

Shining Bright: Reliable, Sustainable and American-Made PV Backsheets

PVModuleTech 2023

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Endurans™ Solar: A global pv materials supplier

Experts in PV polymer science & manufacturing



2011-2021

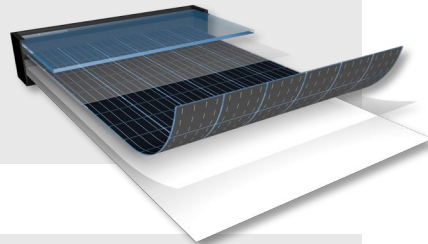


since 2021

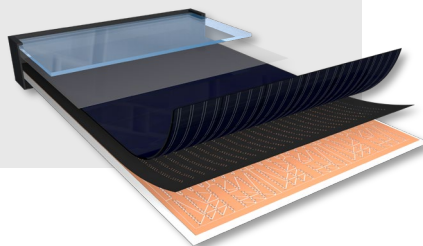


since 2023

High performance backsheets
Endurans™ HP



Conductive backsheets
Endurans™ CB



We believe that the solar industry has a huge role to play in creating a better, more sustainable future for our planet.

And we are making this a reality by boosting the performance of PV modules and developing solutions that are **circular by design**.

Backsheets

A critical module component.

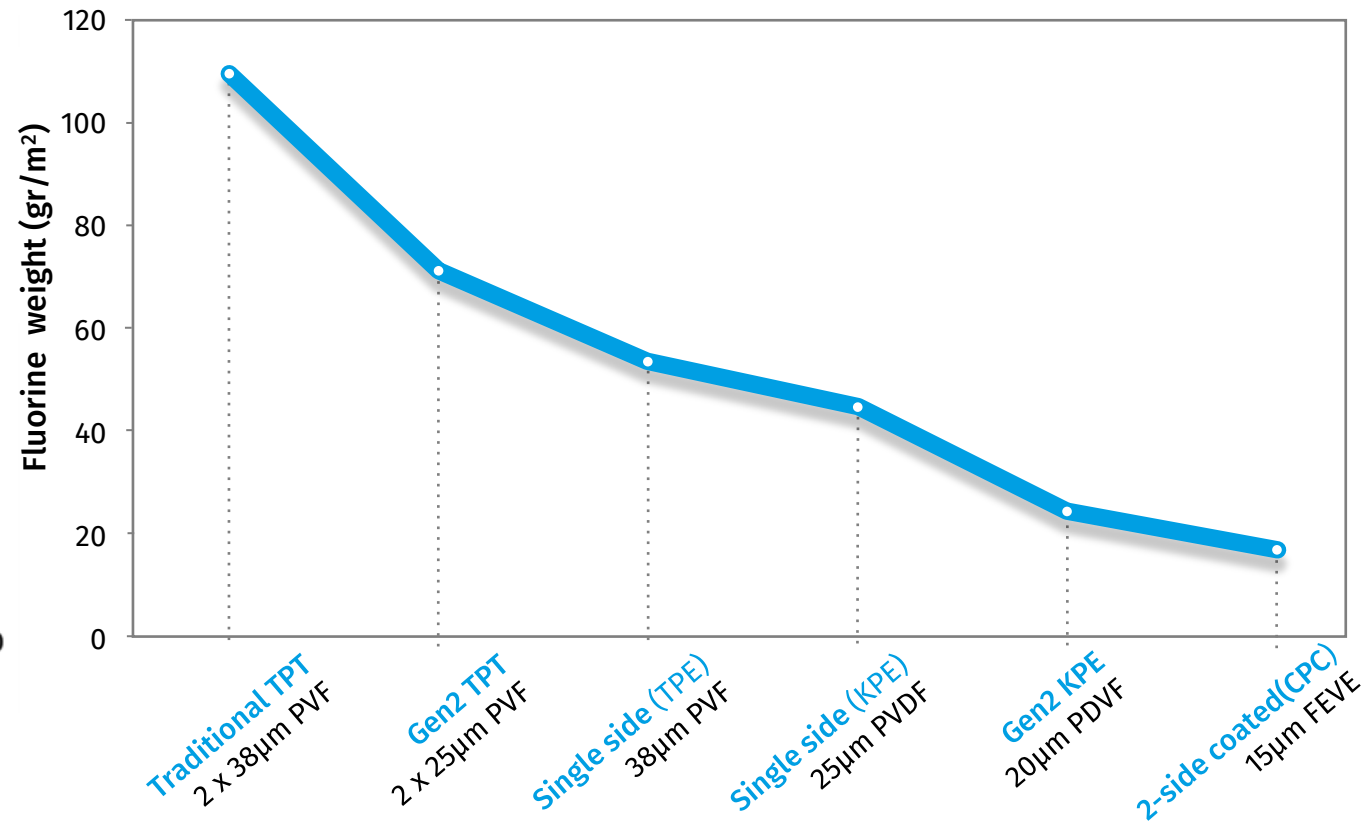
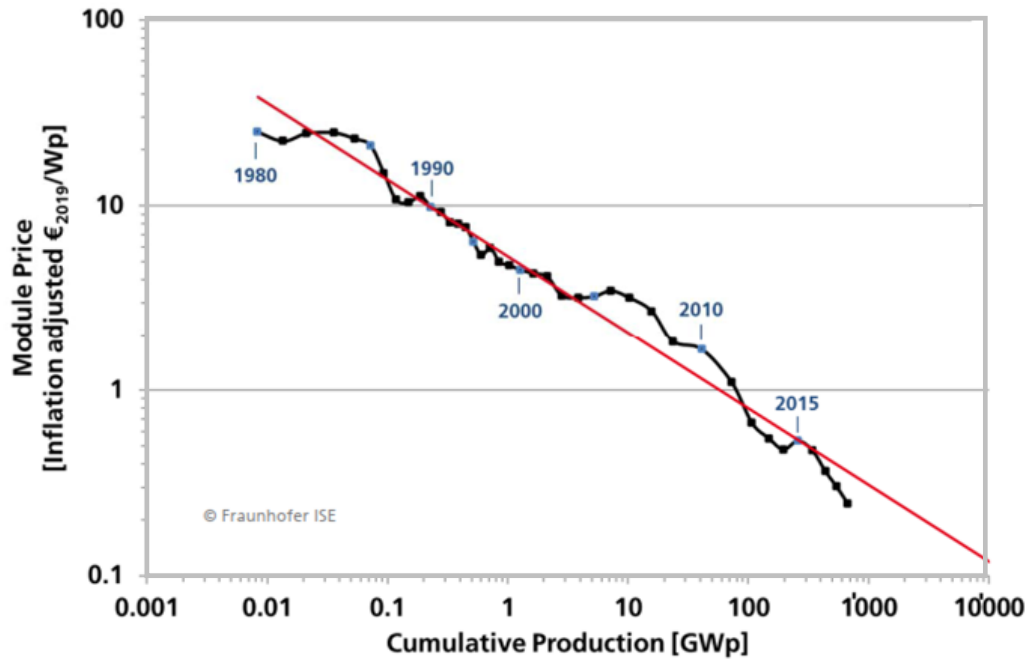
- Reliability
- Supply
- Sustainability



Market reality: severe price pressure of solar modules

Since 1980 every time cumulative production doubled, the price dropped by 25%

Under price pressure, protection of the PET core layer has decreased over time, compromising reliability



Backsheet failures in the field

Under price pressure, protection of the PET core layer has decreased over time

DuPont*

16% of all 3GW inspected modules showed backsheet failures

Solarbankability.org**

1.6 GW of the 160 GW PV capacity installed in 2020 risks backsheet failure. With a potential repair bill of **\$750 million**



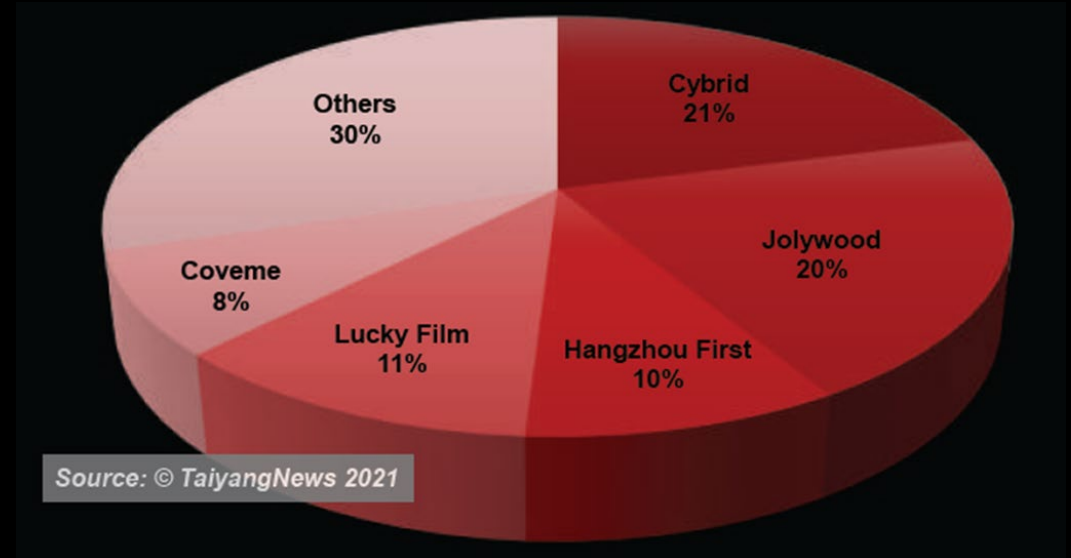
*Source: DuPont 2020 Global PV Reliability Report

** Source: www.solarbankability.org



Backsheet supply

- **Insecure supply chain** with ~ 85% from one country
- **High import duties** on backsheets imported from China
- Reliance on off-the-shelf base films supply. **Most backsheet suppliers do not directly control critical characteristics.**
- Risk of **high module end-of-life costs.** Dominant global market share of fluorine-based backsheets.



The PV waste challenge

By 2050* there will be enough solar panels installed on earth to stack a stairway to the moon and back.

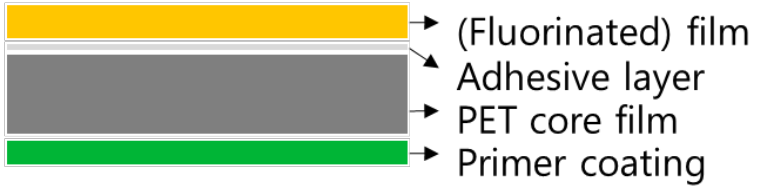


How to turn waste into value?

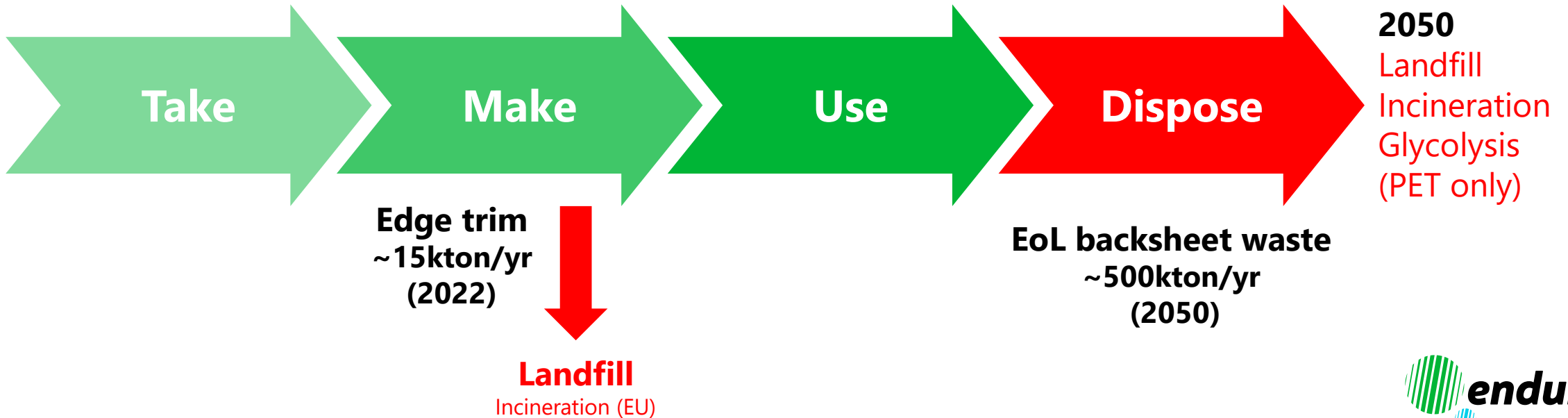
Traditional backsheets follow a linear model

Backsheet material choices made today will have big impact in 30 years

air side



- No option of low-cost mechanical recycling (re-melting)
- Tripling of incineration cost (fluorinated waste)
- Complex chemical recycling (multi-material film)



It's time for change



Our solution is different from traditional backsheets

Endurans™ HP: HPO technology

HIGH PERFORMANCE POLYOLEFINS (HPO)

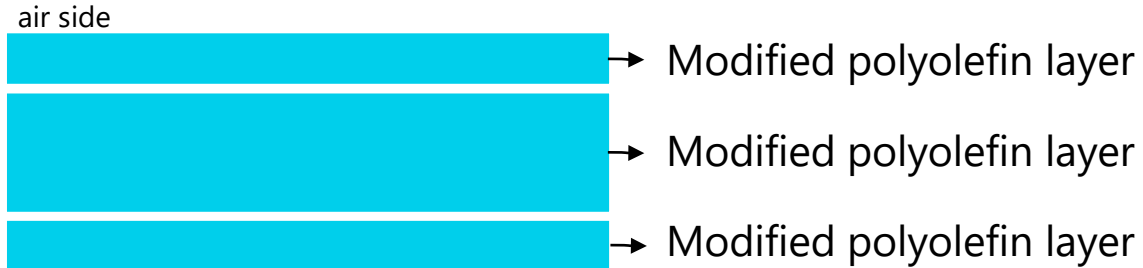
Always a **strong polyolefin core**
moisture & UV resistant polyolefin

Made via **co-extrusion** for
ultimate performance

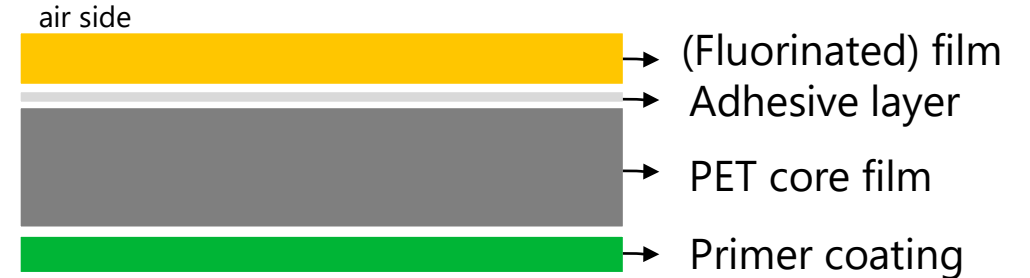


Endurans™ HP: designed to last

Strong robust polyolefin multi-layer backsheet with a mono-layer consistency



Endurans™ HP backsheet



Traditional PET backsheet

Polyolefins: proven in industry

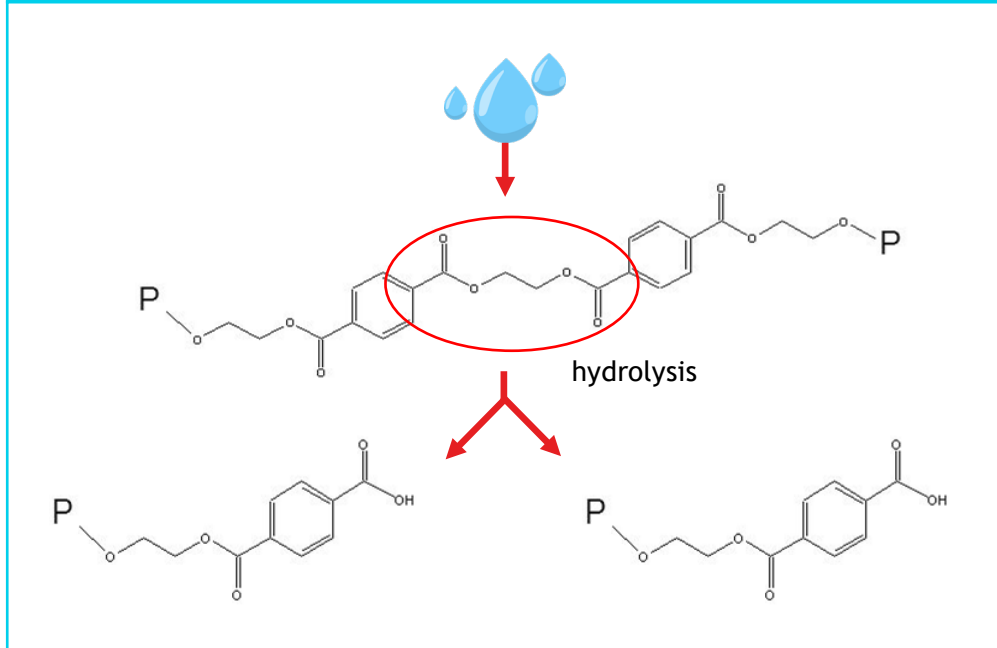
UV, hydrolysis, abrasion & acid resistant

Polyolefin pipes with >50-year lifetime in deserts, on the ocean, to transport hot liquids, acids slurries, in dishwashers, etc. Polyolefins in roof membranes with >30year lifetime exposed to sunlight, rain and temperature cycles.

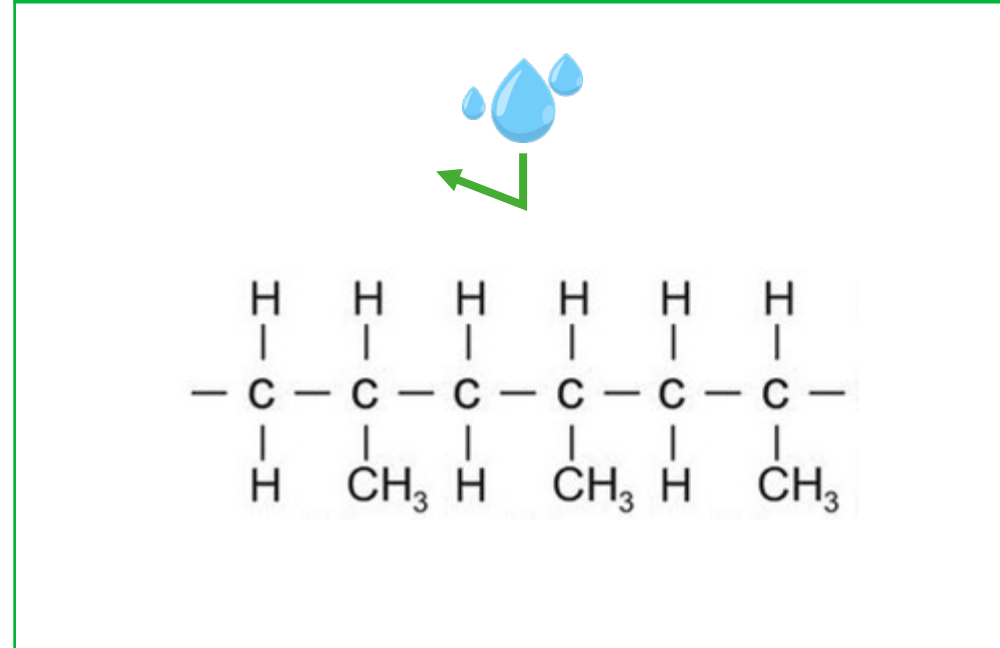
Robust polyolefin core

Excellent water barrier properties to adapt to new cell technologies

PET breakdown



(Modified) polyolefins (HPO)



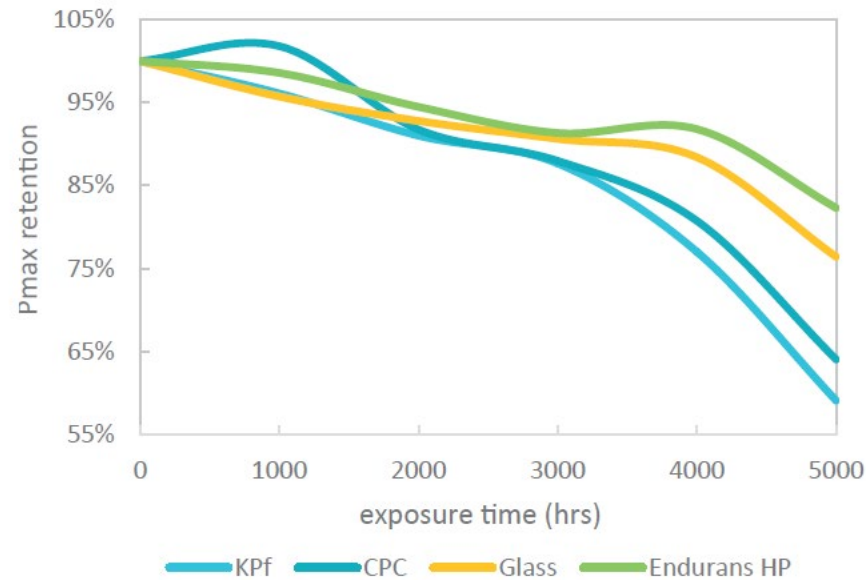
- Traditional backsheets use a PET core
- PET material is polar and sensitive to moisture and UV breakdown
- PET needs protective layers

- Modified polyolefins have non-polar electrical insulation
- Are resistant to hydrolysis and UV breakdown
- Have extremely low water-vapor transmission rate

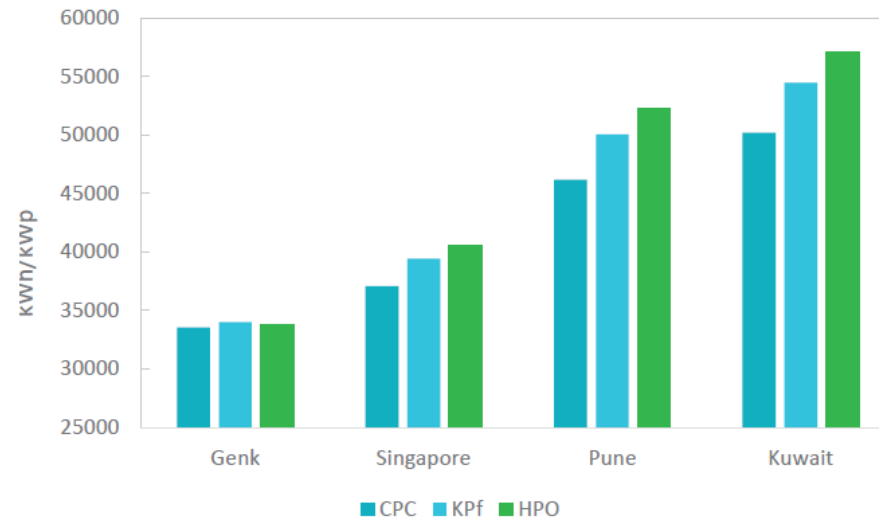
Backsheet performance

Endurans HP: excellent performance due to strong HPO core

Damp heat aging of mini modules: Power retention



Impact of backsheets on Lifetime Energy Yield (30 years simulation)



Source: Extensible TEUE119008 Public summary report 27-11-22



Endurans™ HP: strong track-record

~20
million

Panels using
Endurans™
backsheets

~6
GW

Installed
globally

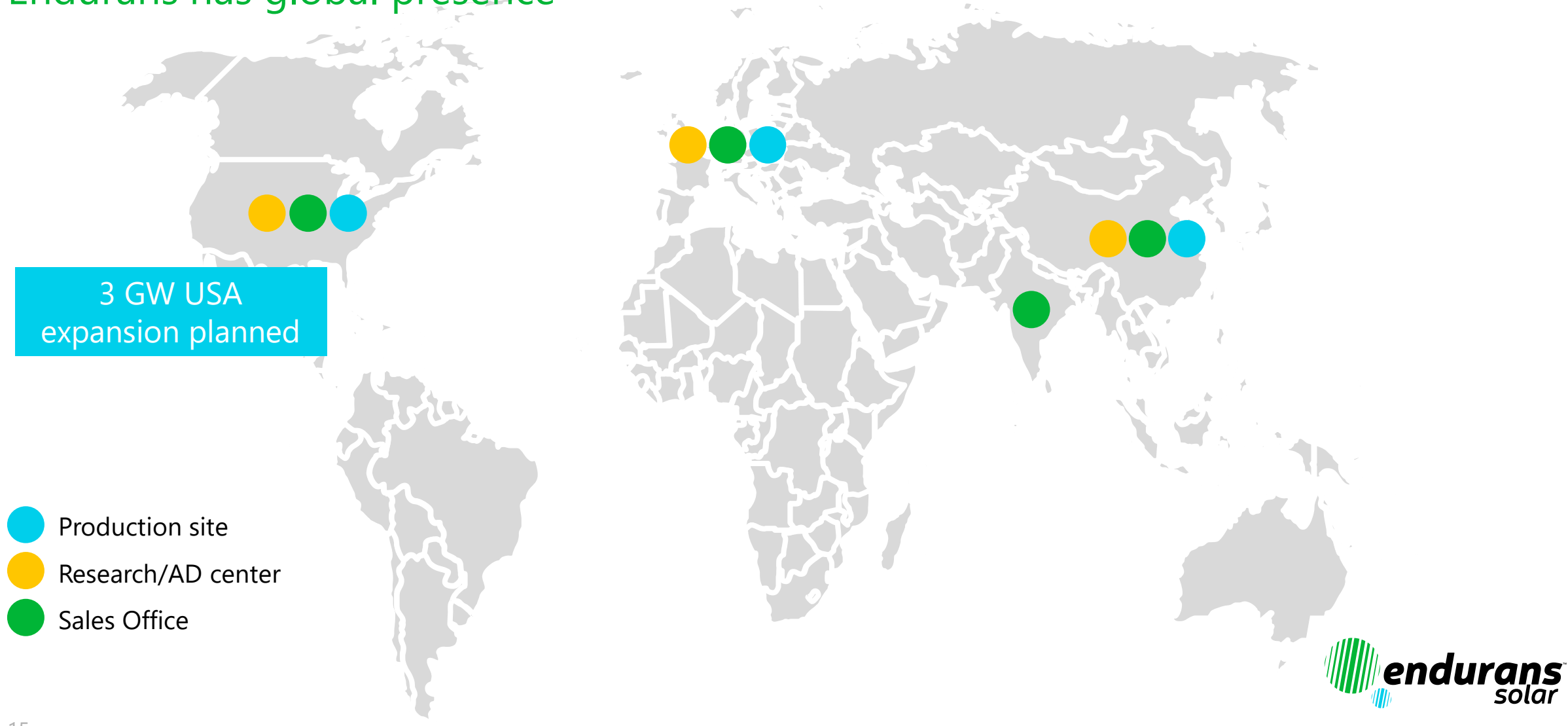
> 8
years

Performance
track record



Backsheet Supply

Endurans has global presence



Made-in-America backsheet

Only active US backsheet manufacturer

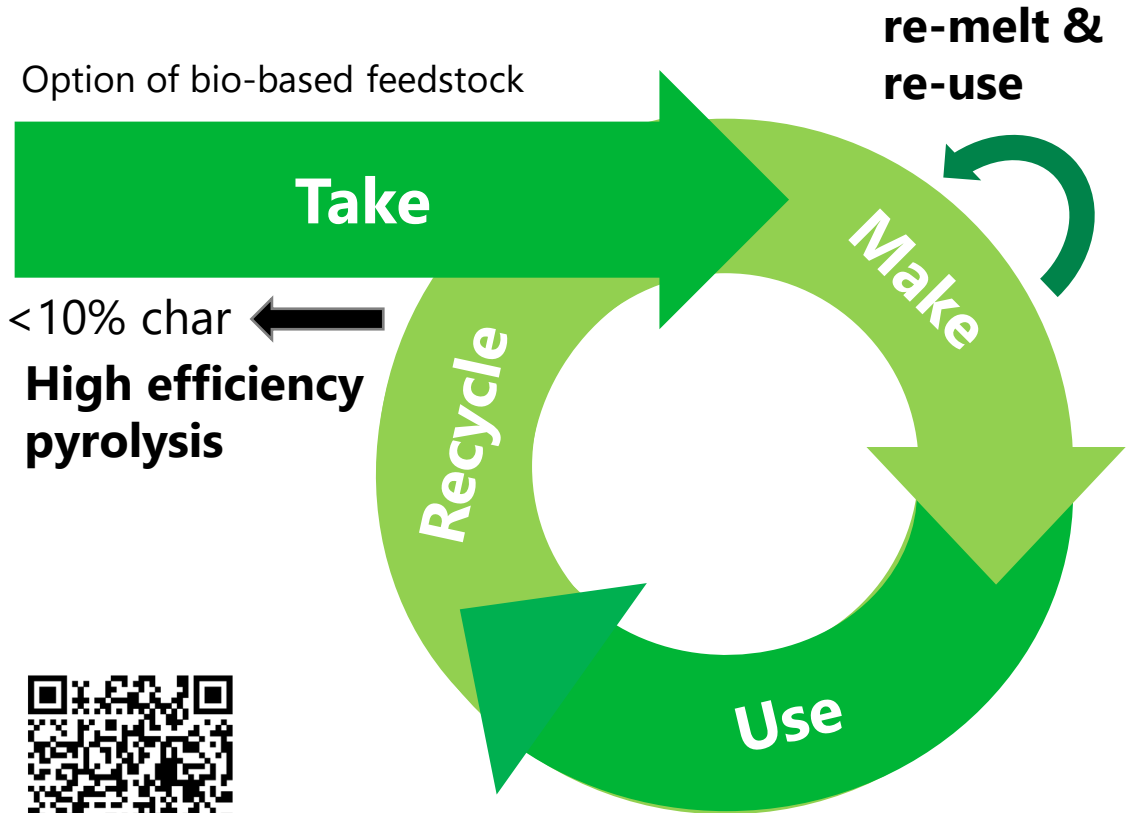
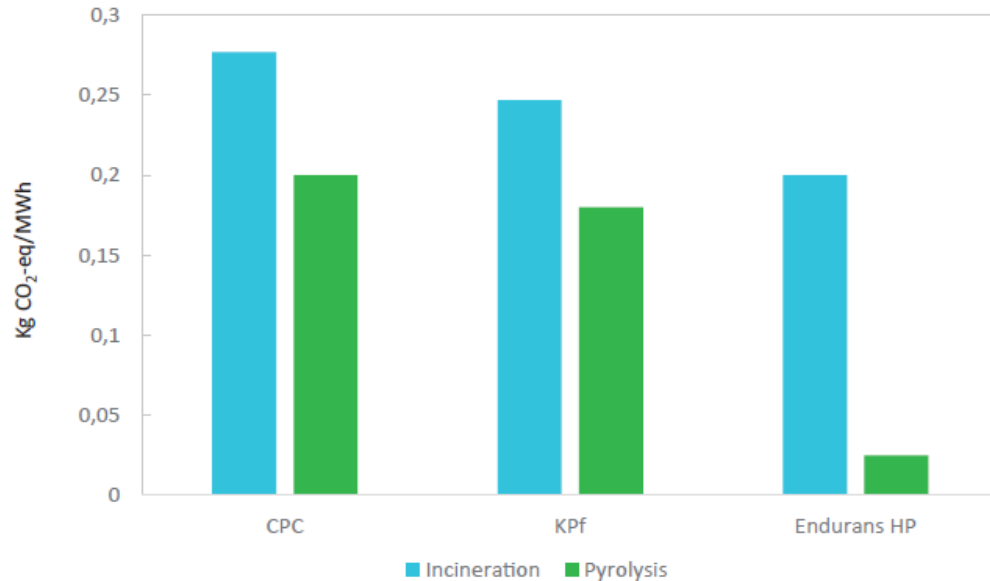
- Local supply & team
- Easier logistics
- Maximize IRA benefits (domestic content)
- No import duties
- Lower logistic carbon footprint
- We are hiring!



Endurans HP: fully recyclable

Lowest carbon footprint per MWh produced

Carbon footprint of backsheets over a 30 year simulated module lifetime: Cradle-to-cradle emissions per MWh produced³.



Source: Extensible TEUE119008 Public summary report 27-11-22

Innovation Pipeline



New product development

Drive for cost reduction, higher performance and sustainability

Backsheet
engineered
for bifacial
modules

High-
performance
Encapsulants

Rear
Perforated
Insulator for
back-contact
modules*



Polymer backsheet for bifacial modules

A simpler, high-yield alternative to glass

For module makers:

- Lower manufacturing costs
- Lower panel costs
- Lighter weight
- Stable pricing

For EPC / project developers:

- Higher energy yield potential
- Lighter weight
- Suitable for areas with high hail risk
- Excellent durability



It's time for change.

Join us.

#ForwardThinkingBacksheets

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Polyolefin co-extruded backsheets (Endurans™HP) have passed assessments and tests done at a/o UL, PCCL, DuraMAT, TÜV-SÜD, CPVT, NREL, Enertis, Black&Veatch IMEC and SmartGreenScans. For more info contact us at info@endurans.com.



Same sun. More power.™

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