

Optivert

A Novel Method for Inverter Optimization

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Agenda

- The problem
- The solution
- Results from field trials
- Product development and next steps

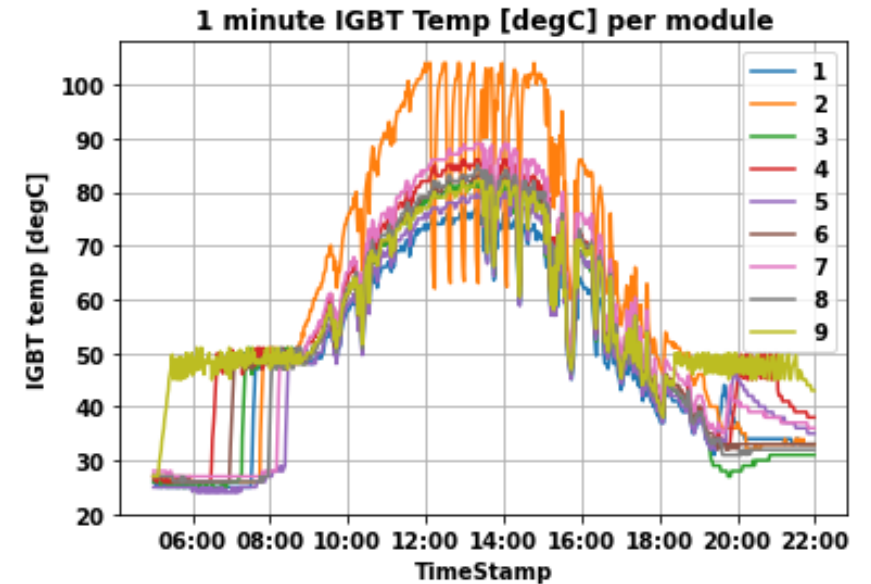
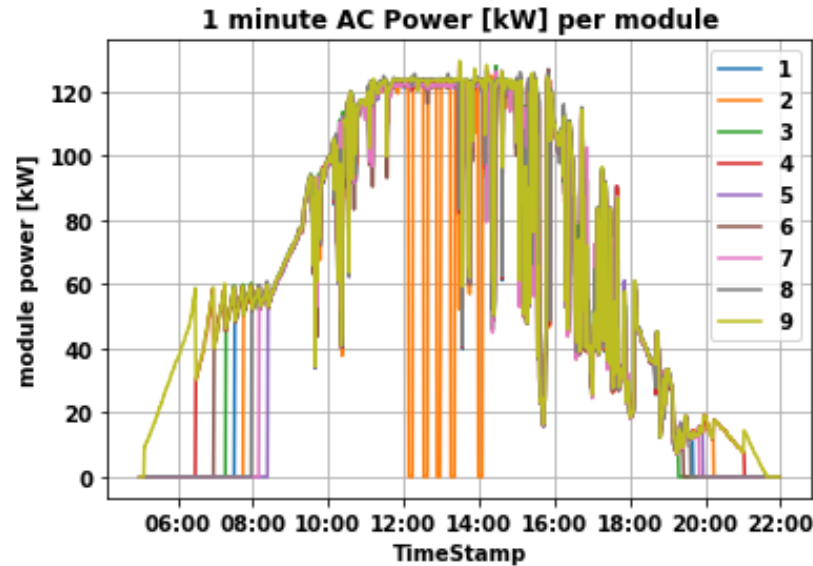
The problem (1/2)

Solar inverters heat up during operation. High component temperatures are more likely on days with high irradiance and high ambient temperature.

High component temperatures can cause a myriad of problems including:

- Lost production due to trips or sub-optimal curtailment strategy
- Catastrophic failure, eg **occasional fires**

Increasing ambient temperature (climate change) means the problem is increasing over time.



This example shows data from Power Electronics (PE) modular inverter. Module 2 repeatedly trips due to reaching the fault threshold (105°C = 221°F)

The problem (2/2)

This slide shows fault data and 1 minute data for one PE modular inverter (composed of 9 inverter modules).

Module 2 IGBT temperature is about 15degC higher than any other module and first trips off just after 12:00.

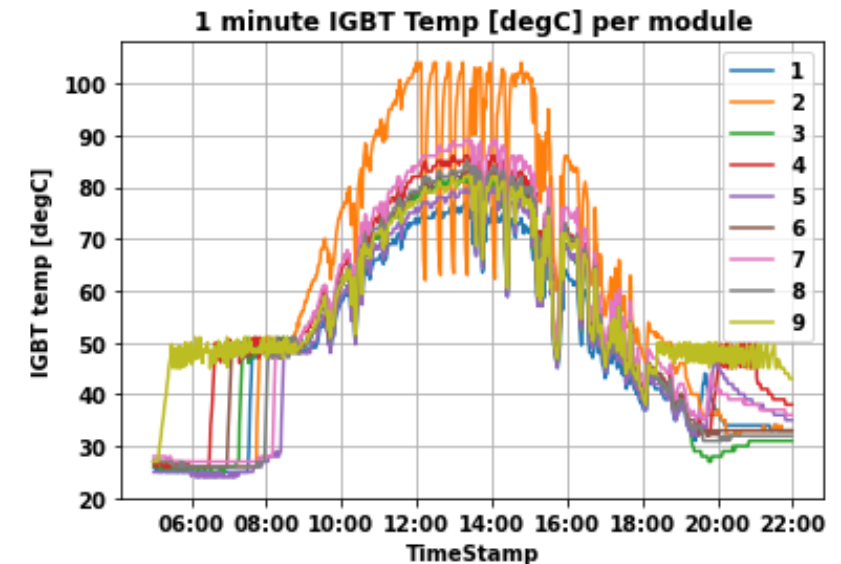
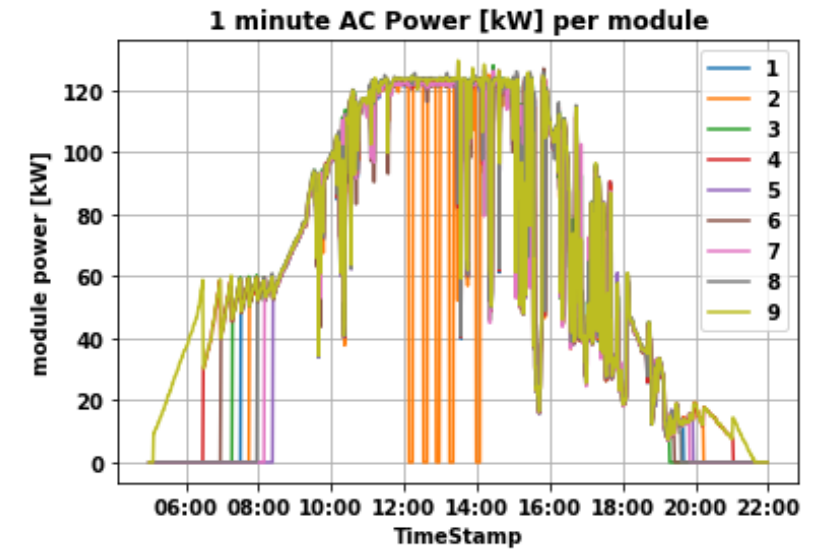
Module 2 has 5 high temperature trips on this day.

Module 2 has 86% more temperature travel than the average of the other modules which means it is wearing out faster.

Module 2 has 21.1x more fatigue damage than the other modules due to the large temperature cycles (fatigue is proportional to cycle magnitude and cycle mean temperature).

Module number	Trip times (UTC)
2	12:05:57
2	12:30:20
2	12:51:36
2	13:13:18
2	13:57:29

Module number	Cumulative temperature travel [degC]	Cumulative temperature travel (as a % of the avg of fault free modules)	Relative fatigue damage
1	377	83%	0.4
2	841	186%	21.1
3	429	95%	0.9
4	529	117%	1.4
5	443	98%	0.6
6	410	91%	0.9
7	459	102%	1.9
8	457	101%	1.2
9	508	112%	0.7



The solution (1/2)

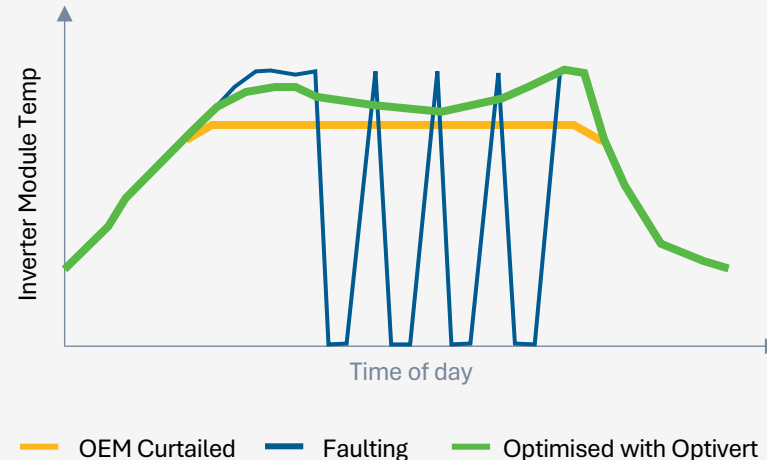
Optivert

Product design

An intelligent inverter temperature management system, activated via on-site edge computer, increasing production and reducing inverter component failures

Product objectives

- Decreased IGBT trips
- Increased yield on hot days
- Reduced IGBT fatigue damage



Test plan

Optivert was trialled on 13 different solar farms across the UK between April and August 2025

Uplift validation was accomplished via a daily toggle method:

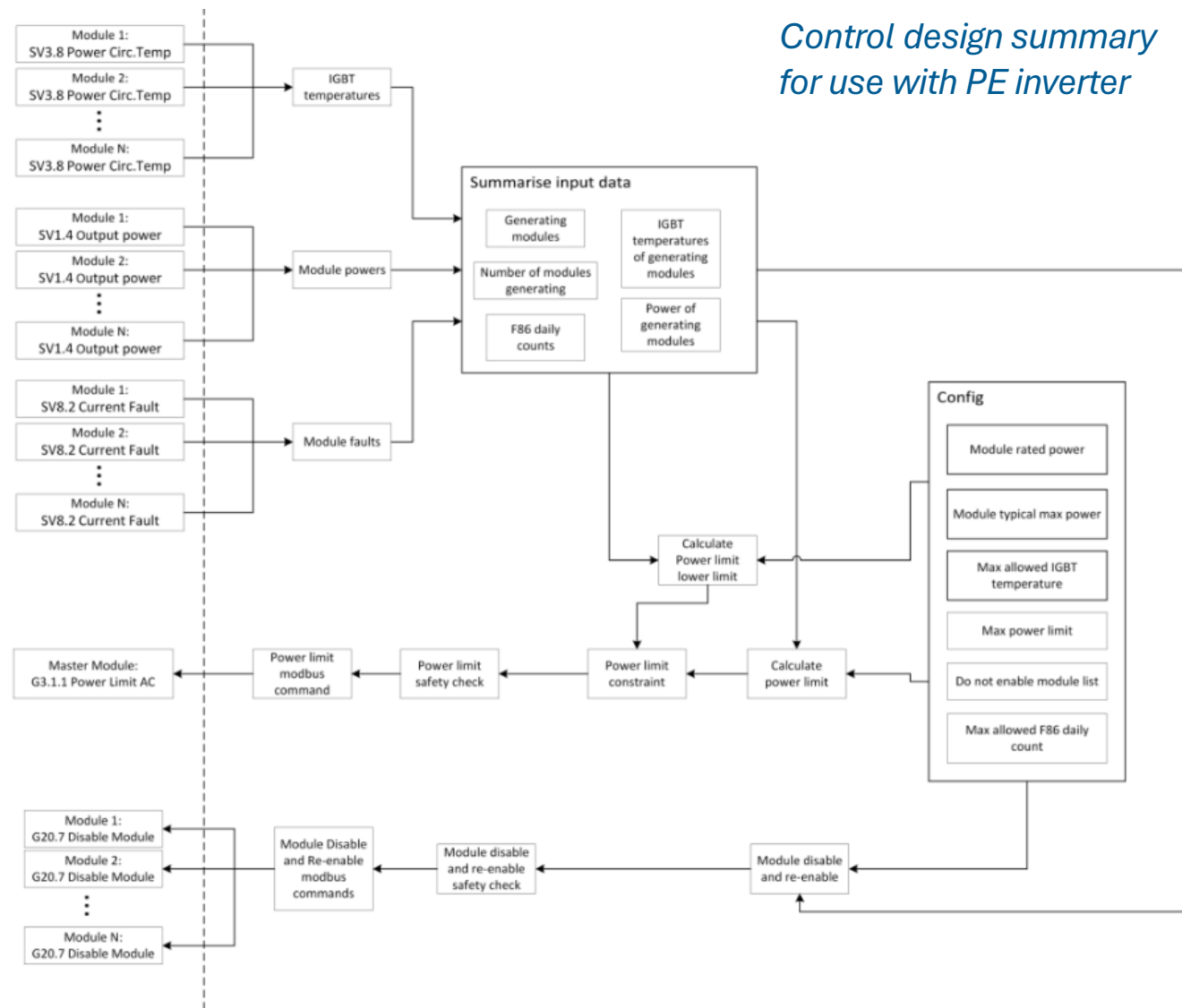
All inverters are split into two groups and for each day, a group changes toggle status. If one group had Optivert enabled on day one, the other group did not, and they would swap roles on the next day.

The solution (2/2)

For the PE (inverter type in field trial) the Optimvert design optimally chooses between the two curtailment options: power limiting vs disabling the problematic module.

When power limiting is chosen a sophisticated feedback controller calculates the power limit.

The solution out-performs the onboard OEM logic which is simple and needs to be configured just right to work well.



Results – portfolio level

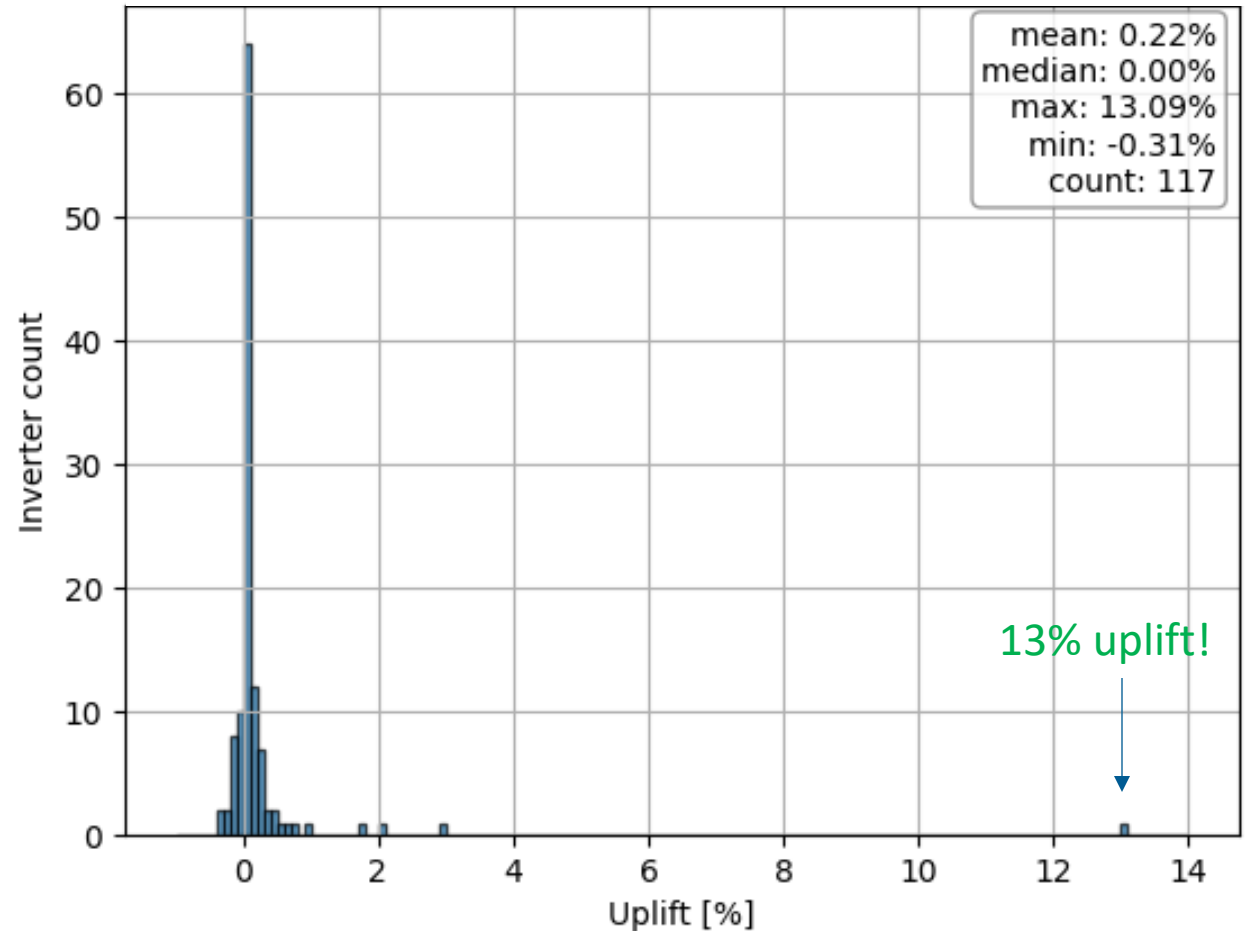
The histogram on the right shows uplift across 117 inverters tested across 13 solar farms during summer 2025. Data from April to August is used.

The mean uplift is clearly positive (**0.22%**) and the distribution is clearly skewed to the right. Maximum uplift on a single inverter is **13%**.

The majority of inverters did not have temperature issues in summer 2025, hence median uplift is 0%.

Substantial inverter component replacements in 2024 means not many issues are present at the moment. So, **this uplift is lower than it would be long term.**

Optivert uplift per inverter, summer 2025

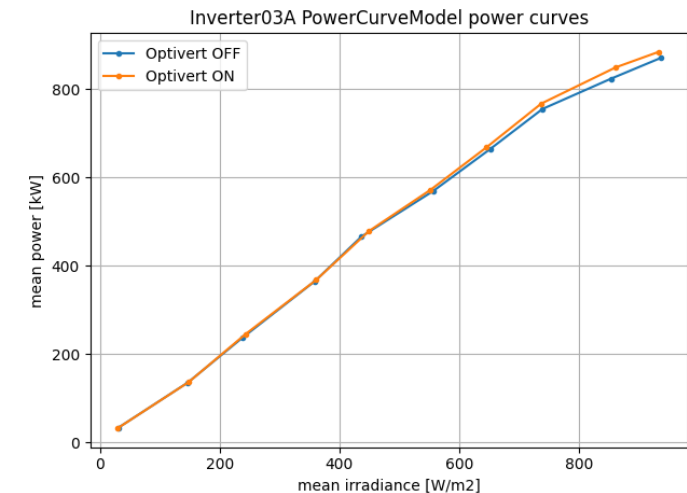
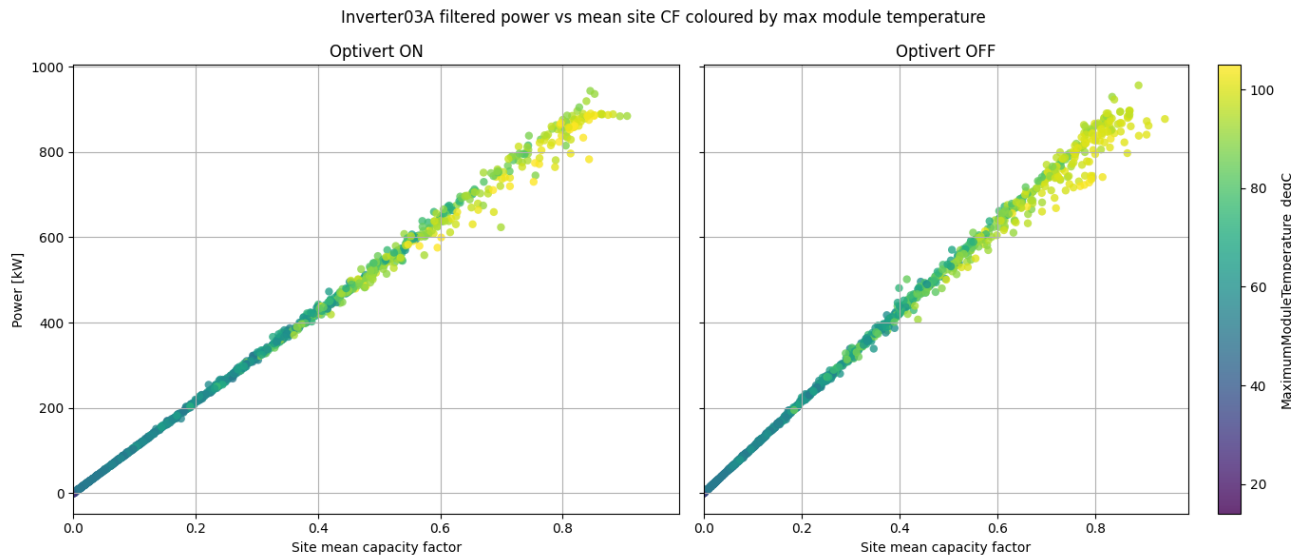
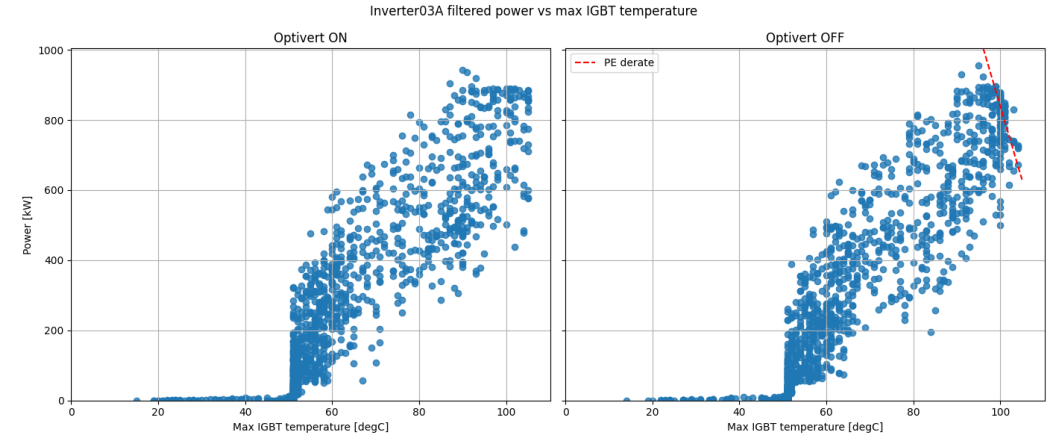


Example: intelligent curtailment during high temperature

This example showcases Optivert's ability to maintain temperature control with the least loss possible.

The baseline is when the OEM temperature derate feature is on, which avoids trips but sacrifices too much energy

The power curve with Optivert ON is clearly better. Optivert increases yield by 1.0% on this inverter.

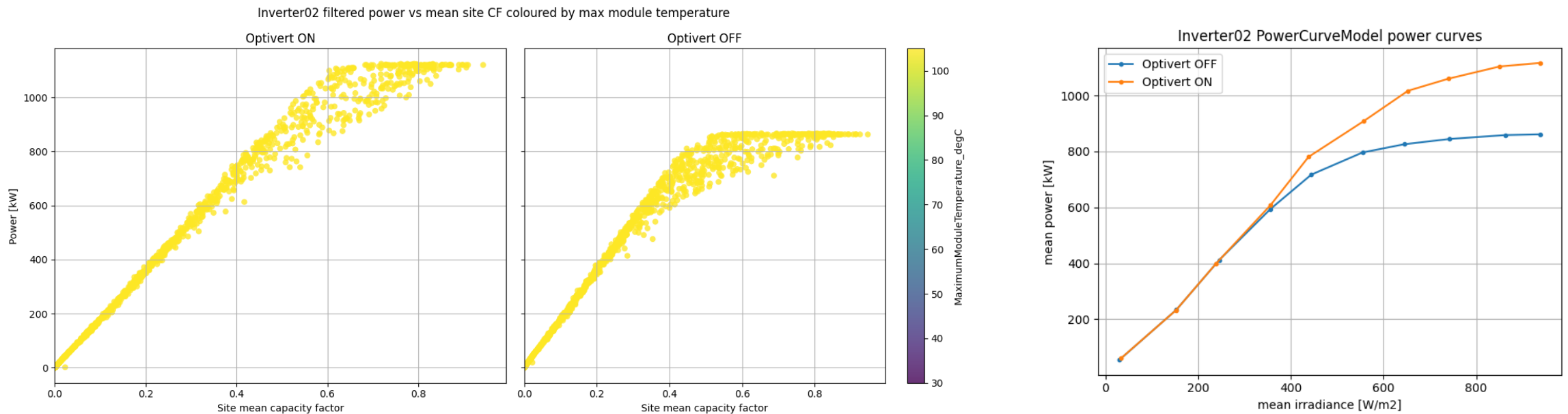


Example: fixing incorrect curtailment

In this example one of the offline inverter modules have an incorrect temperature reading (stuck at 105degC).

Despite the fact that this inverter module is disabled, the OEM curtailment feature still responds to the erroneous 105degC reading. Surprising bug in the OEM controller!

Optivert correctly ignores the erroneous reading and saves 13% energy.



Product development and next steps

Optivert



AEP Enhancement

	AEP Impact	Frequency
Inverter derate mgmt	●	●●
Sensor malfunction	●●●	●
Inverter unplanned event	●●●	●

AEP uplift during infrequent, large curtailment avoidance.
Some inverters will experience >1.0% uplift.



Operational Improvement

	Severity	Frequency
	●	●●
	●●	●
	●●●	●

Manage inverter faults during degradation/prior to IGBT failure
Lower risk of catastrophic events, e.g. inverter fire

+

HelioLive



Analytics

Finding additional

- Module faults
- String performance
- Curtailment req's

Dashboard monitoring site performance

Key takeaways

High inverter temperatures cause a myriad of risks, from AEP loss to catastrophic failure.

The risk increases as time goes by due to climate change (more days with extreme ambient temperature).

Optivert is a new retrofit solution by RES which mitigates these risks as proven in field trials.

The risk is further mitigated with advanced analytics of high frequency data provided by **HelioLive**.

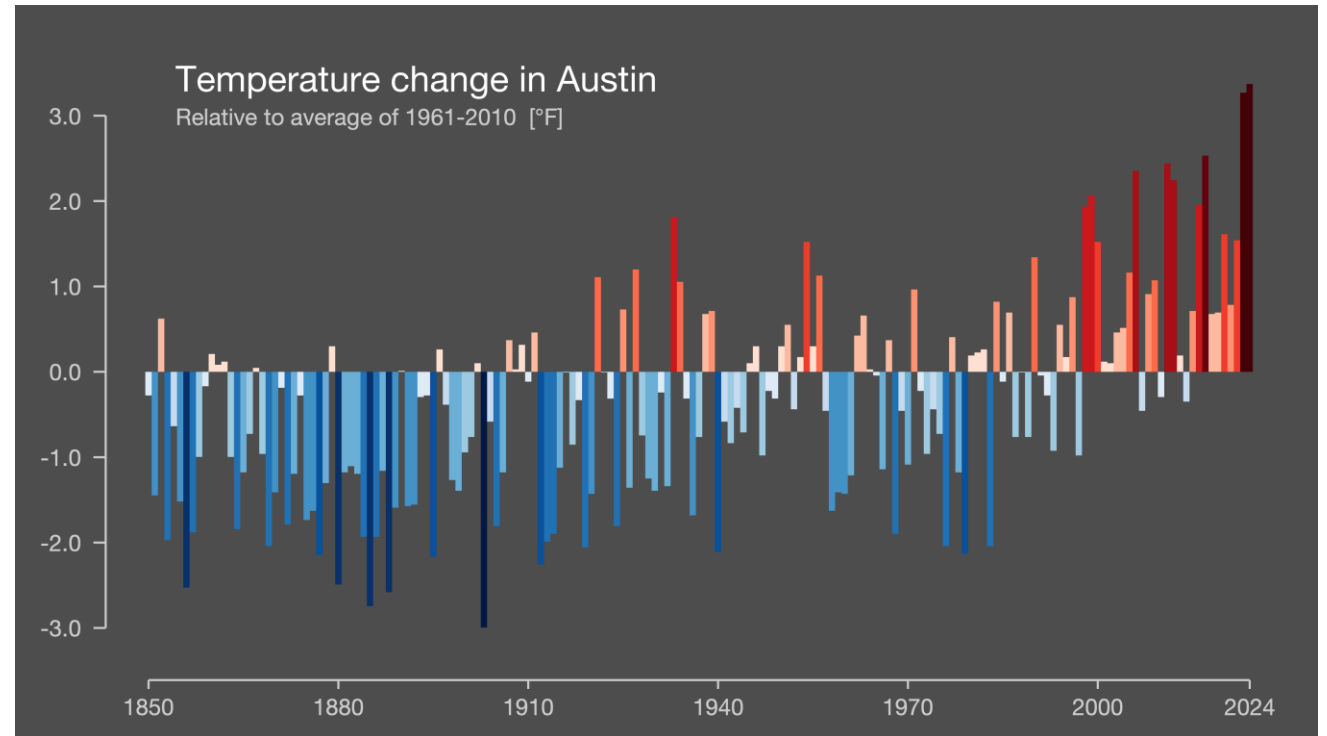


Image credit: <https://showyourstripes.info/>

Thank you!

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