SUSTAINABLE OR SUS?

CONTENTS: A Crash Course in New Material & Textile Innovations - What to Know & What to Look Out For

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Sustainable Design Theory & Practice

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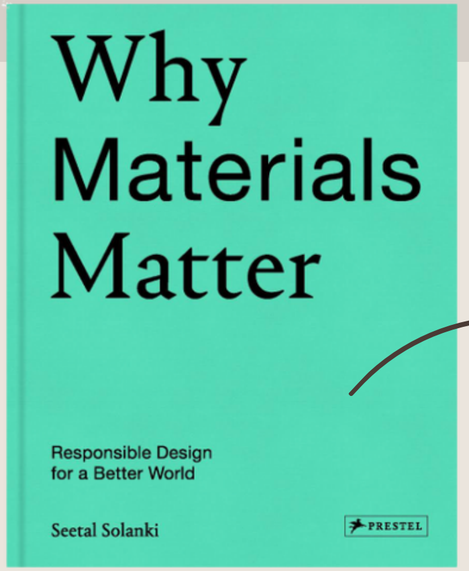
Spiber's Brewed Protein

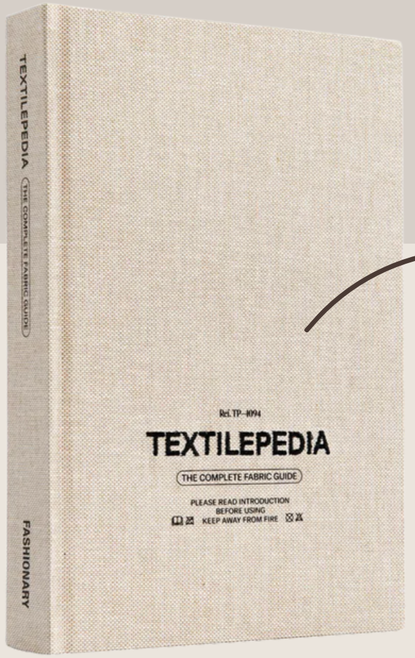
Various lab-grown materials

NEW AGE MATERIALS

Having taken an interest in materials for all of my design projects, I wanted to keep the tradition going to have an overall cohesive collection of work to showcase.

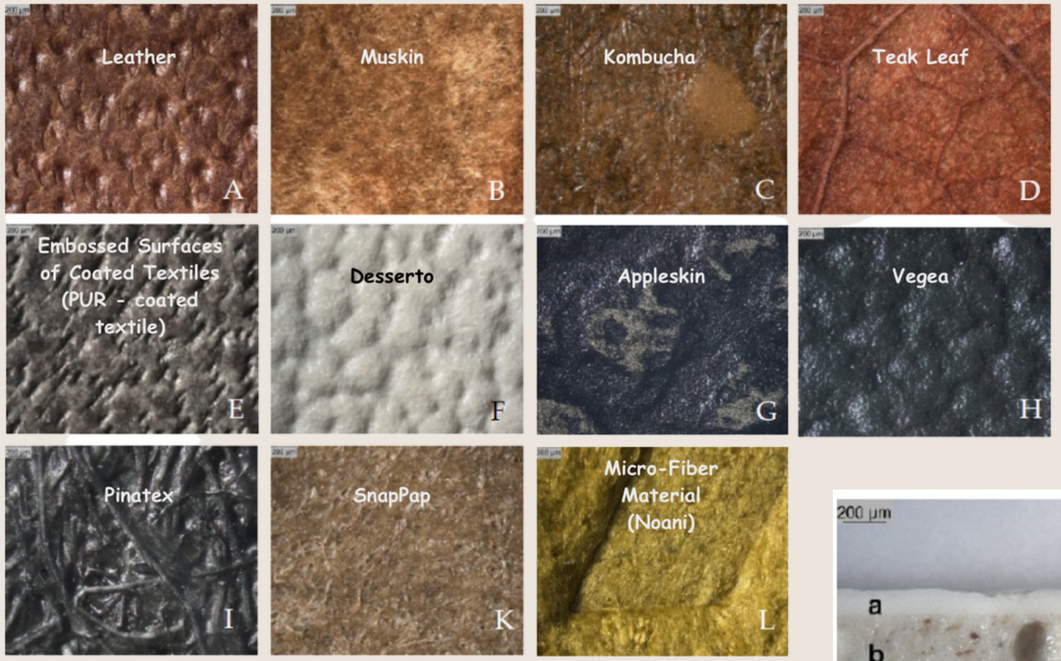
PRECEDENTS





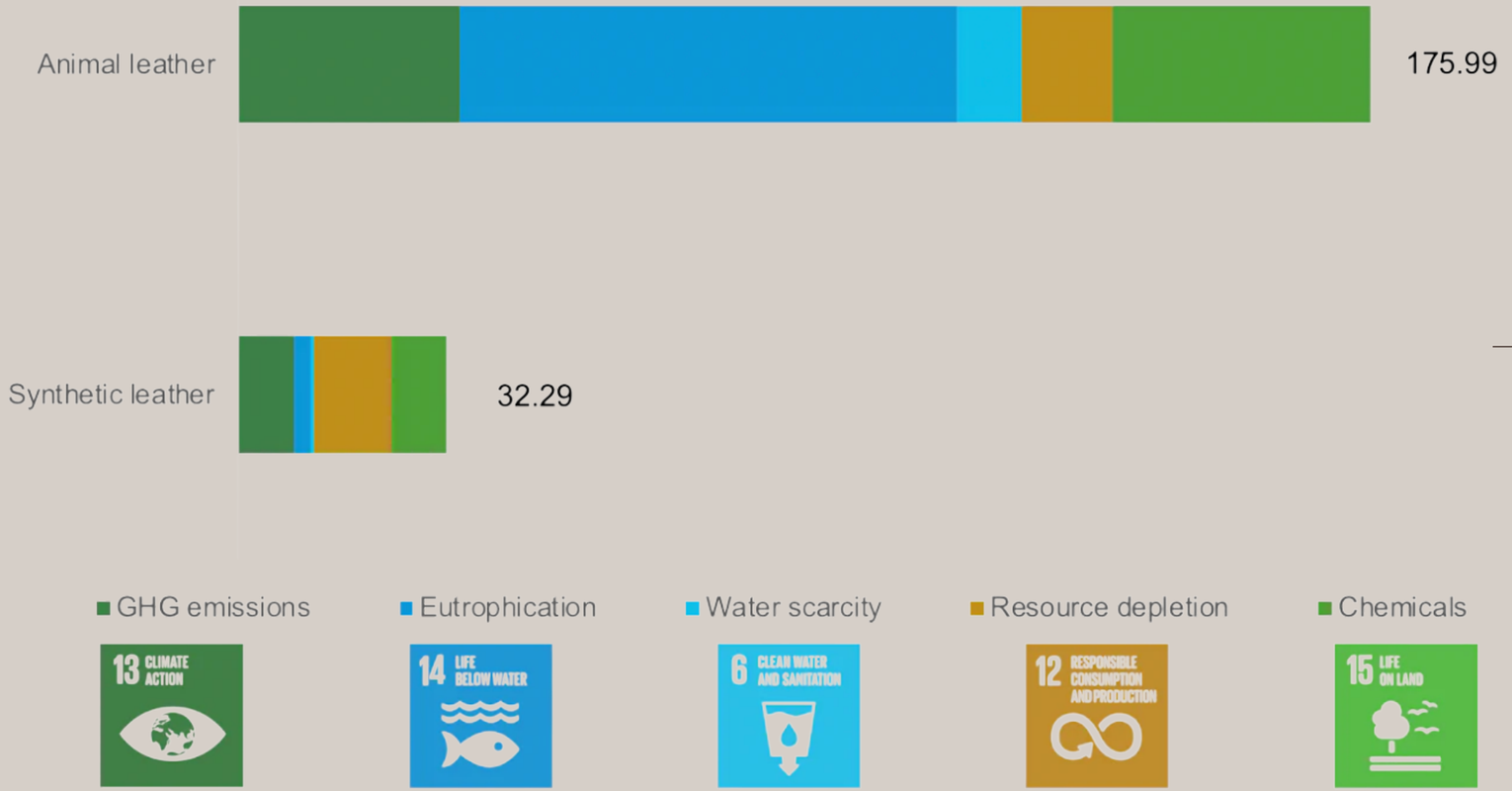
Taking inspiration from books on materials and textiles.

RESEARCH ON NEW TEXTILES



"Beware of greenwashing - although manufacturers advertise with terms such as 'plant leather,' 'plant-based' or 'apple leather made from apple residues', the materials are in fact only partial of plant origin."

Figure 3 – A microscope image of Desserto, showing (a) the top polymeric coating, (b) the foamed polymer and natural material layer and (c) the synthetic textile backing. Reprinted from https://www.mdpi.com/2079-6412/11/2/226



Environmental Impact of Animal Leather vs. Synthetic Leather. The higher the number, the more harmful is a material for the environment. (© Melina Bucher, based on HIGG Material Index)

LEATHER RABBIT HOLE

- Studies show that leather has about 5.5 times the environmental impact than PU-based leather.
- Leather is not a natural product. Animal skins and hides are which can biodegrade, but because leather typically goes through a lengthy tanning process where collagen fiber is stabilized and prevents the skin from rotting, leather cannot biodegrade.
- Did you know that even traditional luxury brands such as Gucci & Louis Vuitton, use coated leather or synthetic leather as durable materials in their collections? Their monogram bags are made of coated faux leather.

FEEDBACK

From handbag designers to my own co-workers, here are some of their thoughts concerning new textile and material innovations

Anya Hindmarch

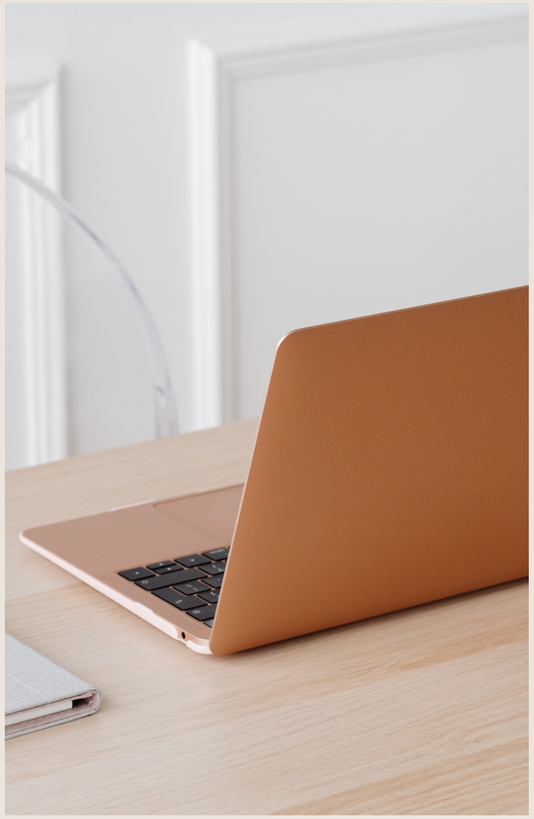
Handbag Designer

"leather, farmed in a regenerative way which is then tanned & finished in a responsible way, is often the most sensible solution when a byproduct of the meat industry"

Bill Amberg

Leather-Based Interiors & Furniture Designer

"But in terms of replacing animal leather, [plant-based leathers] are not strong enough, repairable, or durable enough"



Co-workers

Construction Project Managers

"I don't want to use leather from animals even if it's a byproduct of the meat industry, I want to find other materials that can act similar to leather"

PURPOSE

In a rapidly growing and changing industry, it's hard to keep up with all the new material innovations used in design. This introductory guide is meant to help both consumers and designers get a basic understanding of what bio-based materials are, what they can be used for, and what their environmental impacts are so that we can make conscious decisions when purchasing or designing while avoiding the trappings of greenwashing & misinformation.

Test it Out!
Scratch & Feel
the Texture

Sustainable or Sus?

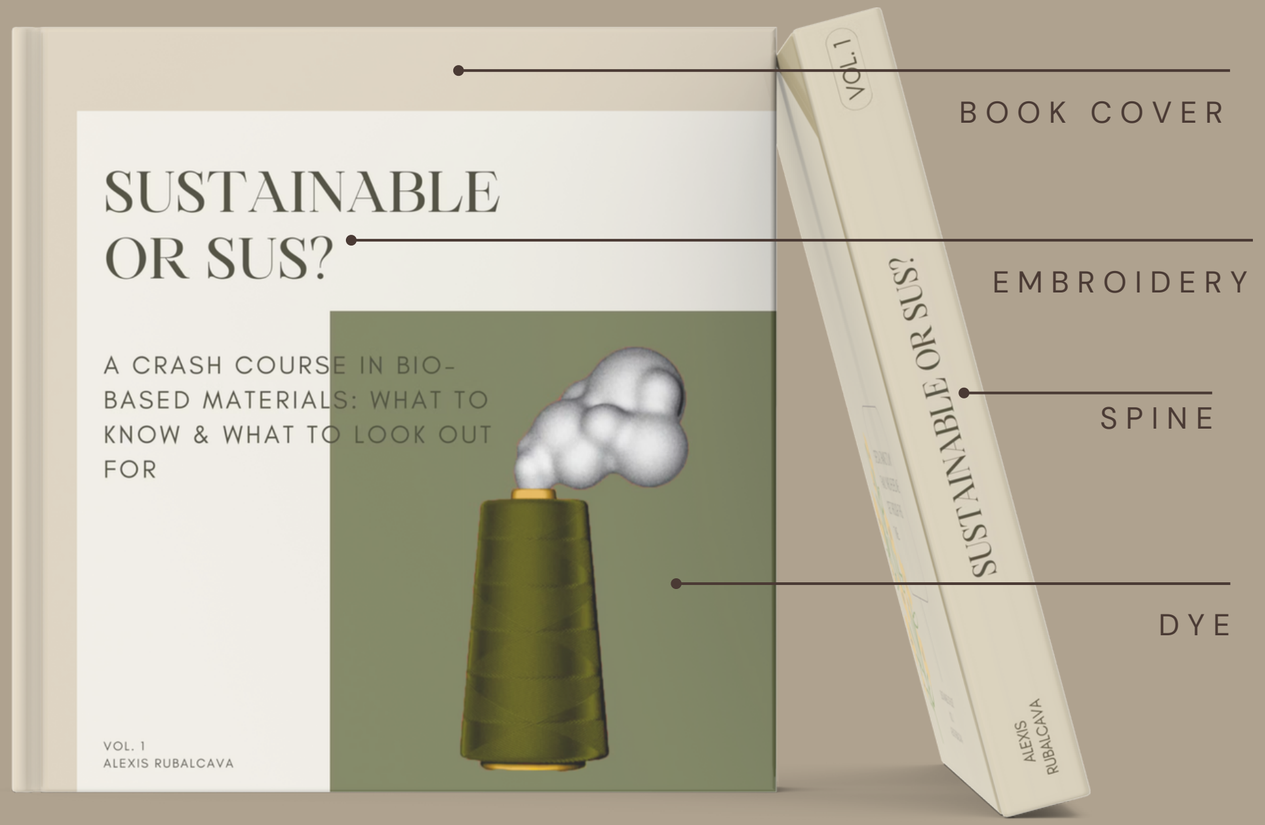
US $35.99

1 Add to Cart

+ DETAILS

- Each page introduces a new material highlighting its components, properties, and uses.
- Fabric swatches are included so that the reader can put them to the test by scratching and feeling the texture.
- Dives into a product containing the material in question to assess its claims of sustainability.

+ SPECS



FSC www.fsc.org RECYCLED Made from recycled material FSC® C000000

Made from Post-Consumer Recylced Paper & FSC Certified

Sustainable or Sus?

US $35.99

1 Add to Cart

+ DETAILS

+ SPECS

- Book Cover - Piñafelt (non-woven blend of pineapple leaf fibers)
- Embroidery - GOTS certified organic cotton
- Spine - Mirum (agri-waste-based) leather for reinforced backing
- Dye - Natural Dyes (mixing of indigo with turmeric)

RECYCLING PROGRAM

- When the book is at its end-of-use, the reader can donate the book or drop it off at any local Free Public Library or participating used book stores. Take a photo or present a receipt, & get a 15% discount on any new volume.
- Each book contains a QR code that leads the reader to an online and updated textile database, so everyone can have access to the latest information, regardless of which volume you own.

Look Inside

Piñatex - The Verdict

LIFE CYCLE ASSESSMENT (LCA)

1. Extraction/Harvesting
2. Processing/Refinement
3. Manufacturing/Assembly
4. Distribution + Use (travel and maintenance)
5. End-of-Life (disposal or recyclability)

Let's take a look at the entire life cycle of a product containing the material in question, Piñatex. To the left is the color coded key to track each phase of an LCA. Each process will be identified by its inputs and outputs.

End-Product

Inputs

Labor
Agri-Waste
Transportation

Labor
Energy
Fiber Extraction Machinery
Transportation

Labor
Energy
Machinery
Fibers
Transportation (Not clear if done in same facility)

Labor
Energy
Machinery
Fibers
Enzymes
Water (?)
Transportation (Same facility?)

Locations (Travel): Philippines

Locations (Travel): Philippines

Pineapple leaf collection

Pineapple leaf fiber extraction - Mechanical Process

Washing & Drying - Mechanical Process (?)

Purification - Degumming through Enzymatic Process; no chemicals - Mechanical Process

Outputs

Agri-waste byproduct
CO2/Methane (Transportation)

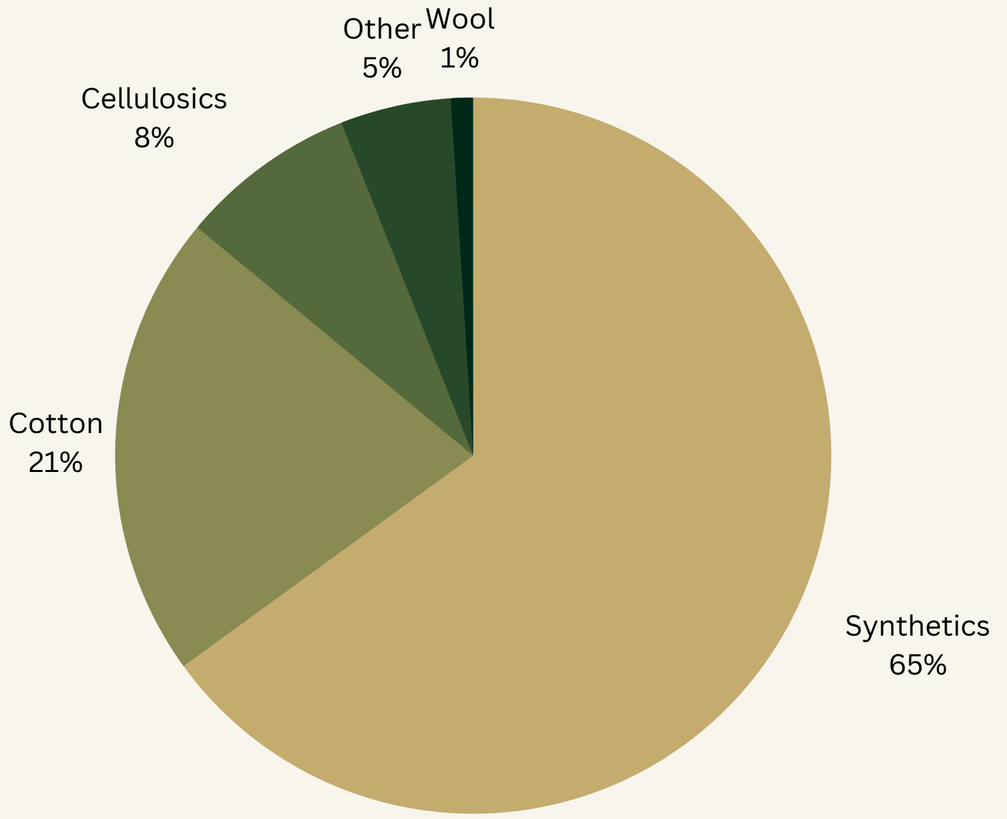
GHGs (from machinery + transportation)
Biomass (Nutrients)
Fibers

GHGs (from machinery + potentially transportation)
Wastewater (?)

GHGs (from machinery + potential transportation)
Waste
Wastewater (?)

MOST POPULAR TEXTILES USED TODAY

1. Synthetics: Polyester, Polyamide, Acrylic, Nylon - 65%
2. Cotton - 21%
3. Cellulosics - 8%
   - 3A Natural Cellulosic Fibers: Flax, Hemp, Jute, Ramie
   - 3B Man-Made Cellulosic Fibers: Lyocell, Viscose, Modal
4. Other - 5%
5. Wool - 1%



LIST OF TEXTILE ALTERNATIVES

1. Piñatex
2. Mirum
3. Desserto
4. Mylo
5. Corn Fibers
6. Tomtex
7. Leap
8. Algiknit
9. Bananatex
10. Vegea
11. Frumat
12. Lino Leather
13. Mycoworks
14. Piñayarn
15. Orange Fiber
16. VitroLabs
17. Reishi
18. Kintra
19. Clarus
20. Alga-Life
21. Spiber

TRENDY TERMS TO KNOW

1. **Biodegradability** - A material is biodegradable if there is any bacteria or fungi in the natural world that can "eat" the material. "Eating" in this case means that it can break the chemical bonds holding the material together, so that the material breaks down into its components.

2. **Circularity** - Instead of a linear approach, circularity embodies a closed-loop system where there is responsible extraction/harvesting methods, manufacturing, use, and end-of-life for every garment or material; closed-loop would from soil to soil.

3. **Greenwashing** - Refers to the presentation of a product or a material as being more environmentally friendly than it actually is.

4. **Life Cycle Assessment (LCA)** - Evaluates all the environmental effects of a product quantitatively for the whole lifetime of that material.

5. **Agri-waste** - Plant residues leftover from agriculture; are all parts of crops that are not used for human or animal food. These are mainly stems and leaves.

LESS TRENDY TERMS BUT STILL IMPORTANT TO KNOW

1. **Embodied Energy** - The total energy consumed resulting from a product's manufacturing, transportation, installation, & use

2. **Polylactic Acid (PLA)** - a vegetable-based plastic material made from corn starch which comes from a renewable source.

3. **Polyurethane (PU)** - A combination of chemicals or compounds that react to create a plastic-like substance.

4. **Natural Rubber** - An elastic material obtained from the latex sap of trees that can be vulcanized (hardened by applying sulfur at high temperatures) and finished into a variety of products.

5. **Leather Tanning** - The process of treating skins & hides of animals to produce leather.

6. **Vegan Leather** - In the context of 'leather,' is a marketing term rather than a descriptor of ingredients. Be wary that although vegan leather is not made of animals, it may contain plastic. This means that many plastic leathers (or pleathers as some call them), are labeled vegan because they don't contain animal product yet contain plastic.

Piñatex

A material resembling leather made of pineapple leaf fibres and plastic

Composition

- 72% Pineapple leaf fibres (PALF)
- 18% Polylactic Acid (PLA)
- 5% Bio PU
- 5% Polyurethane (PU)

Properties

- Water-Resistant
- Soft
- Wrinkle-Resistant
- Lightweight
- Flexible
- Good tensile strength

Pros

- Versatile
- Takes color well
- Easy to care for
- Available in 12 colors

Uses

- Handbags
- Footwear
- Interiors
- Accessories (Belts, Wallets)

Cons

- Not as durable as animal leather
- Not biodegradable
- Low elasticity
- Low heat resistance

Mirum

An all-natural material resembling leather free from both animal & plastic inputs

Uses

- Bags
- Shoes
- Automotive Interiors

Composition

- Coconut Husks
- Rice Hulls
- Natural Rubber
- Cork

Properties

- Strong
- Water-resistant

Pros

- No use of petrochemicals or glues/adhesives
- Uses natural colorants
- Biodegradable
- 100% recyclable + circular

Cons

- Not as durable as animal leather
- No public LCA

Hozen Stripe Bucket Bag, $280

CAN THIS HANDBAG BIODEGRADE?

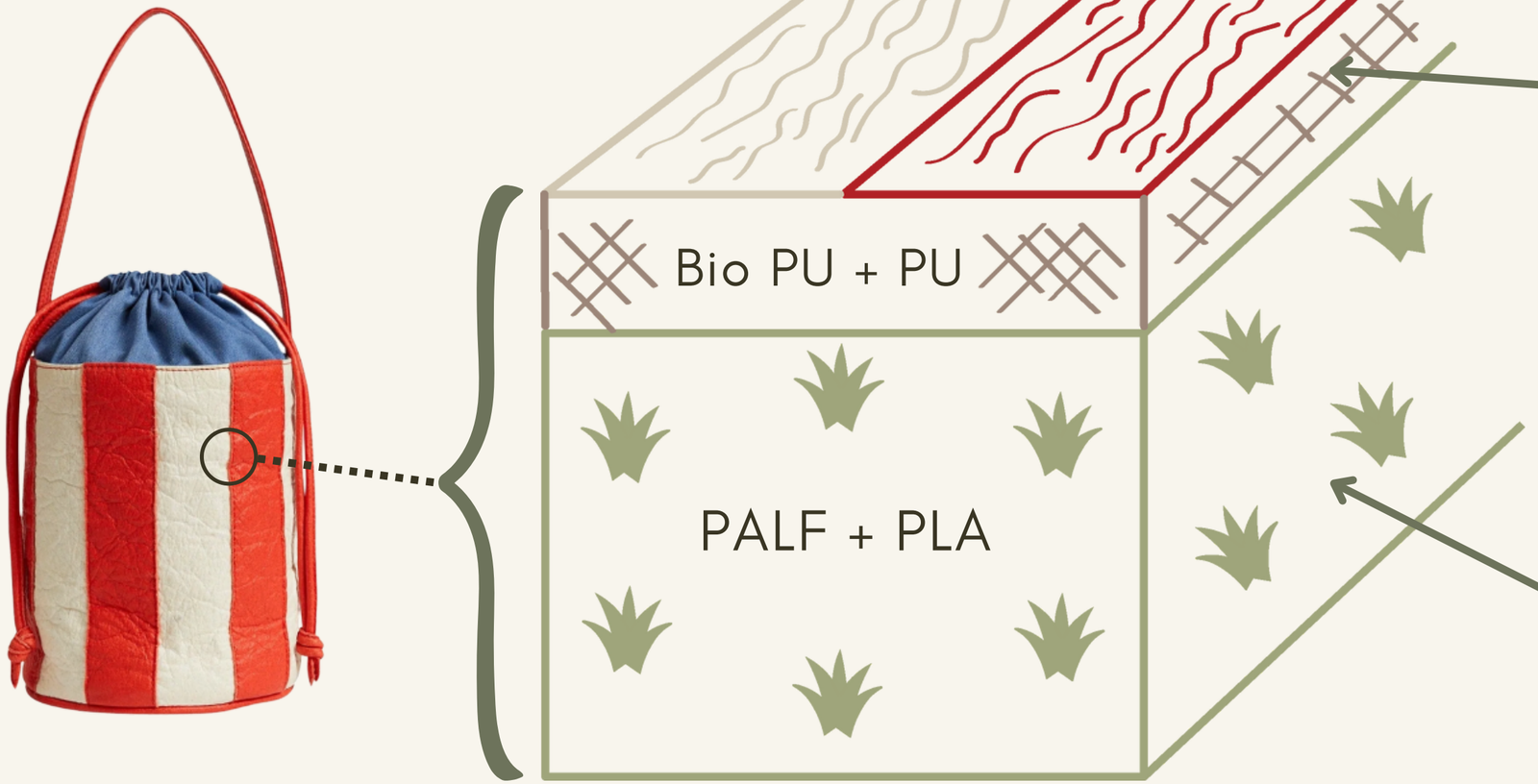
This handbag is made with Piñatex leather. Once it's at its end-of-life phase (meaning you're done using it), and you're ready to dispose of it, could it biodegrade at a landfill? Let's break down the components to take a closer look and find out.

Allbirds Plant Pacers Shoes, $135

WHAT IS REAL VEGAN LEATHER?

Vegan, plant, faux, pleather, fake artificial - with so many names used interchangeably it's tricky to decipher what is what. Let's start with clarifying what is vegan leather.

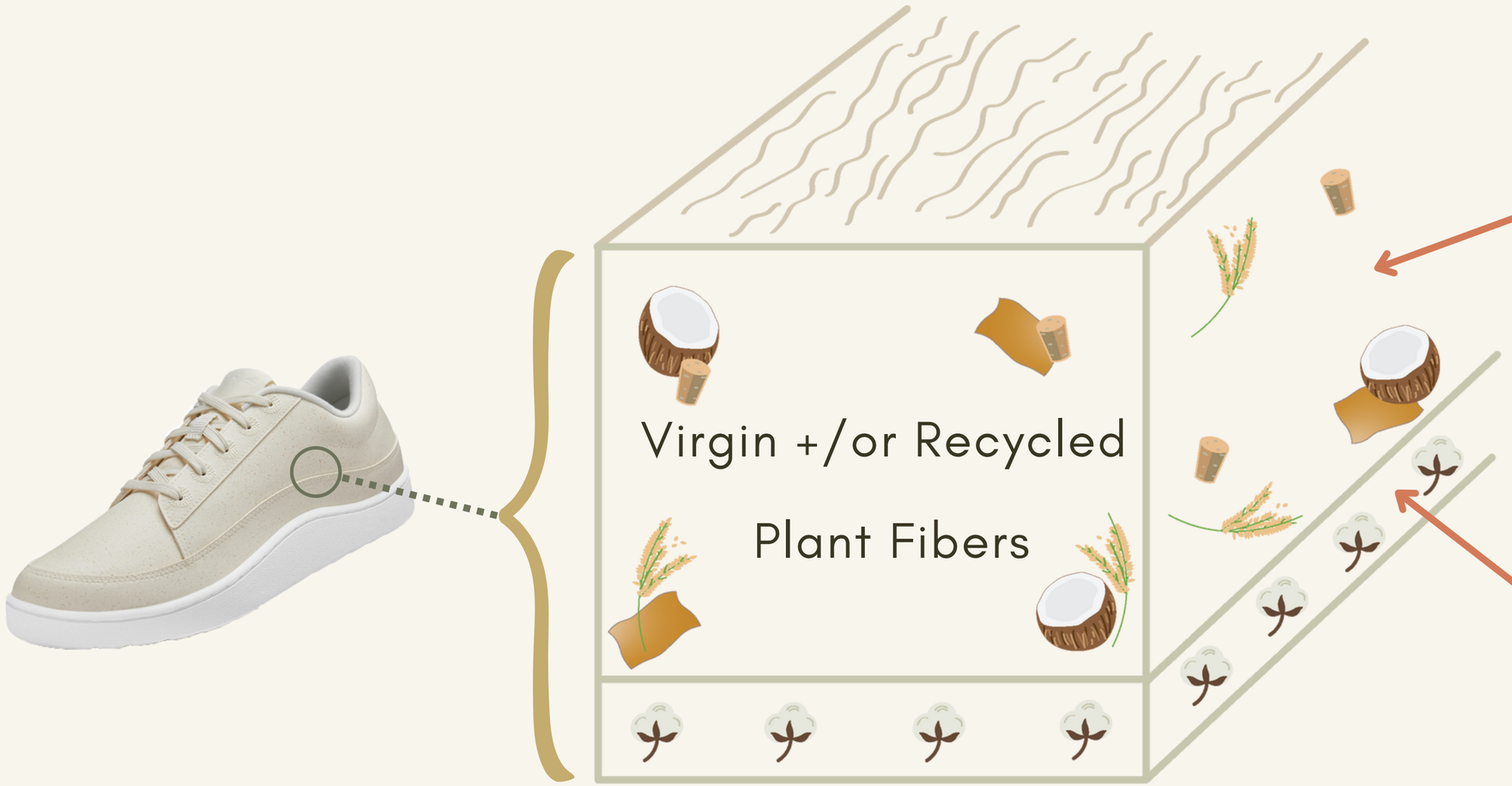
Piñatex - The Breakdown



This is the topcoat layer made of a mix of both bio PU and PU to provide the color and necessary properties of Piñatex. This layer is not biodegradable.

This is the substrate (base material) of Piñatex called Piñafelt which is a non-woven blend of the pineapple leaf fibers (PALF) and PLA. This layer is biodegradable but only under controlled industry conditions

Mirum - The Breakdown



This is the primary layer made of Mirum which is a non-woven blend of the agri-waste components. This layer is biodegradable.

This is the backing of the Mirum fabric made of organic cotton. This layer is biodegradable.

LIFE CYCLE ASSESSMENT (LCA)

1. Extraction/Harvesting
2. Processing/Refinement
3. Manufacturing/Assembly
4. Distribution + Use (travel and maintenance)
5. End-of-Life (disposal or recyclability)

Let's take a look at the entire life cycle of a product containing the material in question, Piñatex. To the left is the color coded key to track each phase of an LCA. Each process will be identified by its inputs and outputs.

End-Product

Inputs

Labor
Agri-Waste
Transportation

Labor
Energy
Fiber Extraction Machinery
Transportation

Labor
Energy
Machinery
Fibers
Transportation (Not clear if done in same facility)

Labor
Energy
Machinery
Fibers
Enzymes
Water (?)
Transportation (Same facility?)

Locations (Travel): Philippines

Locations (Travel): Philippines

Pineapple leaf collection

Pineapple leaf fiber extraction - Mechanical Process via Decorticating (removes bark, husk, rind)

Washing & Drying - Mechanical Process (?)

Purification - Degumming through Enzymatic Process; no chemicals - Mechanical Process

Outputs

Agri-waste byproduct
CO2/Methane
(Transportation)

GHGs (from machinery + transportation)
Biomass (Nutrients)
Fibers

GHGs (from machinery + potentially transportation)
Wastewater (?)

GHGs (from machinery + potential transportation)
Waste
Wastewater (?)

Inputs

Labor
Energy
Machinery
Fibers
Transportation (Same Facility?)

Labor
Energy
Machinery
Fibers
Transportation (Same Facility?)

Labor
Energy
Piñafelt
Transportation (Air Freight, Cargo Ship)

Labor
Energy
Textile Rolls
Transportation (Same Facility?)
Machinery
Top Coating - Polymers
Container with Resins & Pigments

Locations (Travel): Philippines

Locations (Travel): Spain

Carding - Mechanical Process

Piñafelt - Forming of Non-Woven Textiles (Needles are applied, going in up & down motion to form fluffy fiber) - Mechanical Process

Textile Rolls - to get specific lengths & widths

Finishing Textile Process - Textile is put in container with resins and pigments for coloring. No dye process or dye bath used. Water is also not used in this process. Top coating is then applied for strength.

Outputs

GHGs (from machinery + potential transportation)
Some Fiber Waste
Carded Fibers

GHGs (from machinery + potential transportation)
Non-woven textile = Piñafelt
Some Textile waste

Shipped from Philippines to Spain for Rolling

GHGs
Textile Rolls
Some Textile Waste (but biodegradable at this stage)

GHGs
Chemicals - Plastics
Some Textile Waste (no longer biodegradable because of the top coat, see Piñatex - The Breakdown page for reference)

Inputs

Labor
Energy
Colored Textiles
Transportation (Same Facility?)
Machinery

Piñatex - Final Mechanical Process to provide fluidity & softness

Labor
Energy
Piñatex
Packaging
Transportation (distributors, retailers)

End-Product

Labor
Energy
Piñatex Product
Packaging
Maintenance (Apply colorless wax to keep product hydrated)
Transportation to Consumer (Air Freight, Shipping Trucks)

Distribution + Use

Labor
Energy
Piñatex Product
Landfill

End-of-Life

Outputs

GHGs
Piñatex
Some Textile Waste

GHGs
Piñatex Product
Packaging Waste

GHGs
Packaging Waste
Piñatex Product

Piñatex Waste
Plastic Contamination (soil, water)

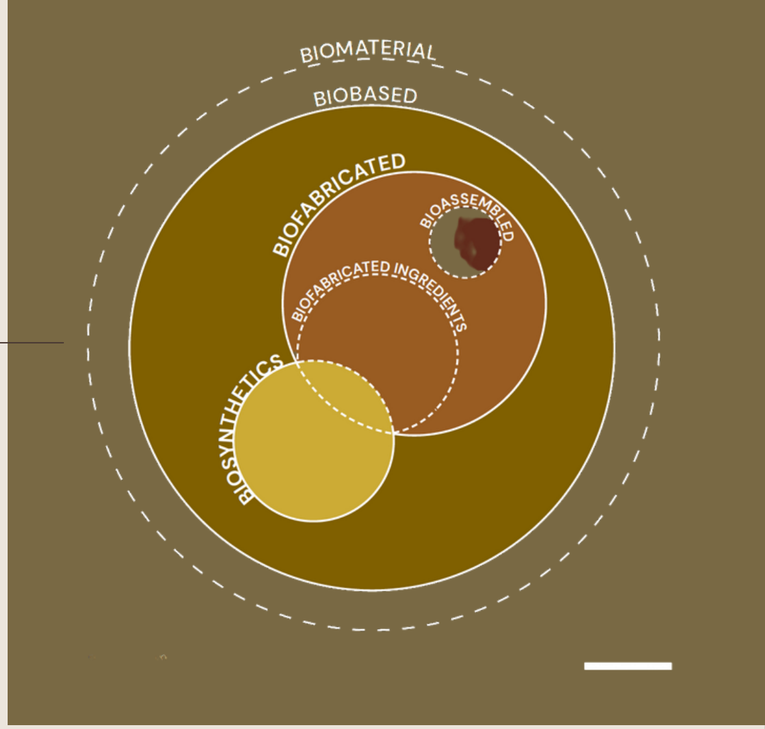
IN CONCLUSION

Piñatex leans more on the side of Sustainable than Sus with their transparency on their product's composition, their public LCA (to a certain extent), and their continued quest for creating a 100% natural product.

- The Common - There are typical wastes of energy such as when the fibers are going through various refining machines, and then GHG emissions once the textiles are traveling to differing facilities both locally in the Philippines and then once traveling abroad for the finishing stages and final destinations.
- The Good - The surprise here is that no water is used during the coloring stage, therefore no wastewater is created; no water pollution, no harm to human and animal water resources.
- The Bad, But Promising - At the end, the textile cannot biodegrade, but the company behind Piñatex, Ananas Anam, is transparent about this and doesn't shy away that their textile is still very much a work in progress - they're working on an all natural version to avoid a plastic coating.

IF I HAD MORE TIME....

- Add various other materials and updates as new information progresses; updated volumes
- Would like to add LCAs of these materials with graphics to breakdown each phase for the reader
- Include maintenance information of fabrics as this is part of the user-phase of an LCA.
- Add all the various colors and textures (metallic, performance, etc.) each material offers.
- Include other types of textiles not just leather alternatives.
- Further sub-categorize biomaterials, biobased, biofabricated, etc.



RESOURCES

https://www.discovermagazine.com/environment/soon-you-could-be-wearing-mushroom-leather-but-will-it-be-better-for-the
https://melinabucher.com/blogs/stories/vegan-leather-guide-2
https://blog.naturalfiberwelding.com/mirum-lca-carbon-footprint
https://melinabucher.com/blogs/stories/vegan-leather-guide-1
https://www.ananas-anam.com/responsibility/
https://thisismold.com/process/materials/pineapple-leather-is-a-sweet-alternative-to-the-norm
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https://ecocult.com/desserto-cactus-leather-sustainable/
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