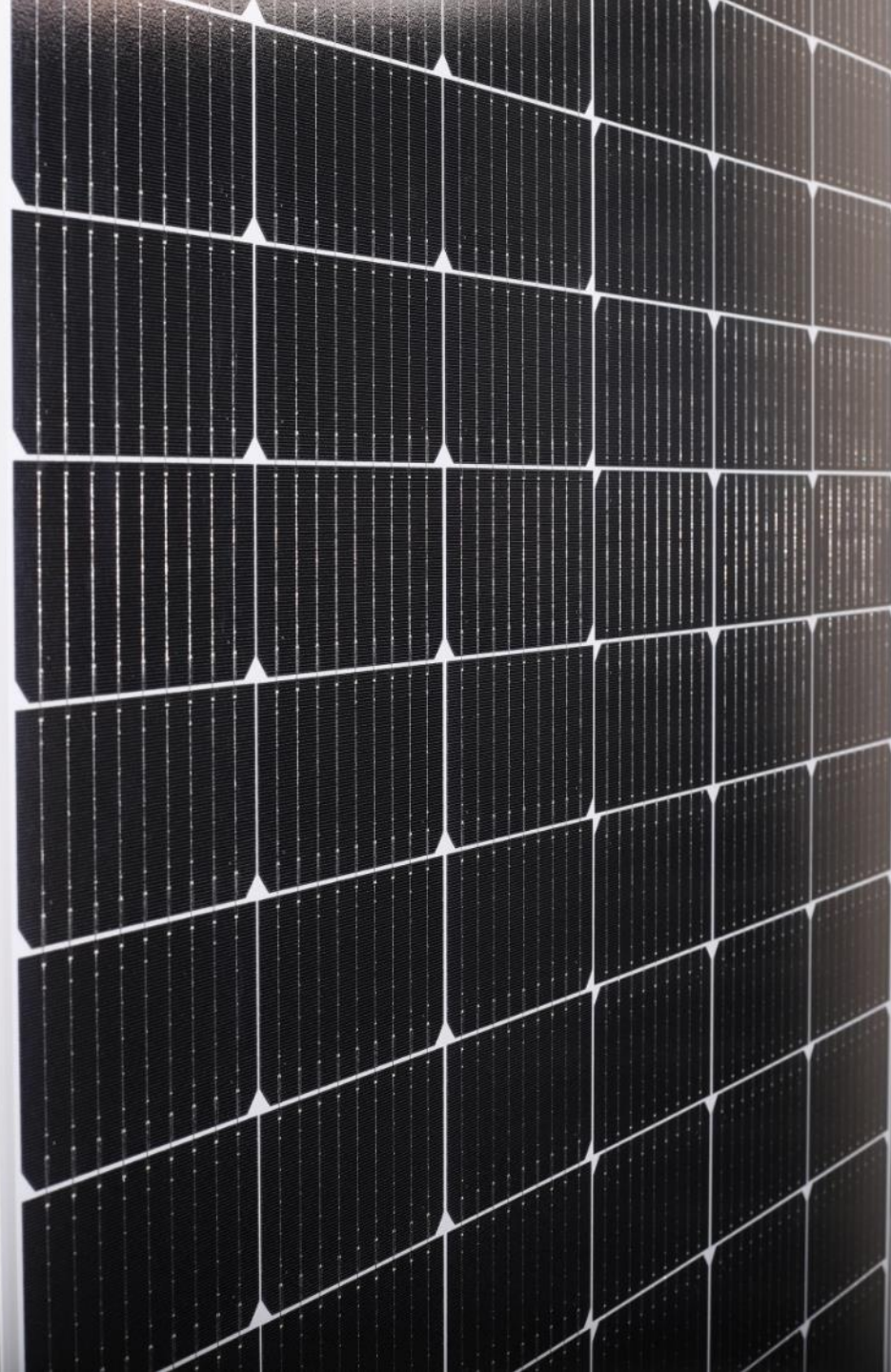


Infrared soldering



Thermal Laser Separation





DUALLPV

« Disruptive and Ultra-low-carbon
Architecture for a Lower LCOE »



**Low environmental
impact**



Patented interconnect
Improved shade management



Bifacial
Yield +5% to +15%



Fluorine-free
Reduced toxicity



TLS-Dicing™
Damage free and kerfless cell-
cutting process



**Low Voltage - High
Current – 1500 V_{DC}**
Reduced cabling needs



Lead free
RoHS compliant

Paris 2015 - COP21



TLSTTM vs LSC: Yield comparison

Cutting process	Input (Full cells)	Rejection rate (%)	Cell price (\$/Wp)	Production capacity (MWp)	Cost (\$/year)
LSC	5600	0.57%	0.14	200	\$160 000
TLST TM (3D Micromac)	5600	0.07%	0.14	200	\$20 000

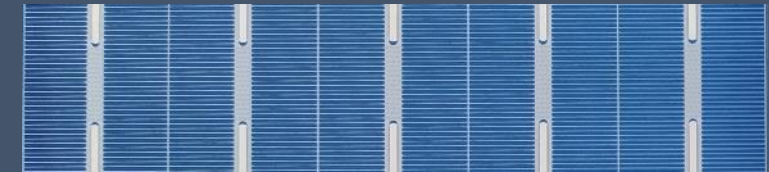
TLSTTM process

Pros : Lower OPEX
Cons : Higher CAPEX

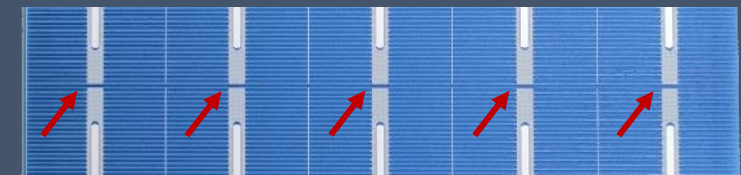
LSC process

Pros : Lower CAPEX
Cons : Higher OPEX

Optimized cell layout = Higher Yield

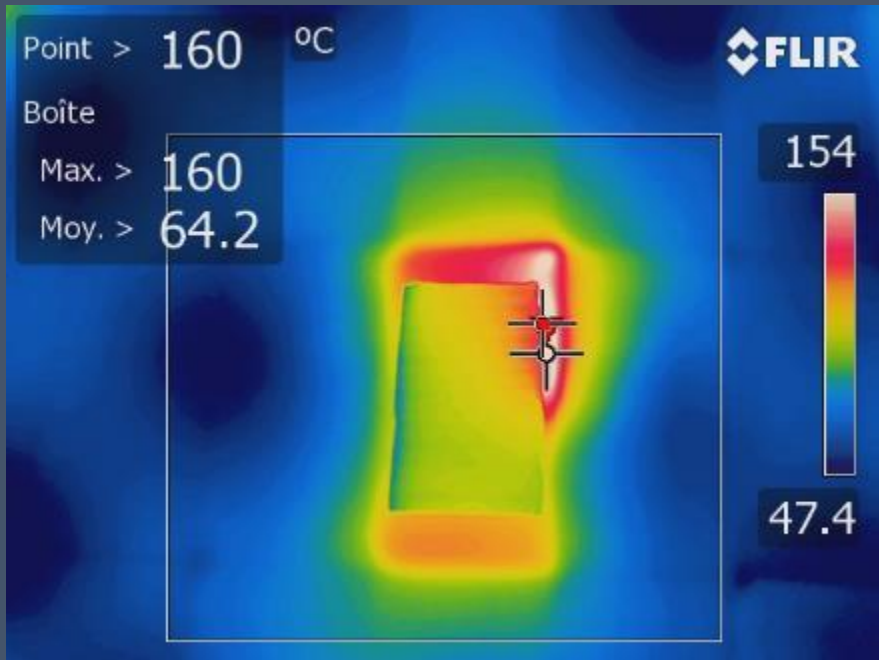


Cell backside - 2018



Cell backside - 2020

TLSTM vs LSC: Behavior during hotspot tests



Using LSC, hot spots materialized around the cutting area

Modules produced with TLSTM

- Hotspot test PASS

Modules produced using LSC

- Hotspot test FAIL
- Appearance of major visual faults : Backsheet burns

TLSTM vs LSC: Mapping of the shunt resistance of module cells

- No observable damage for both cutting technique (Visual + EL imaging)
- Cells cut with LSC process show lower R_{SH}
- Lower mechanical strength induced by cutting process transform into hotspot risk after lamination process

Cut with TLSTM
 Average R_{SH} : 207 Ω

399	205	190	173	209	168
464	226	145	394	234	198
358	148	190	163	205	213
336	230	224	232	168	171
335	188	152	210	120	139
334	217	161	223	220	172
368	213	214	158	183	230
450	179	221	158	94	165
172	189	144	205	180	213
446	249	190	112	158	278
185	206	152	171	146	164
460	159	179	141	201	207
250	155	160	213	139	168
204	280	189	236	196	182
235	172	170	155	160	82
184	97	134	171	125	156
386	174	199	228	180	193
271	170	127	192	155	203
265	209	179	206	192	147
375	170	188	234	162	224

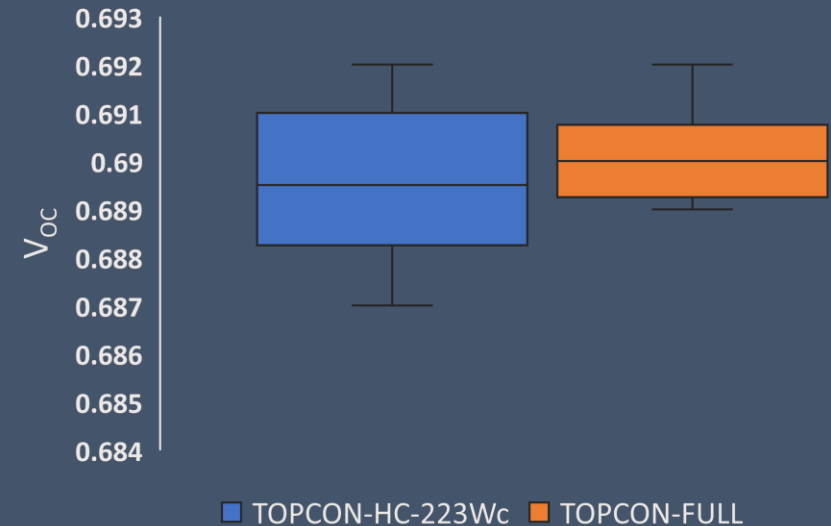
Cut with LSC
 Average R_{SH} : 104 Ω

67	71	126	85	151	107
65	24	298	71	189	67
74	48	90	74	114	88
73	3	82	82	158	87
60	5	240	76	188	82
55	6	219	84	163	78
59	73	206	66	170	80
73	74	148	80	152	66
72	75	189	68	164	62
64	68	177	77	187	75
56	60	121	81	170	73
72	72	217	73	211	65
77	48	160	75	179	96
79	50	127	50	218	70
69	83	156	75	156	79
67	65	216	77	172	88
61	68	232	77	194	77
72	58	138	73	121	78
71	83	148	80	210	93
58	72	142	98	206	80

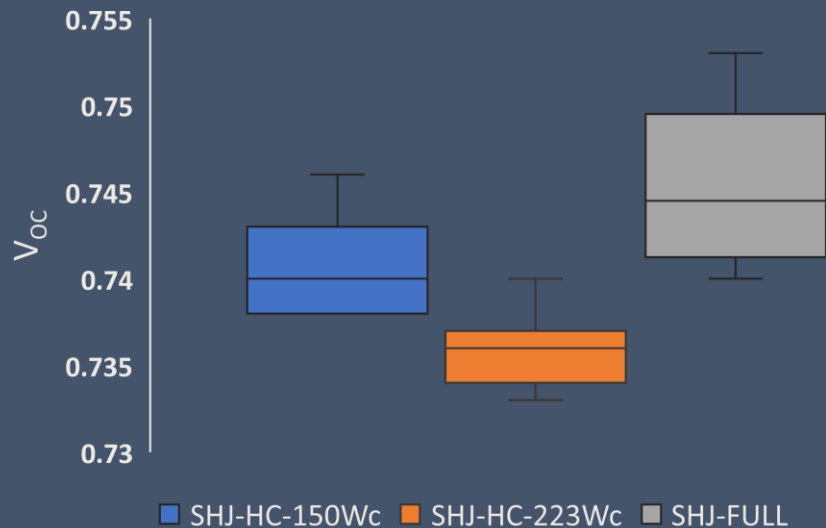
Shunt resistance mapping of the panel

TLS™ : Impact of cell technology – TOPCon

- No measurable power loss after cutting using TLS
- No adjustment of the TLS tool needed to switch from bifacial PERC to bifacial TOPCon
- Thickness similar to PERC (170 μm)

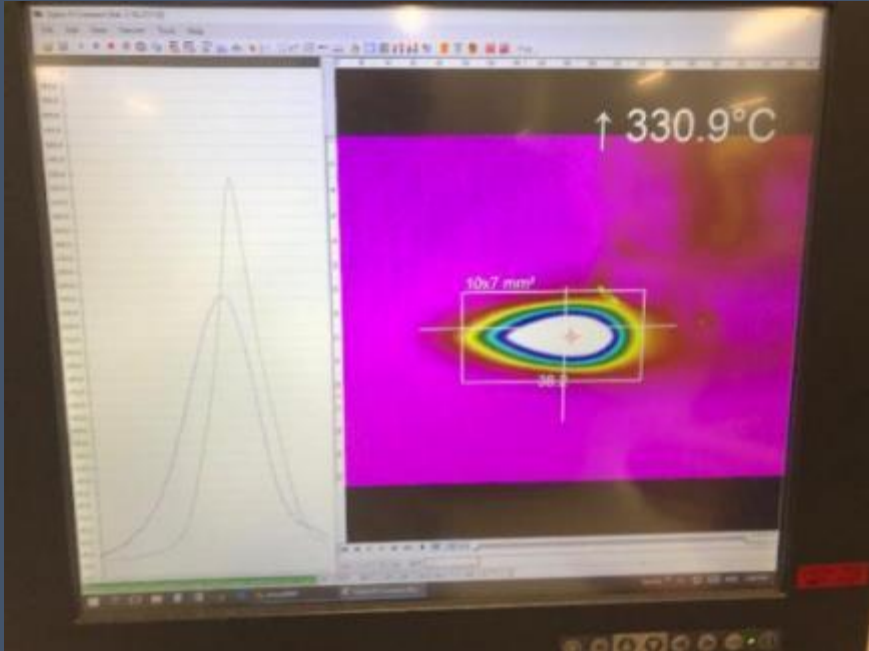


TLSTTM : Impact of cell technology – SHJ



- Lower cell thickness (130 μm)
- Many optimization required (2 hours) :
 - Airflow for cell separation
 - Laser settings
 - Handling system
 - Etc...
- Power loss :
 - Before optimization : -0.59 %_{abs}
 - After optimization : -0.29 %_{abs}
 - Financial losses > 500 k€/year for a 200 MW line

Tips from an end-user



Thermal imaging camera :

- To check if the temperature at the wafer surface is correct
- To check the shape of the heated area (misalignment detection, etc.)



Microscope :

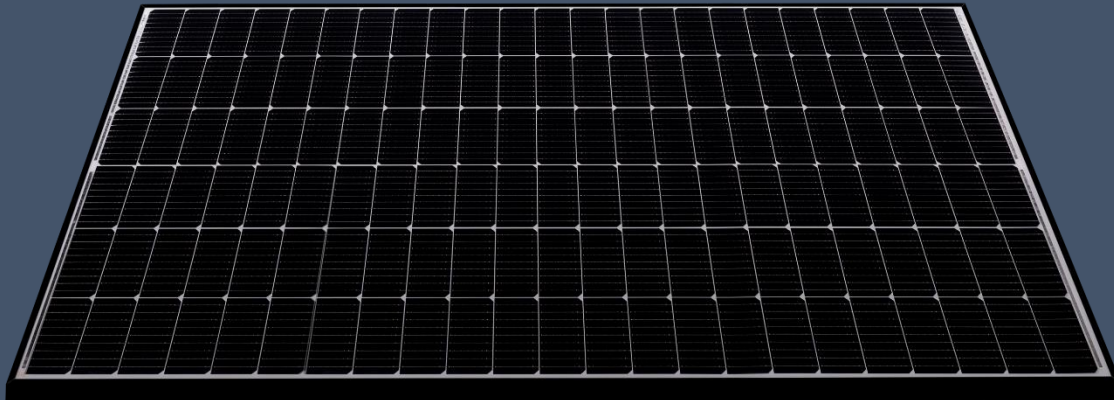
- To check the quality of the cut

Cutting out the cracks:

Advantages of thermal stress cutting

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**Thank you for your
attention!**



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