COOLBACK®

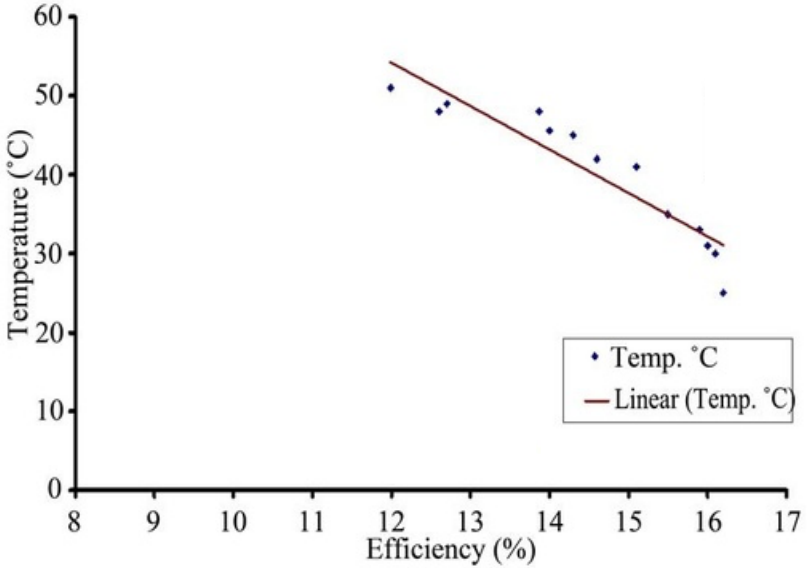
IMPROVING THE OUTPUT & LIFETIME OF PV THROUGH COST EFFECTIVE COOLING

pv magazine WEBINAR

May 28 2019, 10.00-11.00H CEST

HEAT LOSSES EXPLAINED

TEMPERATURE v EFFICIENCY
FOR A Si SOLAR CELL



The effect of higher temperatures at the moderate working range is a drop of 6-7% in efficiency, or the equivalent of approximately 20 Wattpeak per 60-cell module

Effect of high temperatures on degradation/ lifetime not included in standard IEC tests

STC: *output measure in flashtest at Tcell of 25 °C, irradiation 1.000 Watts/m2, AMN 1,5*

NOCT: *measuring Tcell at 800 Watts/m2, Tambient 25 °C, wind 1 m/s, mostly around 40-50 °C*

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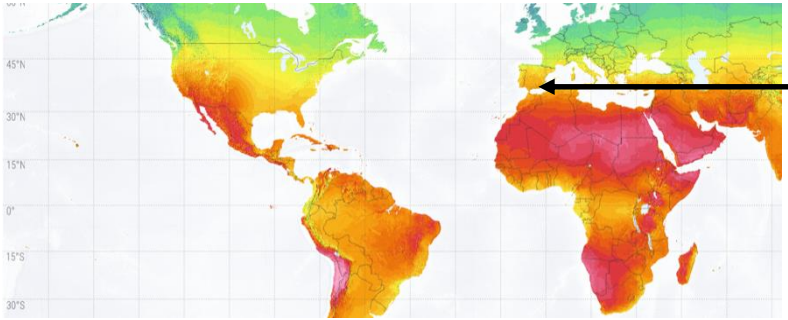
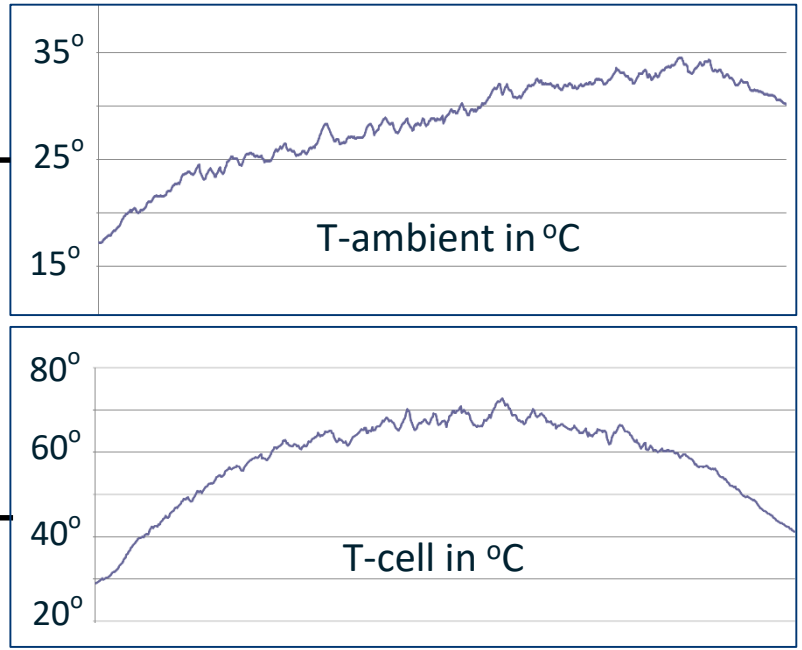
HEAT LOSSES OFTEN UNDERESTIMATED

Cell temperatures are however not maximized to 60°C, not even in moderate environments where they can measure 70°C or more, while they easily reach 80-90°C in desert & tropic regions. This is dT of 60-70°C above STC, losing 20% output.





DATA FROM A SINGLE DAY
(Sevilla, Spain- May 2019)

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PREVIOUS COOLING ATTEMPTS

Several attempts and technologies have been tested since the 1980's:

PHASE CHANGING MATERIALS

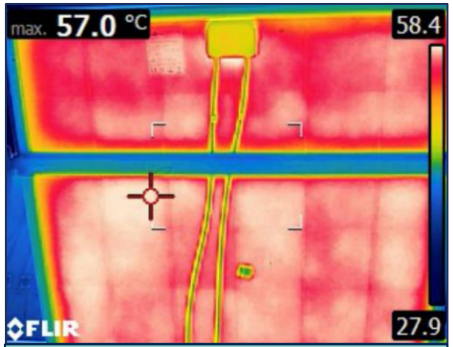
COOLING RIBS - MASSIVE ALUMINUM

PV THERMAL, WATER-COOLED SYSTEM

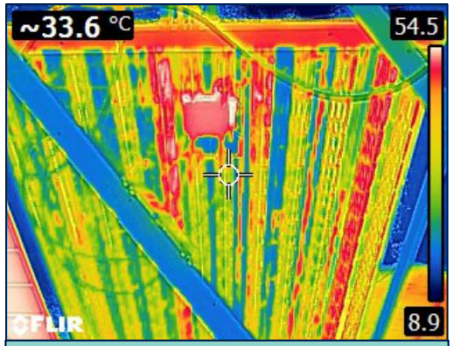
All options remain small scale as they do not fit standard PV product or production, they add weight, add costs and most of them have limited effect on cooling.

NEW COOLING APPROACH

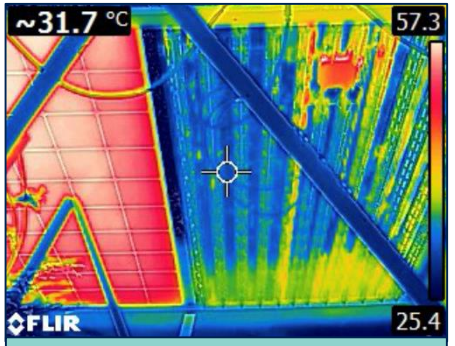
New approach by COOLBACK Company: R&D with minimal (but optimal) material use.



FRAMED MODULE



FRAME + COOLBACK



UNFRAMED + COOLBACK

Considering: measurement errors (IR failures, Thermocouple, Module/Cell) in temperature are only useful for comparison. For yield, the most accurate measurement is open circuit or real output (Watts) by sensitive instruments.

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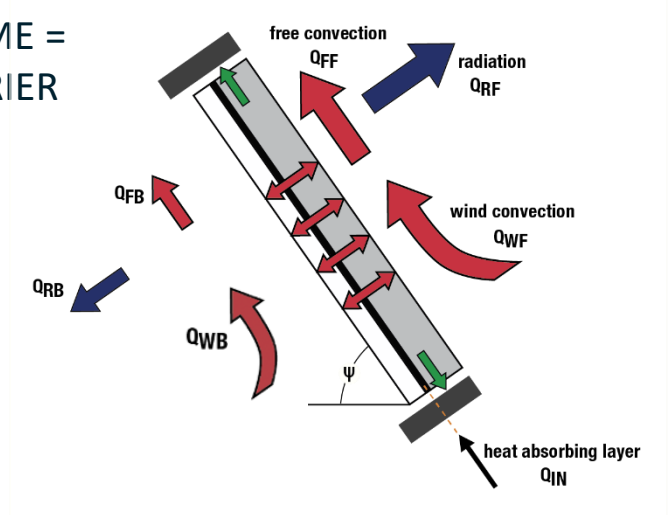
COST EFFECTIVENESS = COST SUBSTITUTION

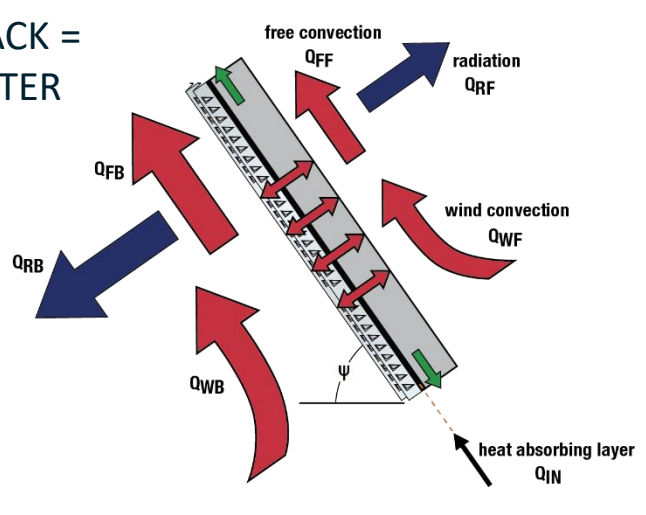
Cost effective cooling is obtained by substituting materials, not adding them.

Re-designed and integrated frame, together with a rib design that optimizes airflow and support, promotes cooling for NO additional costs.

FRAME = BARRIER



COOLBACK = PROMOTER



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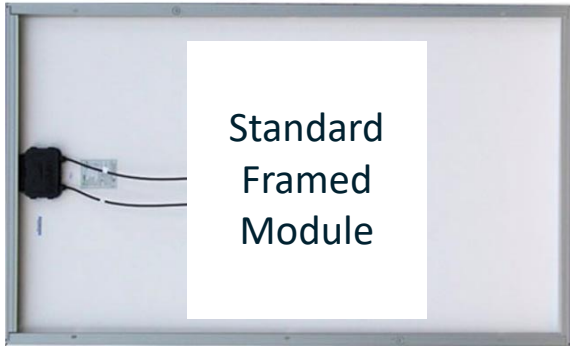
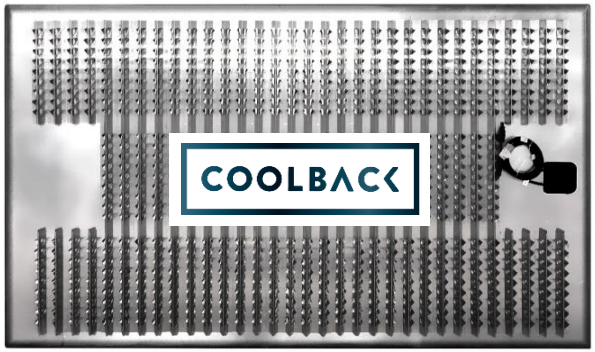
UPGRADED FEATURES FOR FRAME



1. Mechanical design standpoint only
2. Disputable cooling effects, edge only
3. Frame blocks and locks-in heat
4. Height & form limit stacking options
5. No functional integration with module



1. Mechanical + support + cooling design
2. Large surface for powerful cooling
3. Unobstructed air flow for heat removal
4. Nesting = stacking volume & costs
5. Integrated with backsheet & mounting

THERMAL EFFECTS - SIGNIFICANT & STABLE

A frame replacement with increased surface area on a module's backside has been studied under several conditions, with varying altitude, irradiation, wind and temperature.

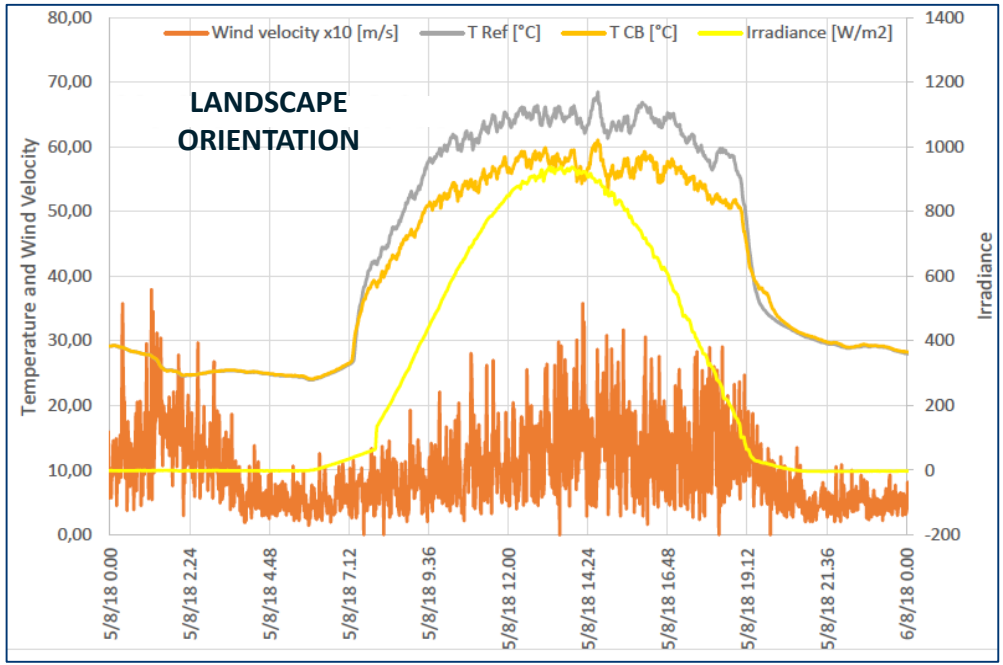
Test locations: Italy, Spain, Qatar and The Netherlands

PV module comparisons: mono-, poly, H-pattern and back-contact technology

Shape and airflows are basis of final designs and testing.

LOWER TEMPERATURES

Effect of lower temperatures at tracking implemented in design.



source: KIWA - springtime, Northern Italy

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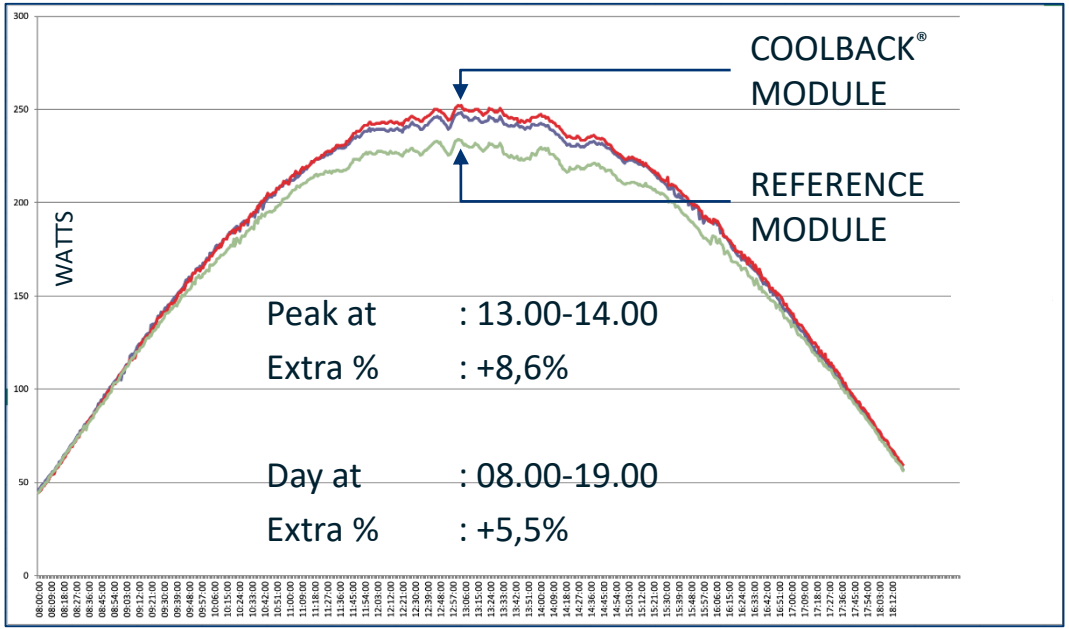
HIGHER OUTPUTS

The kWh output effect, already in fixed tilt, is significant – also at moderate temperatures. The lower temperature (in everyday/thermal cycle) reduces degradation, prolonging lifespan.

Peak	: 13.00-14.00
Sun	: 985 W/m2
Tamb	: 29,40° C
Tref	: 68,90° C



source: KIWA, Spain - springtime

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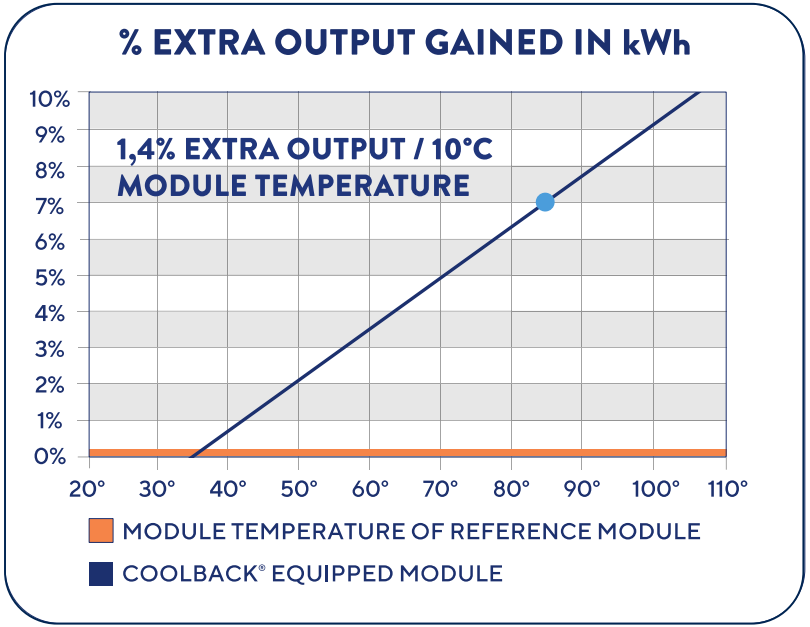
LOWER HEAT LOSSES ARE PREDICTABLE

Wind, ambient temperature and, mainly, irradiation have an effect on output performance of PV modules.

Predicting cooling gains per location is possible by measuring the temperature of the reference
(= standard) module.

COOLBACK® yields an additional 1,4% extra output per 10°C above 35°C. Valid up to 4,5 m/s windspeed.



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IMPORTANT FOOTNOTES & FOLLOW-UP

Footnotes:

- COOLBACK® creates extra Watthours, no extra Wpeak
- NO influence on module ($/Wp) prices, due to frame substitution – possible when produced with (automated) production. Retrofitting is not a cost-effective option

Installation:

- Field or flat roof: sufficient ventilation is required

Lifetime:

- COOLBACK® has a positive effect on temperature and stiffness: both influence the real thermal cycling and therefore the aging of materials. Further research and results will be available in future presentations (including SNEC Workshop)

Availability:

- 4 module manufacturers supply COOLBACK® equipped modules, more to follow soon

2-MINUTE SUMMARY

COOLBACK®