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# The SIGN AGAIN guidebook.



**PVC banner shreds thermally pressed into a recyclate panel.**

By Amber Markus
Made possible by TU Delft and Horizonteer

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This guidebook is designed to provide accurate and authoritative information on the print and sign industry. It is spread with the intention to convince people to take the sustainable route when given the choice. The author will not be held responsible for the consequences of any actions and/or decisions taken as a result of any information given or recommendations made.

## Table of content

Introduction_____1

The core problem_____2

The solution _____3

Sign Again_____4-7

Materials with similar properties comparison _____8-10

Materials within similar industries comparison _____11-13

Sign Again processing methods _____14-15

The end of life _____16-17

## Introduction

### Why should you read this?

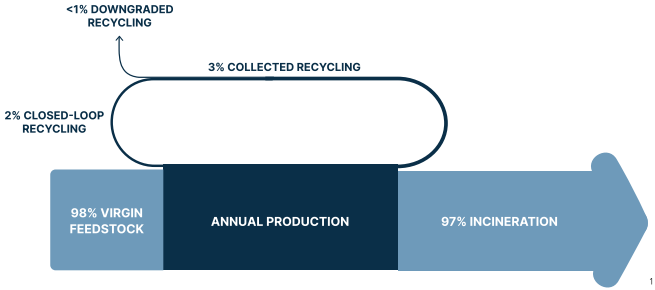
Welcome to the Sign Again guidebook. Currently, the print and sign industry operates on a highly linear, disposable model where materials are used briefly and subsequently discarded. With upcoming EU Circular Economy legislation and Extended Producer Responsibility (EPR) mandates, this 'take-make-use-dispose' approach will soon become a costly financial and regulatory liability.

This guidebook is designed for people who are interested in using recycled material to produce sustainable products and who want to future-proof their operations. It provides transparent, tested data on Sign Again, a recycled composite material made from PVC banner waste. By reading this, you will understand how to practically work with this unique material, how it compares to virgin plastics and how you can integrate it into profitable, circular business models that actively reduce your carbon footprint.

# The core problem

## Why does the system need to change?

The material loop is barely closed due to a fragmented stakeholder system. The figure below shows how much material is lost in the loop, there is lack of a take-bake system and incentive for producers, manufactures and consumers alike to make sure the materials go back in the system for reuse.



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Today, 97% of PVC banners end up in incinerators after a single use. Why is this number so high? Traditional banners are a monstrous hybrid material, a permanent fusion of polyvinyl chloride (PVC) coating and polyester (PET) woven fibers. Due to a thermal mismatch, PVC melts at 170–190°C while PET requires 260–280°C, makes them chemically incompatible for high-quality recycling. So, these materials cannot be economically separated using standard recycling methods, they are rejected by traditional recycling facilities and sent to be burned or end up in a landfill. As disposal costs and incineration taxes continue to rise, the industry desperately needs a viable alternative to keep these valuable plastics in use.



2

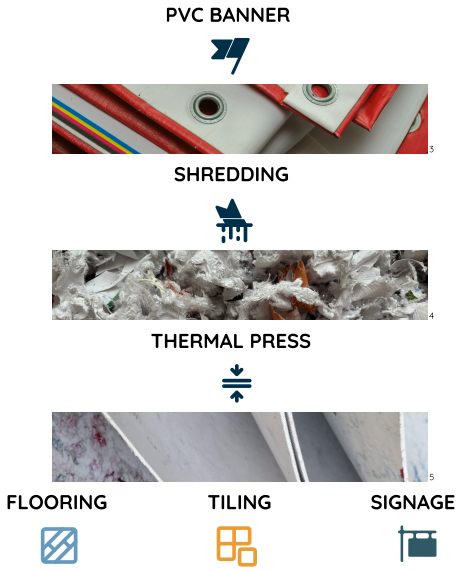
1 Material flow of PVC banners (based on Ellen McArthur Foundation, 2019)
2 Image of banner (FSEID, 2025



# The solution

## What is a solution to move towards a circular economy?

Instead of attempting the nearly impossible task of separating the PVC from the PET, the Sign Again process embraces the hybrid nature of the waste. The used banners are collected, shredded into coarse fragments and thermally pressed into heavy yet flexible composite panels. By turning lightweight banners into dense panels, we capture kilograms of waste rather than grams (2.8-5.6 kg/m²).



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However, achieving a true circular economy requires more than just new materials, it requires new business models. To maximise the value of Sign Again, we recommend transitioning to Product-Service Systems (PSS). Instead of simply selling a sign or a floor panel to be eventually thrown away, manufacturers can lease modular event flooring, reusable road plates or temporary signage. By incorporating a take-back scheme into the service, the material is guaranteed to return to the manufacturer, completely closing the loop.

3 PVC banner (FIXME source)
4 Shredded PVC banner (image from author)
5 Sign Again panels (image from author)

## What is Sign Again?

Sign Again is not a one-to-one replacement for virgin plastics, it is a unique composite with distinct mechanical behaviours and properties. Here is what the technical data means for your designs:

| **Properties.** | | |
|---|---|---|
| Price | 4.29-6.14 | EUR/kg |
| Density | 1400 | kg/m^3 |
| Young's modulus | 90-270 | MPa |
| Yield strength | 2.00-5.30 | MPa |
| Tensile strength | 3.50-6.75 | MPa |
| Flexural modulus | 160-815 | Mpa |
| Flexural strength | 20-30 | MPa |
| Hardness - shore D | 49-61 | |
| Water absorption | 0.4-3.38 | % |



**Price (4.29 – 6.14 EUR/kg)**

This sits at a mid to high range price point. However, this price reflects true cost of local mechanical recycling and a reduced carbon footprint.
Design implication: Justify the cost by leaning into the material's circular storytelling and the upcoming taxes on virgin plastics.

**Density (1400 kg/m³)**

Sign Again is a heavy, dense composite. It outweighs many lightweight plastics and natural materials.
Design implication: Use this weight as an asset. It is ideal for ground-based, stable applications like event flooring, heavy tiling, road plates or wall tiling where weight provides stability

'Sign Again is best suited for compressive or low-load applications, such as protective road plates, event flooring, siding or wall tiling, rather than weight-bearing structural frameworks.'





**Young's Modulus (90 – 270 MPa)**

This measures how stiff the material is when pulled. A low score indicates that the material is highly elastic and will stretch significantly before it permanently deforms.

**Yield Strength (2.00 – 5.30 MPa)**

This is the exact amount of stress it takes to permanently warp the material. Because this number is relatively low, Sign Again yields easily under pulling forces.

**Tensile Strength (3.50 – 6.75 MPa)**

This is the maximum pulling force the material can take before it physically tears.
Design implication for these three: Because of its shredded, fibrous composition, the material tears under heavy tension rather than holding firm. Do not use this material for hanging heavy structural loads or in high-tension applications.

'Designers must embrace its heavy, ductile and heterogeneous nature. This can be achieved by utilising it in modular, compressive and impact-resistant applications where its specific technical quirks become assets rather than liabilities.'

**Flexural Modulus (160 – 815 MPa)**

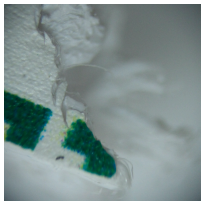
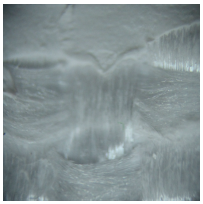
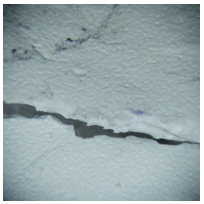
This represents the material's resistance to bending. This range means the material is highly ductile, it bends deeply under a load instead of snapping or shattering.

**Flexural Strength (20 – 30 MPa)**

The maximum bending stress it can take before structural failure.
Design implication for both: The material has excellent impact absorption. If it is dropped or struck, it will yield rather than break. It performs exceptionally well in compressive, flat applications (like flooring) rather than spanning wide, unsupported gaps where it might sag.

**Hardness (49 – 61 Shore D)**

This classifies Sign Again as a medium-hard, semi-rigid material.
Design implication: While its softness prevents it from shattering, it makes the surface susceptible to cosmetic scratching, gouging and localised indentation. Product designs should embrace its speckled, textured aesthetic, which helps hide surface wear over time.

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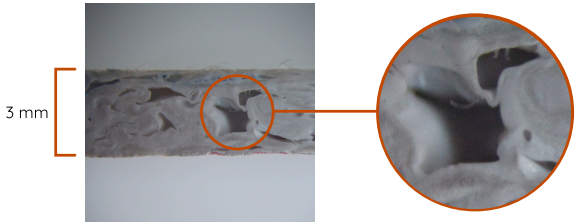
**Water Absorption (0.4 – 3.38%)**

The material is largely water-resistant, making it viable for wet environments. However, because the pressed shredded fibers create microscopic internal channels, it is not 100% waterproof.
Design implication: For permanent outdoor installations, seal the exposed edges to prevent moisture from seeping in and causing freeze-thaw damage.

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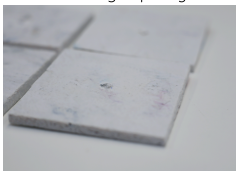
6 Microscopic images of Sign Again (image from author)
7 Microscopic images of side view of Sign Again (image from author)





**Screw pull (260 - 735 N / material strip)**

Tests show that the primary failure mode is material stripping, where the screw tears through the composite rather than snapping the fastener. This is due to the material's heterogeneous density.
Design implication: Designs must avoid single-point, high-tension screw connections. Instead, mechanical loads must be distributed using bolts with washers, threaded inserts or interlocking modular joints that do not rely on the material's internal thread-holding capacity.

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'Designers must consider the potential for edge-swelling or freese-thaw damage, potentially mitigating this by sealing exposed edges or designing products that allow for thermal expansion.'

When evaluated against traditional virgin materials, Sign Again occupies a unique niche in the market. It is significantly stiffer and more resilient than flexible elastomers like butyl rubber or leather, yet remains far more yielding and flexible than highly rigid structural plastics such as ABS or pure PET.

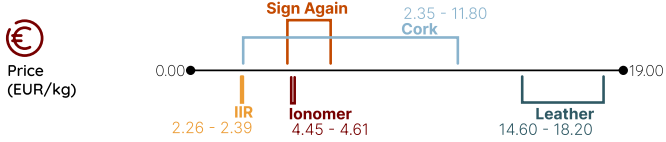
Beyond its mechanical performance, the material offers a distinct aesthetic advantage. Unlike the uniform, pristine finish of virgin plastics, Sign Again features a speckled, textured appearance derived from shredded coloured banners. This characteristic serves a practical function by naturally camouflaging surface wear; to further minimise the visibility of scratches, the application of a matte or embossed finish is recommended. In a market where clients actively seek 'visible circular stories,' this recycled aesthetic serves as a powerful, transparent communication tool to showcase a brand's commitment to sustainability. On the other hand, the material can be easily printed on top of to without the visual texture obstructing the new design.

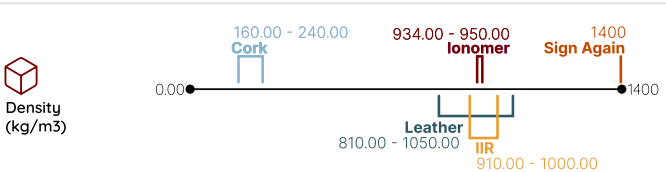
8 Images of Sign Again before and after a screw pull test (image from author)

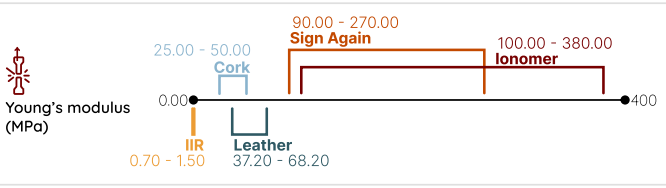
## How does Sign Again compare?

There are some materials which have some overlapping material properties. This is based on the Young's modulus, yield strength and tensile strength. These can be found below.

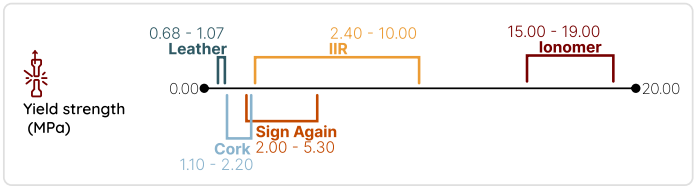
- Sign Again
- Ionomer
- IIR (isobutylene isoprene rubber)
- Cork
- Leather

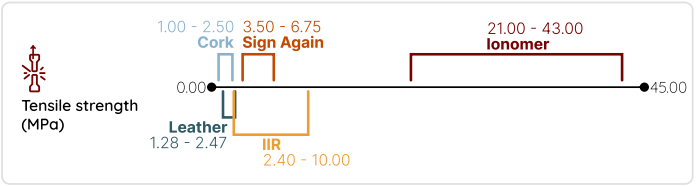


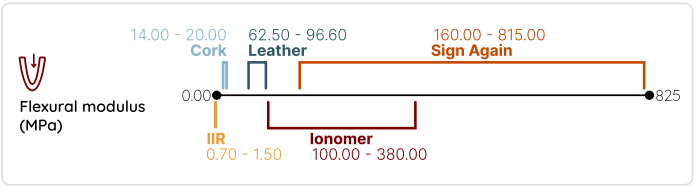



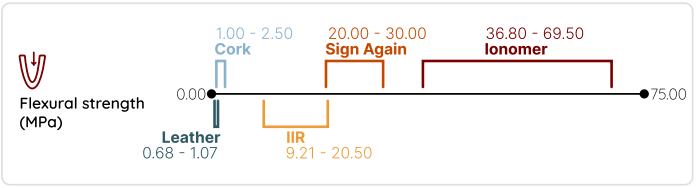





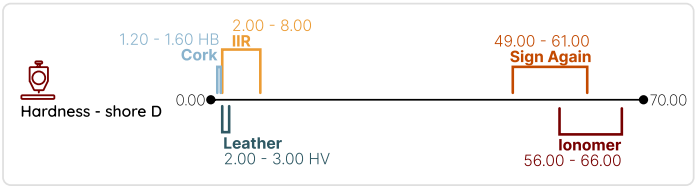



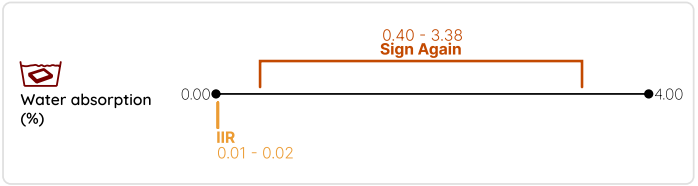



# Materials with similar properties comparison




*HB=Brinell Hardness, HV=Vickers Hardness - these are different units and can not be compared 1:1 to Shore D



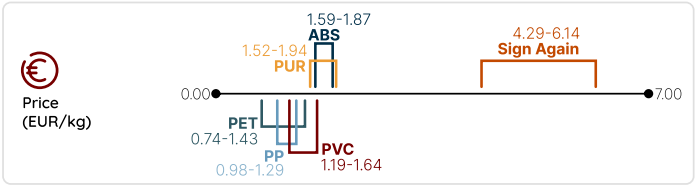

*Database didn't offer data for other materials

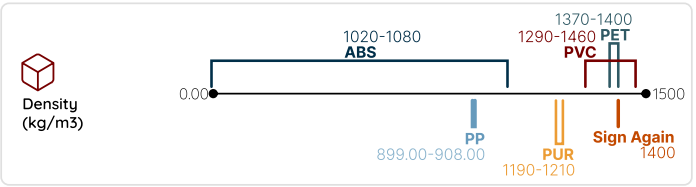
# Materials within similar industries comparison

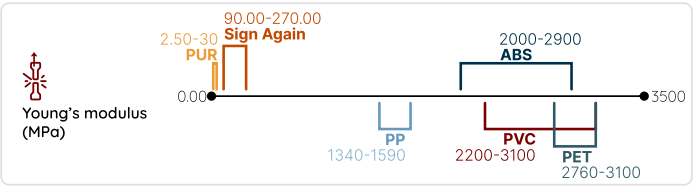
## How does Sign Again compare?

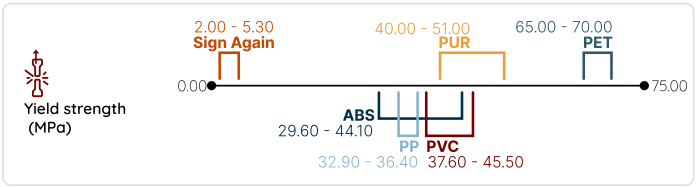
Sign Again is compared to materials which are used in the industries where the composite is already on the market. Here we look at (temporary) flooring, wall tiling and signage.

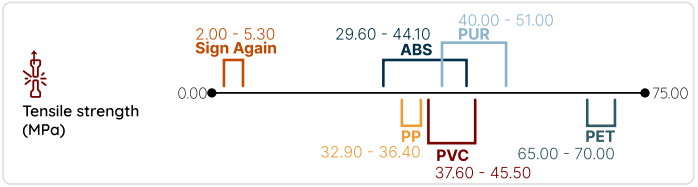
- Sign Again
- ABS
- PVC
- PET (polyethylene)
- PUR (polyurethane)
- PP (polypropylene)

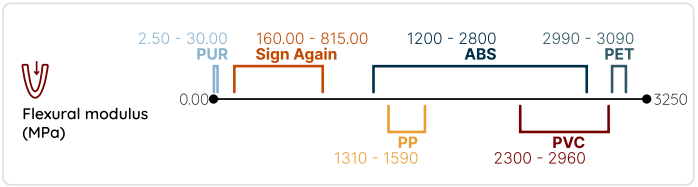


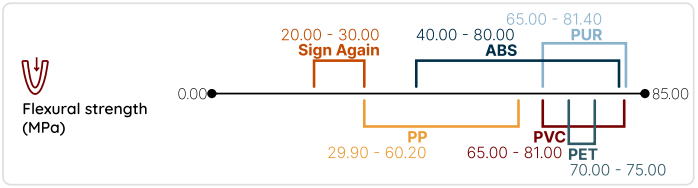





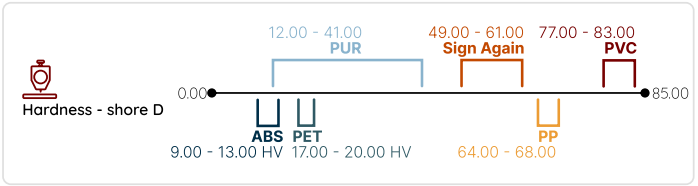






Materials within similar industries comparison

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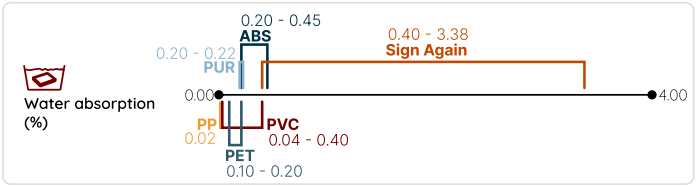


## Altering.

Working with a recycled composite requires specific handling to ensure safety and durability. To get the panel material into smaller pieces there are a few recommendations for an accurate and clean cut found below.

CNC/ZUND | Drilling | Box cutter | Water jet | Guillotine

## Clean it up.

If the edges are rough from cutting the material, there are some strategies to get it more smooth through the use of sandpaper or a CNC machine.

Sandpaper | CNC

## Fastening.

To connect pieces of Sign Again to each other there are some ways to do this effectively, like with screws or PVC glue. The panel material can also be attached to other surfaces using screws, nails or tracks.

Nails | Screws | PVC glue | Tracks

## Watch out.

Any saw blades or large drill bits will create very rough edges, however, it is efficient in cutting the material.

⚠ Drilling | Electric saw ⚠





## Avoid.

Avoid anything that significantly heats the material while processing it, to minimise toxic gas emissions, such as laser cutters. An other option would be to have very good airflow and filters capturing the emissions.

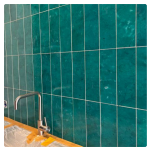
⚠ Laser cutter ⚠

## Applications.

Now you are probably wondering how this recyclate can actually be applied in real world applications. Below are some examples of what is already produced from Sign Again, but there are still many options to explore and experiment with.

WAY FINDING | FLOORING | TILING | DIVIDERS

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**AND MORE..**

To get a better idea of what the material feels like and how it compares to the materials mentioned in this guidebook get in contact with Horizonteer, Igepa or other companies carrying Sign Again and ask for a sample. The texture board below accompanies the guidebook by giving you a tactile experience. This can also be found at the mentioned companies.





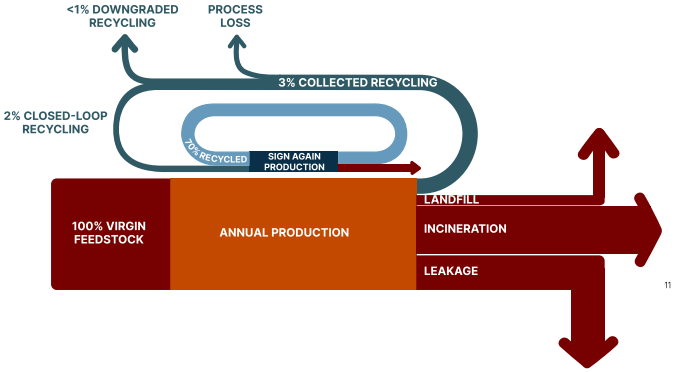



10

9 Images of current applications of Sign Again (FIXME source)
10 The Sign Again texture board to give the user a tactile experience (Images from author)

## How can Sign Again be recycled?

The lifecycle of Sign Again does not end after one application. The sheet material can be mechanically recycled up to 7 times while retaining its core properties. At the end of a product's functional lifespan, whether it is a scratched floor panel or an outdated sign, the material must be returned through a designated take-back scheme. Upon return, the old panels are simply re-shredded and pressed back into brand new boards. By participating in this reverse logistics system, you ensure that this material lives its full potential and achieving a regenerative circular economy within the print and sign industry.

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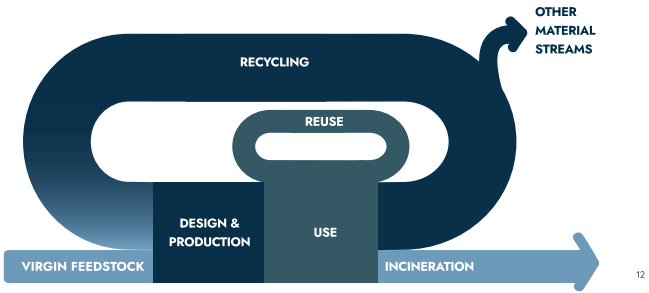


12

*11 Material flow of PVC banners into Sign Again loop (inspired by Ellen McArthur Foundation, 2019)*
*12 Circular economy ideal to be achieved in nearby future (inspired by Ellen McArthur Foundation, 2019)*





As is clear from the images on the previous page, Sign Again is not the almighty solution to reach a zero waste system. PVC needs to be phased out throughout the years as there is no way to sustainably process it. It is necessary to use mono material products to recycle better or move to materials which are biodegradable.

## Circular checklist:

VALUE IS LOST

- Refuse
  Do not buy virgin material if you get the choice.
- Rethink
  Transition leasing panels rather than buying them to guarantee recovery.
- Reduce
  Optimise your project layout to minimise off-cut waste and maximise material yield. To keep your product in use longer, you can seal all exposed edges against the weather and choose textured finishes that mask surface scratches from foot traffic.
- Reuse
  Avoid permanent adhesives and instead use bolts and washers so that you can easily disassemble the installation and use the panels again for your next project.
- Recycle
  At the very end of the product's life make sure your panels are returned to be shredded into a brand-new generation of Sign Again.
- Recover
  If the material becomes too degraded or contaminated after multiple lifecycles to be shredded again, ensure it is sent to a controlled waste-to-energy incineration facility rather than a landfill.

By following these steps, your are personally ensuring that your project never contributes to the 97% incineration rate, but instead stays within a regenerative loop. For more information go the the Sign Again website or get in contact with the collaborating partner Horizonteer.

**signagain.com**

**horizonteer.nl**

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