



MATERIAL  
INNOVATION  
INITIATIVE



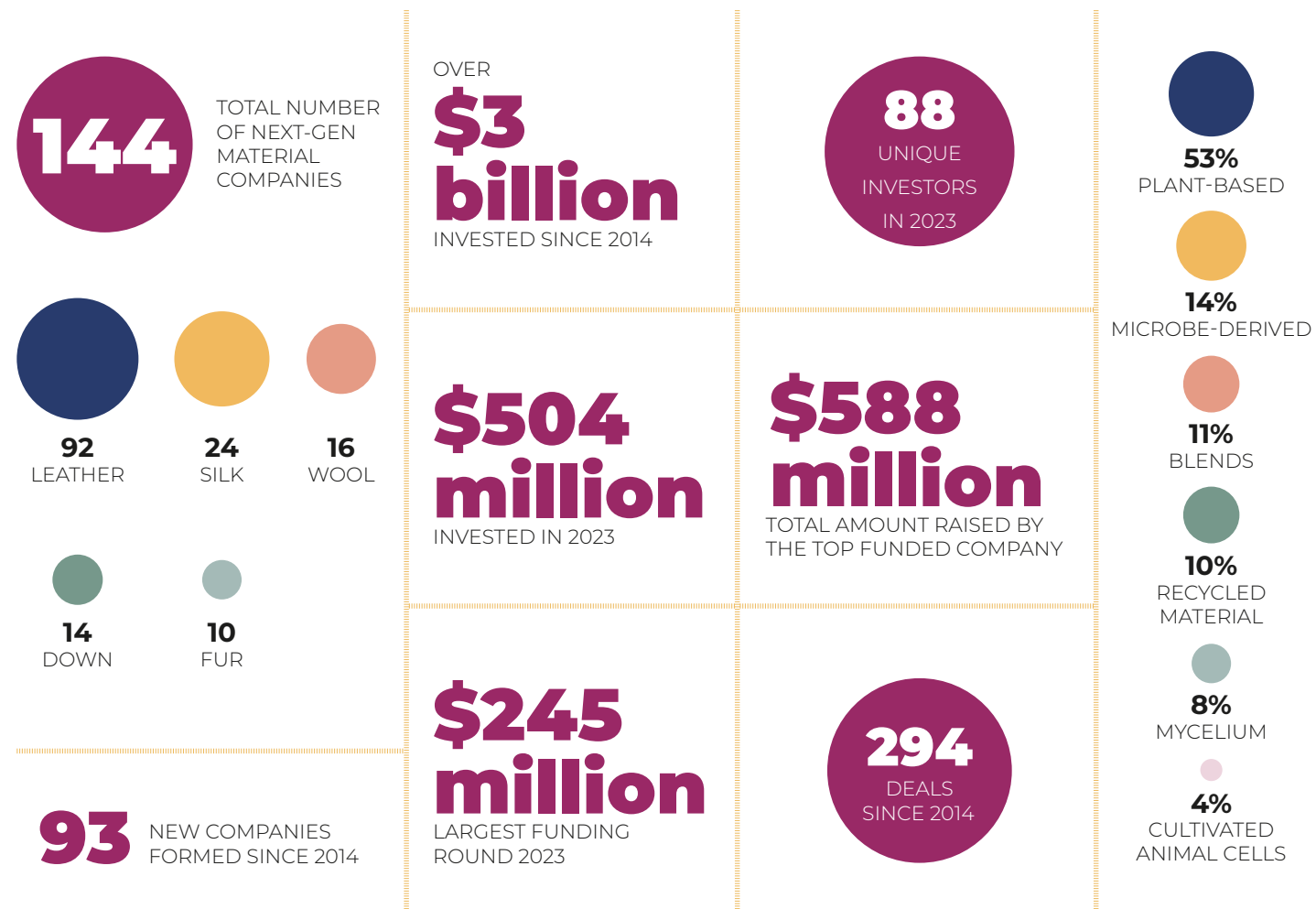
# 2023

STATE OF THE INDUSTRY REPORT

**NEXT-GEN MATERIALS**

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# STATE OF THE NEXT-GEN MATERIAL INDUSTRY AT A GLANCE (2023)



**Exhibit 1.** State of the next-gen material industry at a glance (2023)

Source: Material Innovation Initiative. All data as of Dec 31, 2023.

\*Note: Some companies create more than one next-gen material.

\*\*Note: To simplify the broad landscape of formulation and processing approaches for next-gen materials, MII categorizes next-gen innovation by main input (greater than 50%)

**IN** Look for the IN logo throughout this report for next-gen material industry insights.

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PART A

**TOWARDS**

**NEXT-GEN**



Image credit: BioFluff x Tetera Taronja Design

# 1. FOREWORD

The adoption of next-gen materials that are high-performance, animal-free, and environmentally preferable is key to shift the world away from reliance on unsustainable material supplies and practices. To this end, Material Innovation Initiative (MII) has continued to produce and share research, connect and engage, educate, and advocate. This is the fourth State of the Industry Report: Next-Gen Materials offered by MII.

Despite global VC funding falling 42% and deal count falling 30% to reach a 6-year low in 2023, funding for next-gen materials companies increased.<sup>1</sup> The next-gen materials industry enjoyed a 10% rise in investment funding in 2023, showing significantly higher investments than the general market.

In this report you will find research, analysis, and insights to guide your understanding of the next-gen materials industry. Whether your interest is as an investor, entrepreneur, or as a member of a startup or brand, we have prepared this document to give you the most actionable information about the shift away from animal- and/or petroleum-based materials that is beginning to ripple through the fashion, automotive, and home goods industries.

Part A includes the **Definition and Scope** that explains some key concepts and categorizations relevant to the next-gen materials industry. We also invited experts to make **Predictions** on trends, risks, and opportunities.

In Part B, we introduce the three categories of key stakeholders in this industry, or **The 3 i's: innovators, investors, and industry brands**. Innovators are companies, including startups, that create innovative next-gen materials. Investors provide the necessary

funding for innovators' R&D activities and business growth. Industry brands are the established companies that are the biggest buyers and users of materials, such as Nike, IKEA, and BMW. Industry brands play multiple important roles in the ecosystem, including funding both internal and external innovation initiatives, switching to next-gen materials as their raw materials, and collaborating with next-gen material startups to create new products. All this leads to acceleration of commercialization and scale-up production of next-gen materials to replace their conventional counterparts.

In Part C we present you with a **Fresh Viewpoint** to interpret the data presented in Part A and B.

From 2023 forward, many more regulations will come into force globally, demanding the fashion industry to deliver on its sustainability goals. This is an encouraging development and will no doubt sustain the growth in demand for next-gen materials. Next-gen materials, on the whole, are poised to be more sustainable than animal-based and petrochemical-based materials. But there is no one silver bullet solution. It is necessary to work on progress, not perfection, in advancing a new product. At the same time, it is important to acknowledge that brands with the interest and money to be the first adopters of next-gen materials expect quality. We continue to notice the insufficient supply of materials that meets the needs of brands and consumers.

As the industry continues to mature, and next-gen materials are no longer just a media-hyped craze, stakeholders need to work together and focus on improving quality and scaling faster. Conversations will need to take place with deeper understanding of the subject matter, not based on half-truths or misinformation. This report is presented to form a basis of mutual understanding.

## EXPERT PREDICTIONS



"The era of the fashion industry self-regulating sustainability is coming to an end. Multiple countries are working on implementing new rules and regulations requiring reporting of environmental impact. Fashion brands and manufacturers need to revamp their 'business as usual', starting from the raw materials they use which account for the greatest climate impact across the fashion life cycle."

**Nicole Rawling**  
Co-Founder & CEO, MII



"Recognizing that regulations will affect brands operating in the U.S. and European markets, more brands are likely to devote staff to working with next-gen innovators to bring these products into their portfolio of suppliers. Initial units will be small as innovators build out their supply chains and inputs. But this will lay the groundwork for growth and potential long-term partnerships between brands and innovators."

**Thomasine Dolan**  
Director of Materials Innovation and Design, MII



"It will be critical for next-gen material innovations to outmatch incumbents with both superior performance and environmental impact via quantifiable metrics. Sustainability alone may not be enough for widespread adoption. Scaling, supply chain integration, and cost also remain huge challenges - innovators won't be able to count on "green premiums" and need to focus on making a business case with brands."

**Sydney Gladman, Phd.**  
MII Advisor



"The next-gen material startup ecosystem will continue to advance despite the difficult market. We see fashion brands hiring technical resources like chemists; a growing number of innovators with offerings that meet performance and price expectations; new product launches; and more awareness on the consumer side. It is inevitable that the inclusion of next-gen has hit the mainstream and may not be 'next-gen' for long..."

**Christine Goulay**  
Founder at Sustainabelle Advisory Services, MII Advisor



"There will be continued innovation of next-generation materials in the coming year (especially ones with increased bio-based inputs) which is super exciting as an entrepreneur in the sustainable luxury space. Also, as we recently saw with Gucci's first handbag made from their newly created material Demetra, I believe that more brands will begin to embrace animal-free alternative materials in the near future."

**Tina Bhojwani**  
Founder & CEO at AERA, MII Advisor



"The future of the fashion industry lies in the support of innovation, especially within the next-gen material sector. From luxury to opening price point, attention must be paid to sourcing materials that do not cause continued harm to the planet, the people and to the animals. I look to the Material Innovation Initiative as a beacon in leading the way to elevating and accelerating materials that align with the values and goals of an industry built on change."

**John Bartlett**  
Director of Fashion, Executive and Professional Studies Continuing and Professional Education at The New School Parsons Executive Education, MII Director



"As the market remains tepid, fundraising will be difficult. Hopefully industry strategics step up and invest and/or partner as customers to help fund and support the startups in their industry so they are able to continue to make progress on alternative materials for the industry."

**Corinna Chen**  
Partner at Material Impact, MII Advisor

## 2. Definition and Scope

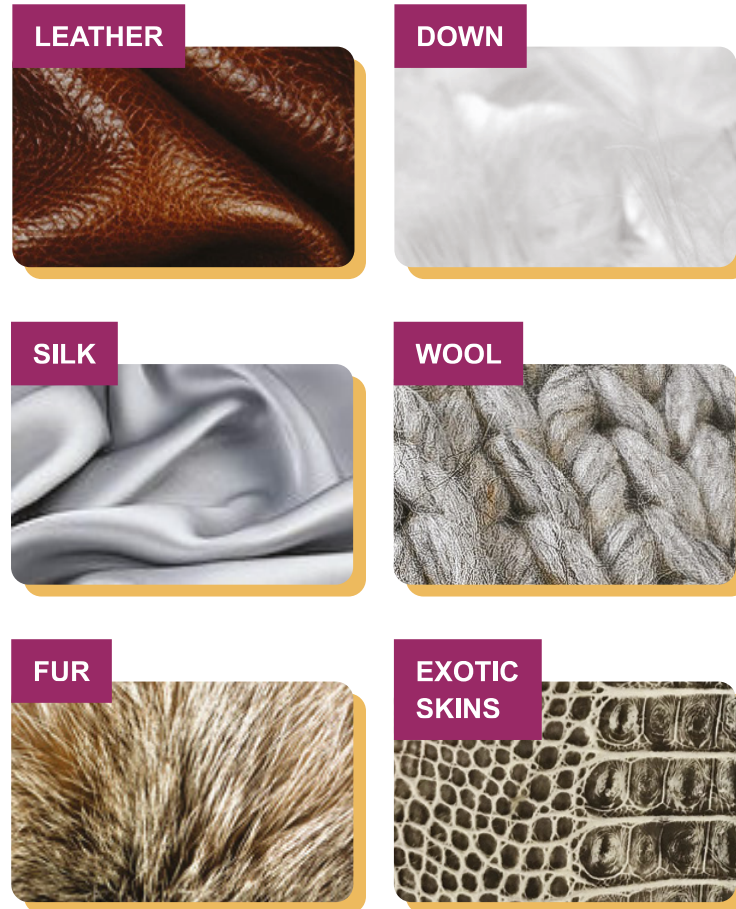
“**Next-gen materials**” are animal-free and more sustainable than incumbent (animal-based) and current-gen (petrochemical-based) materials and replicate the high performance of the materials they are designed to replace. MII currently focuses on replacements for conventional animal-based leather, silk, down, fur, wool, and exotic skins. These next-gen replacement materials use a variety of biomimicry approaches to replicate the aesthetics and performance of their animal-based counterparts.

Examples of exclusions from this definition:

- Materials designed for use in construction, thermal cooling, and packaging solutions that traditionally do not make use of animal-based materials;
- Recycling and upcycling technologies; wearable technologies;
- Dye, cut, trim, or other manufacturing and supply chain technologies.

“**Current-gen materials**” are those used to substitute for animal-derived materials by winning on price. Synthesized leather made from petrochemicals, for example, sells at wholesale at one-third the price of the animal leather equivalent. We generalize these petroleum-based alternatives (e.g., polyurethane (PU), polyvinyl chloride (PVC), acrylic fiber) as “current-gen materials,” but their current applications in the market are far beyond animal-based material replacements. More clothing is made from polyester and nylon, both petrochemical-based, than from cotton. Examples of “current-gen” alternatives include PU for leather, polyester for silk, and acrylic for wool.

“**Disruptive textile technology**” refers to adjacent technologies that are not currently next-gen materials themselves, but that may offer components or resources for next-gen material development. Sustainable innovation in synthetics such as bio-based, biodegradable, and recycled polyester or polyurethane, and in sustainable renewable-sourced fibers such as cellulose and natural fibers, could have a broad impact in the plastics and textiles industries as a whole and, in some cases, in the



next-gen materials space. Manufacturing support and recycling or recovery providers are also critical players to ensuring holistically sustainable next-gen products. Because these broad players and technologies may become promising feedstocks or resources for next-gen material innovation, MII has created a separate list of [Disruptive Textile Innovation Resources](#) to provide next-gen material innovators an easy way to find potential collaborators.

“**Innovators, investors, and industry brands**” refers to the three groups of key stakeholders in the next-gen materials industry. The scope, definition, limitations, and assumptions underpinning the analysis of each stakeholder group are stated in each corresponding section in this report.

### Incumbents, current-gen, and next-gen materials

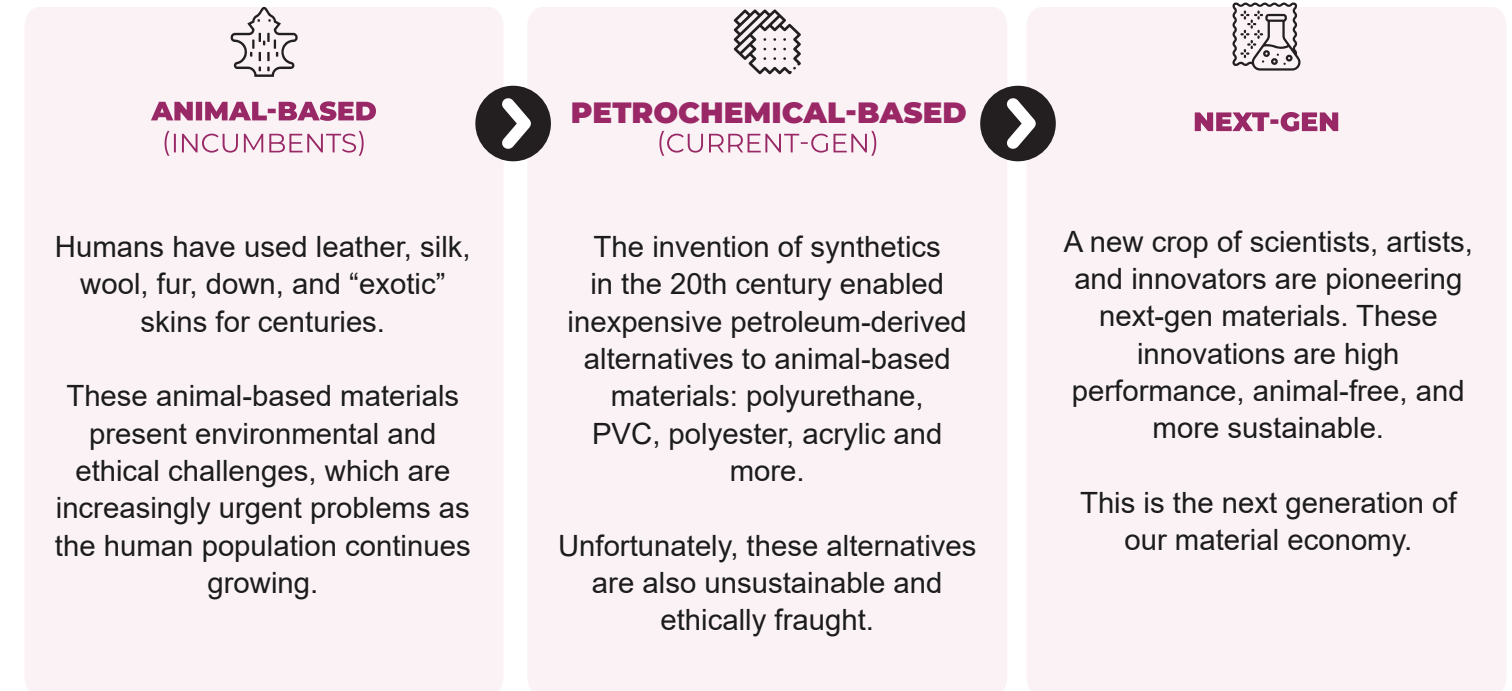


Exhibit 2. Incumbents, current-gen, and next-gen materials




Image credit: von Holzhausen

# Main Input Categories


Not all next-gen materials are made using the same process or technology. To simplify the broad landscape of formulation and processing approaches for next-gen materials, MII categorizes next-gen innovation by main input (greater than 50%): plant-derived, mycelium, cultivated animal cells, microbe-derived, recycled material, and blend.

We expect materials made from similar technologies will have similar advantages and disadvantages, but, it is also important to remember that each innovator has their own specialized process, team, and strategy. We encourage industry brands to evaluate each company individually and not assume issues with one material from one innovator will also occur with materials from other innovators.




**PLANT-DERIVED**

Applies to next-gen materials derived from virgin or waste/byproduct plant matter. For simplicity, fungi (fruiting body rather than the root-like structure), and algae inputs are included in this category, even though they are not plants.




**MYCELIUM**

Applies to next-gen materials that utilize the root-like structure of some fungal species called mycelium. This category is distinctive from the plant-derived category due to the rich activity of next-gen innovation involving mycelium.



**CULTIVATED ANIMAL CELLS**

Applies to next-gen materials that utilize tissue engineering approaches to grow animal cell constructs (e.g., skin) in the laboratory.



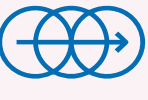
**MICROBE-DERIVED**

Applies to next-gen materials that utilize cellular engineering approaches such as cell culture or fermentation processes to produce products such as proteins and biopolymers for next-gen material formulations.



**RECYCLED MATERIAL**

Applies to next-gen materials that utilize recycled plastic or recycled textile feedstock as a main input.



**BLEND**

Applies to next-gen materials that use a blend of components not well-captured by any of the above categories.

## Conceptual landscape of next-gen leather materials

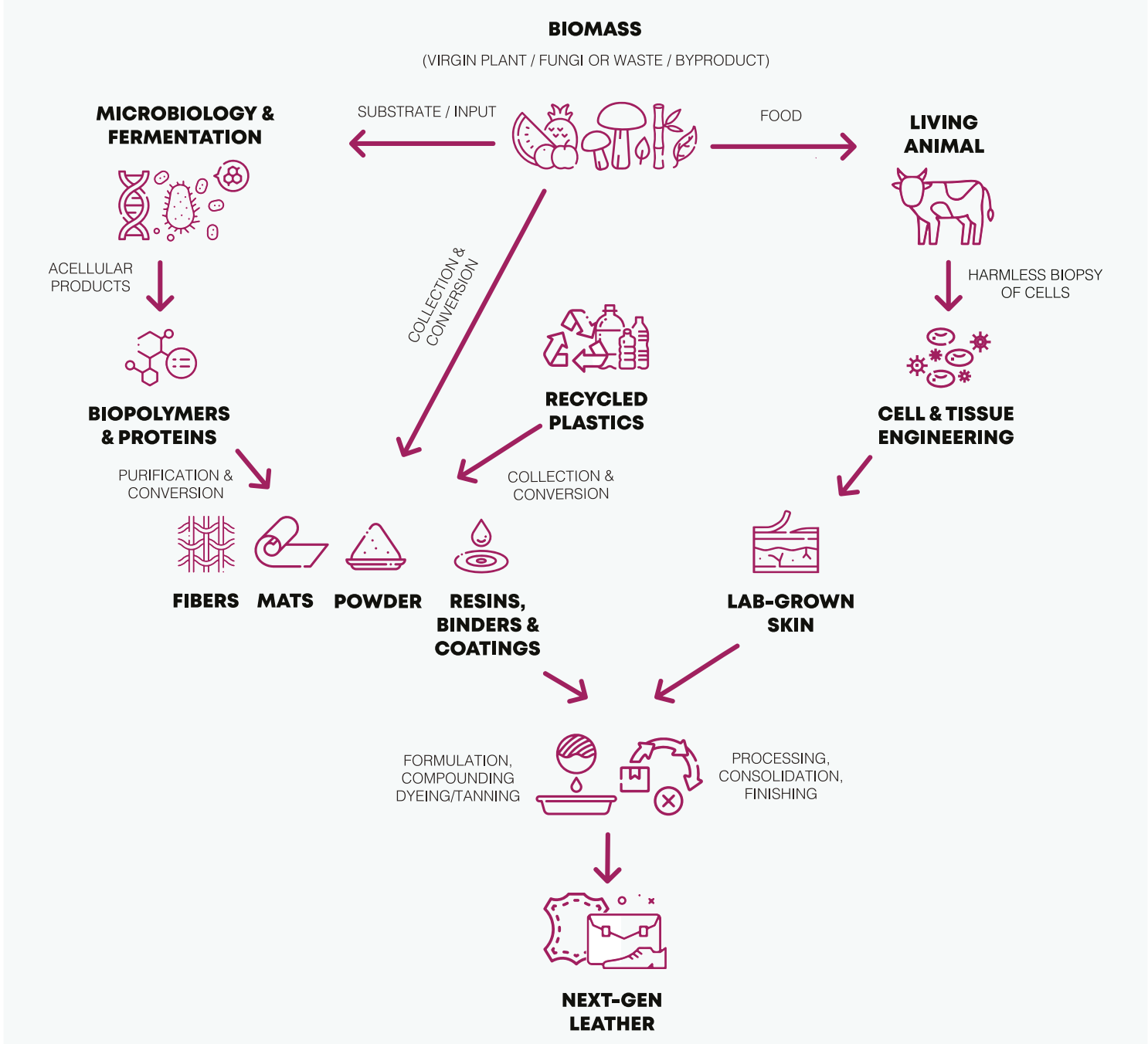


Exhibit 3. Conceptual landscape of next-gen leather materials

As an example, Exhibit 3 above illustrates the variety of approaches for producing a next-gen material such as leather.

To learn more about next-gen materials science and engineering, see [MII's other reports](#).

Please note that many material companies continually refine and update the formulations and technology behind their materials. At MII, we make every effort to keep up to date, especially on our website. This report represents the best information available at the time of publication.

PART B

**KEY**

**STAKEHOLDERS**

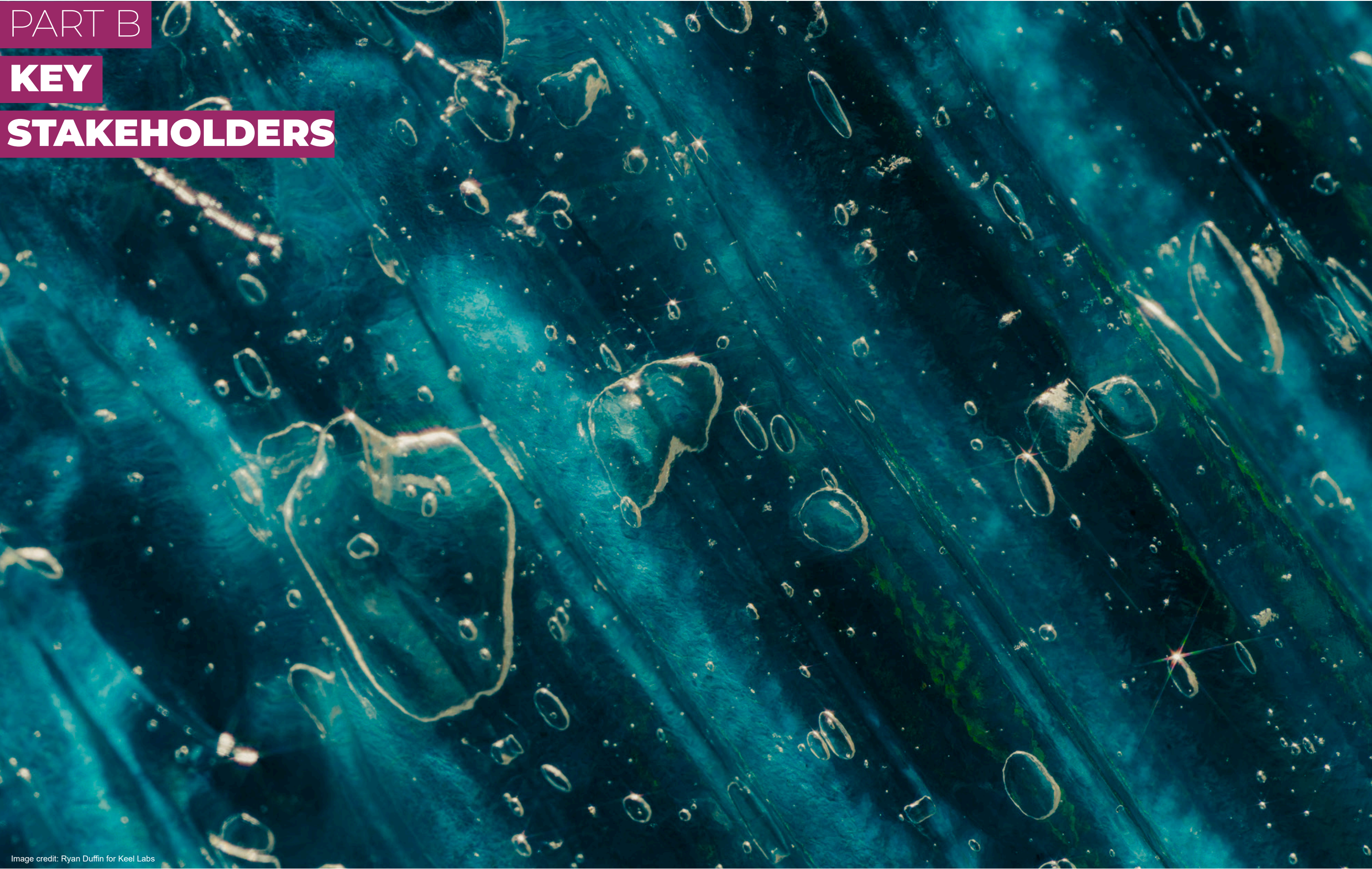


Image credit: Ryan Duffin for Keel Labs



# 3. INNOVATORS



## Overview

This section provides an overview of companies in the next-gen materials industry. The number of companies that develop next-gen materials currently stands at 137, with the majority working on next-gen leather with plant-based input.

### Numbers of companies by year founded (2014-2023)

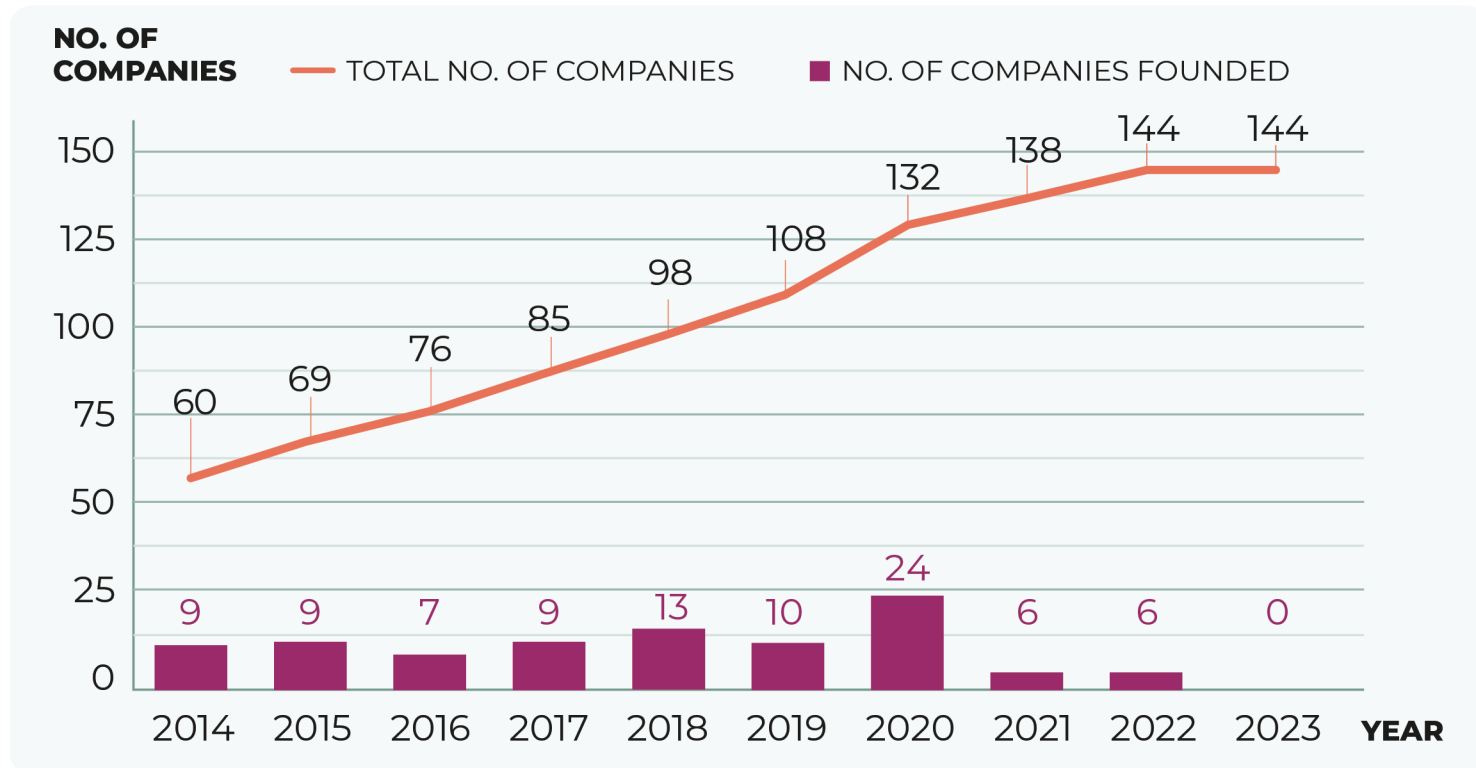


Exhibit 4. Numbers of companies by year founded (2014-2023)

### IN

Having tracked material innovators for a few years now, it has become clear to us that many of them may choose to stay in stealth mode until they are ready to launch. While there was no new venture publicly announced to have incorporated in 2023, our analysis covers an additional 29 companies that existed previously but decided to publicly disclose their activities in next-gen materials in 2023. This report does not cover those companies who remain in stealth mode.

### Number of companies by type of next-gen material (2023)

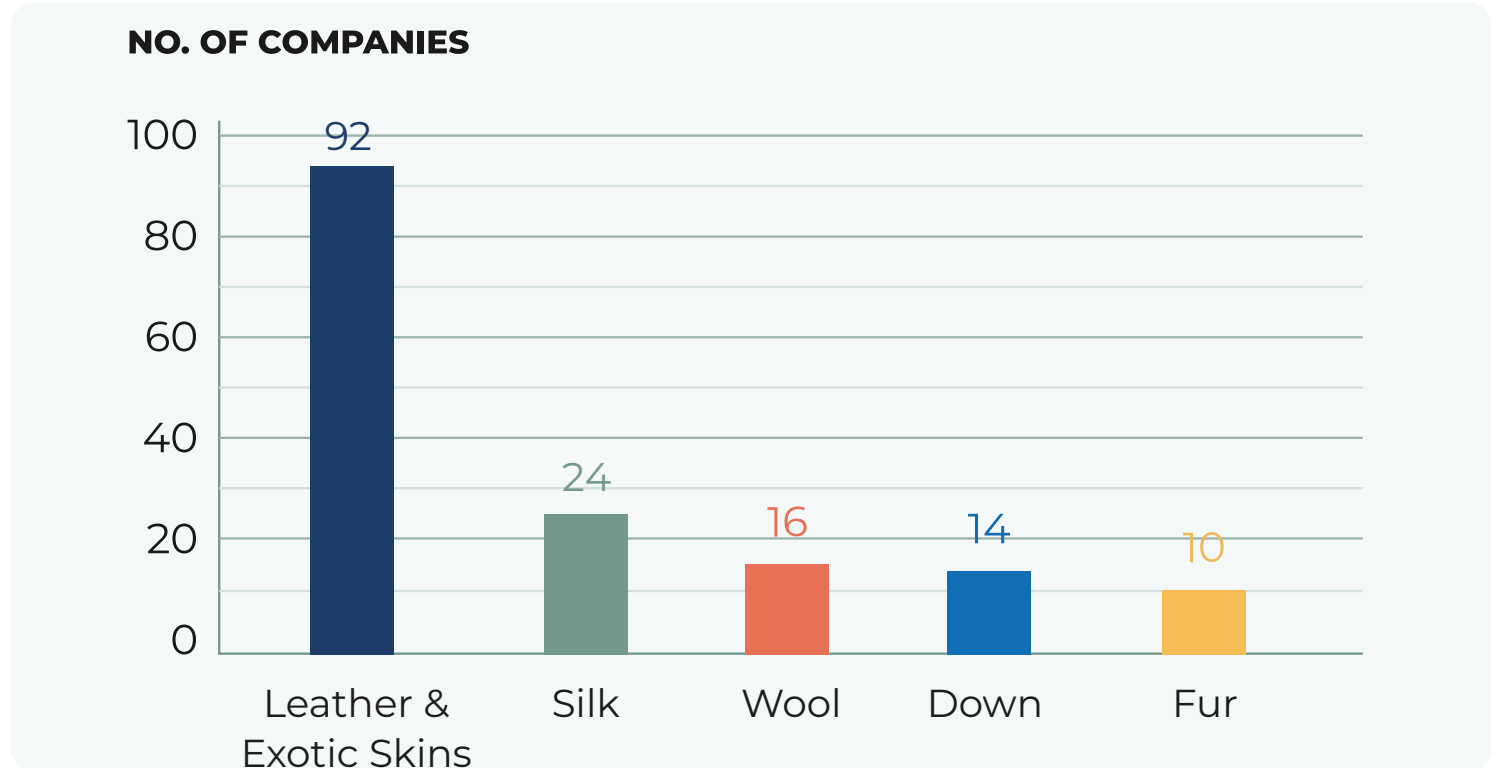


Exhibit 5. Number of companies by type of next-gen material (2023)

### IN

Of the 144 companies, the majority (92) work on biomimicry of animal leather and exotic skins. Twenty-four (24) work on biomimicry of silk, sixteen (16) on wool, fourteen (14) on down, and ten (10) on fur.

Approximately 64% of current players in the next-gen materials industry target next-gen leather, leaving other categories such as silk, wool, down, fur, and exotic skins with limited innovation efforts.

Silk, fur, and exotic skins in particular, are attractive for early stage innovators. High value product targets could enable a faster path to price parity than commodity markets. For example, polyester yarn hovers around \$1/kg,<sup>2</sup> while raw silk averages around \$55/kg.<sup>3</sup> These underserved product categories currently mean a lack of competition, which may be attractive to innovators and investors looking to enter the next-gen materials industry.

\*Some companies work on more than one replacement of animal-based materials. Some of the next-gen material companies market their material as simply "next-gen", rather than as a next-gen replacement for a specific animal material. In this report, the material is placed in a next-gen category according to its primary application in end products.

## Number of companies by main input and technology (2023)

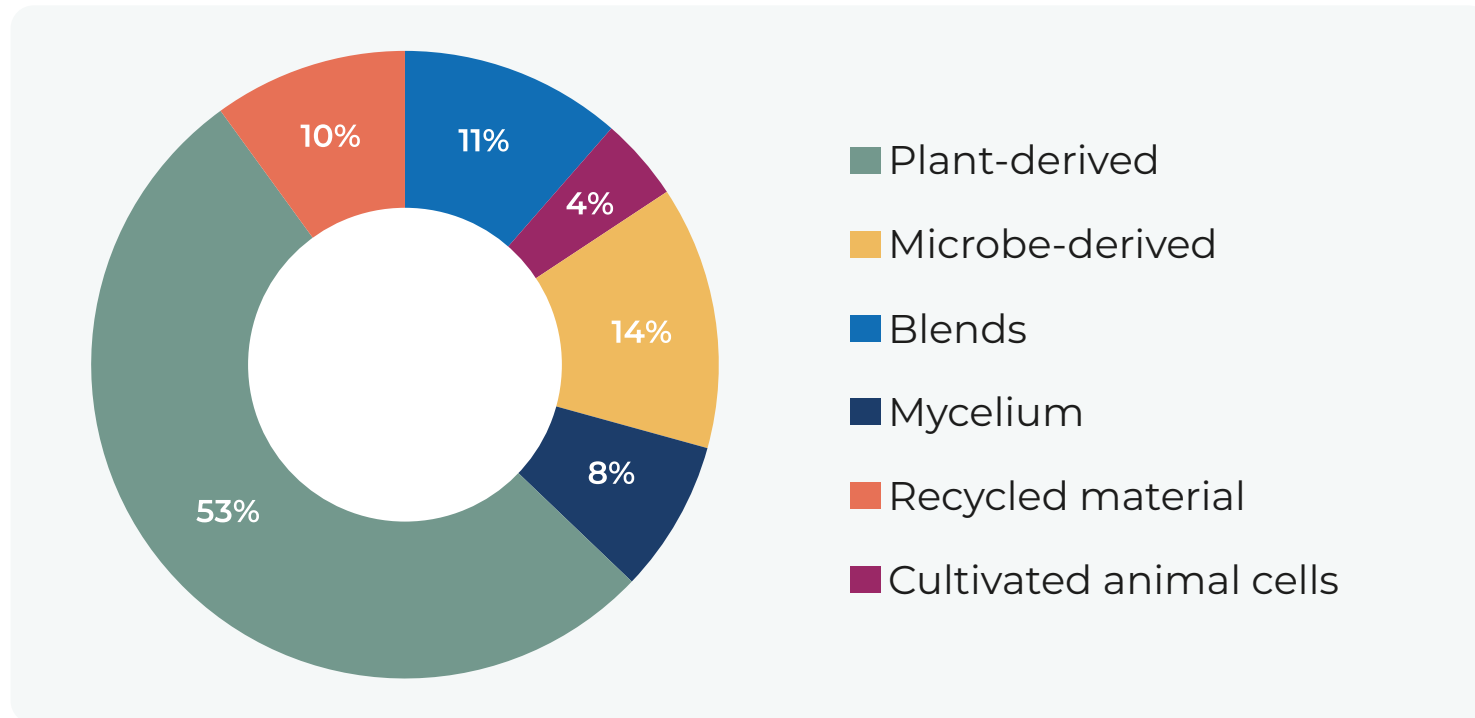


Exhibit 6. Number of companies by main input and technology (2023)

## Number of companies by country (2023)

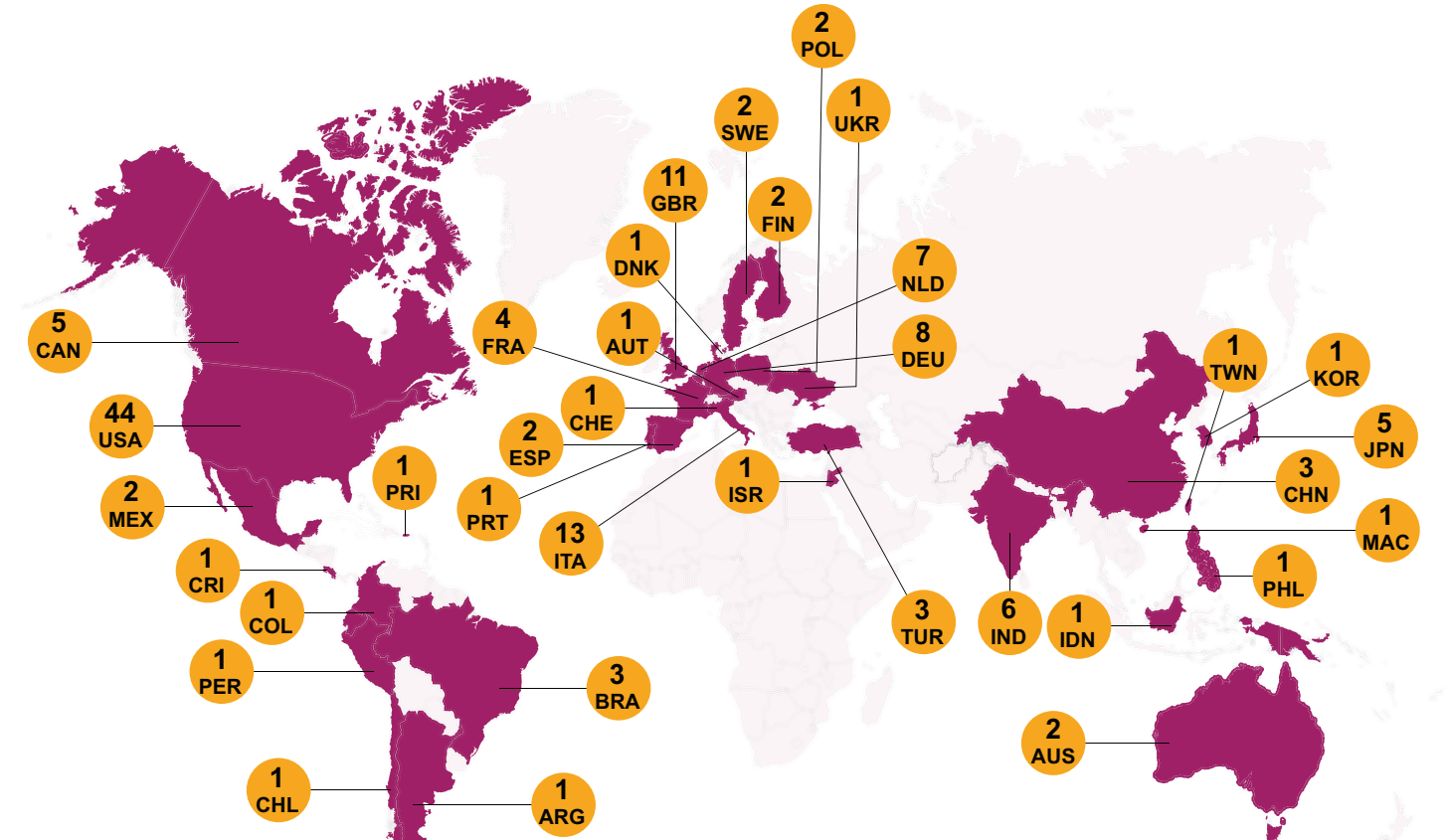


Exhibit 7. Number of companies by country and region (2023)

### IN

Although next-gen materials are commonly associated with using plants and plant-derived materials as a main input, many different technologies and inputs are part of reimagining next-gen materials.

Of the next-gen material companies listed below, while the majority of them - 52.9% - do use plant-derived materials as a main input, the rest don't. 13.6% use microbe-derived materials, 11.4% use blends, 7.9% use mycelium, 10.0% use recycled material, and 4.3% use cultivated animal cells.

Material innovators employ a variety of inputs and technologies to create materials that range from mats to fibers to insulating fluff. Some technologies

allow a company to achieve diverse biomimicry and applications.

The feedstock, main input, and technologies employed can have significant impact not only on product aesthetics and performance, but also time and cost to scale-up. We expect materials made from similar technologies will have similar advantages and disadvantages but, it is also important to remember that each innovator has their own specialized process, team, and strategy. We encourage industry brands to evaluate each company individually and not assume issues with one material from one innovator will also occur with materials from other innovators.

### IN

"The good news for material innovators is that searches for sustainable textiles are at an all-time high. Brands are looking for sustainable alternatives but also need materials that meet their price, availability, aesthetic, performance, and lead times. Currently, they are struggling to find apples-to-apples replacements for their not 'environmentally preferred' fabrics.

The good news for brands is that while they are facing the grand challenge of sustainability, there is an emerging industry that has sustainability baked-in to their products and operations that can help them transition. And though they might not have all of the options like novelty weaves, colors, textures, and weights ready to order, it is just a matter of time.

For right now this industry needs patience, partnership and commitments.

Next-gen materials are poised to replace incumbent textiles and materials that are not

sustainable. For now, what they can offer is the chance for a brand to imprint the next generation of textiles with their aesthetic and performance needs by co-developing with them. These next-gen material innovators offer inspiration to design and production teams alike due to their unique inputs and transparency. They offer a buffet of recyclable, circular, biodegradable end-of-life scenarios for future products. Eventually, like the incumbent mills and makers before them, they too will have suitcases filled with headers including novelty weaves and designs and shorter lead times. Much of this can and will be achievable over the next few years if everyone is committed to working together to make it happen."



**Thomasine Dolan**  
Director of Materials Innovation and Design, MII

**Exhibit 8.** Next-gen material innovators (in alphabetical order) (2023)

The list focuses on known companies that innovate in next-gen materials. Not included are business-to-consumer companies that do not develop and create their own materials, but source instead from a material supplier; R&D happening within corporations that is not publicly disclosed; startups in stealth mode; and any other material innovations that do not fall within the definition of next-gen materials as defined in [section 2 \(Definition and Scope\)](#).

| Company                                  | Material name(s)                        | HQ  | Founders                                     | Year Founded | Biomimicry           | Main Input              |
|--|---|-----|--|--------------|----------------------|-------------------------|
| 3D Bio-Tissues Ltd                       | Lab Grown Leather                       | GBR | Dr Che Connon, Dr Ricardo Gouveia            | 2019         | Leather/Exotic Skins | Cultivated animal cells |
| Adriano di Marti                         | Desserto®, Deserttex®                   | MEX | Adrián López Velarde, Marte Cázarez.         | 2019         | Leather/Exotic Skins | Blend                   |
| ALT TEX                                  | N/A                                     | CAN | Myra Arshad, Avneet Ghotra                   | 2019         | Silk                 | Microbe-derived         |
| AltMat                                   | Altag                                   | IND | Shikha Shah                                  | 2019         | Wool, Fur            | Plant-derived           |
| Amadeu Materials                         | LaVeg                                   | BRA | Flavia Amadeu                                | 2016         | Leather/Exotic Skins | Plant-derived           |
| AMSilk                                   | Biosteel® (fibers & finishing)          | DEU | Thomas Scheibel                              | 2008         | Silk                 | Microbe-derived         |
| Ananas Anam                              | Piñatex®                                | GBR | Carmen Hijosa                                | 2011         | Leather/Exotic Skins | Plant-derived           |
| Arda Biomaterials                        | New Grain™                              | GBR | Edward Mitchell, Brett Cotten.               | 2022         | Leather/Exotic Skins | Plant-derived           |
| Banofi                                   | Banofi Leather                          | IND | Jinali Mody                                  | 2022         | Leather/Exotic Skins | Plant-derived           |
| BARKTEX®                                 | Bark Cloth                              | DEU | Mary Barongo-Heintz & Oliver Heintz          | 1999         | Leather/Exotic Skins | Plant-derived           |
| Beyond Leather                           | Leap™                                   | DNK | Hannah Michaud, Mikael Eyd.                  | 2016         | Leather/Exotic Skins | Plant-derived           |
| BioFluff                                 | BioFluff®                               | USA | Ashwariya Lahariya, Martin Stüebler.         | 2022         | Fur                  | Plant-derived           |
| Bioleather                               | N/A                                     | IND | Pritesh Mistry                               | 2019         | Leather/Exotic Skins | Microbe-derived         |
| Biophilica                               | Treekind™                               | GBR | Mira Nameth                                  | 2019         | Leather/Exotic Skins | Plant-derived           |
| Bolt Threads                             | Microsilk™                              | USA | Dan Widmaier, David Breslauer, Ethan Mirsky. | 2009         | Silk                 | Microbe-derived         |
| Botanè                                   | Botanical Cashmere                      | ITA | Paola Caracciolo                             | 2020         | Wool                 | Blend                   |
| Bucha Bio (rebranded to Rheom Materials) | SHORA ™                                 | USA | Zimri T. Hinshaw                             | 2020         | Leather/Exotic Skins | Plant-derived           |
| Carbonwave                               | N/A                                     | PRI | Geoff Chapin, Ben Ellis.                     | 2020         | Leather/Exotic Skins | Plant-derived           |
| Circ                                     | N/A                                     | USA | Peter Majeranowski                           | 2018         | Silk                 | Recycled                |
| Corium Biotech                           | N/A                                     | PRT | Maria Gonçalves Maia, Margot Muller.         | 2020         | Leather/Exotic Skins | Cultivated animal cells |
| Coronet                                  | BioVeg                                  | ITA | Enrico De Marco                              | 1966         | Leather/Exotic Skins | Blend                   |
| Culthead                                 | N/A                                     | GBR | Rina Einy                                    | 2018         | Fur                  | Recycled material       |
| Devo Home                                | N/A                                     | UKR | Oksana Devoe                                 | 2008         | Fur                  | Plant-derived           |
| Eco Supreme                              | N/A                                     | USA | Ivan Wang                                    | 2008         | Down                 | Microbe-derived         |
| Eco Vegan Leather Private Limited        | Ultraw Vegan Leather                    | IND | N/A  | 1920         | Leather/Exotic Skins | Plant-derived           |
| Ecopel                                   | GACHA-Fur, KOBA® Faux fur, Cannaba Wool | CHN | Christopher Sarfati                          | 2003         | Fur                  | Blend                   |

| Company                 | Material name(s)           | HQ  | Founders  | Year Founded | Biomimicry           | Main Input              |
|-------------------------|----------------------------|-----|---|--------------|----------------------|-------------------------|
| EcoSimple               | N/A                        | BRA | Cláudio Rocha, Marisa Ferragutt.  | 2010         | Wool                 | Recycled material       |
| Ecovative Design        | MycroFlex™, Forager™ Hides | USA | Gavin McIntyre, Eben Bayer.   | 2007         | Leather/Exotic Skins | Mycelium                |
| ENKA                    | N/A                        | POL | Parent Company: International Chemical Investors Group  | 1924         | Silk                 | Plant-derived           |
| ESG Brands              | BANEX™                     | USA | Chase Kahmann, Gavin Pechey, Ryan Bachman, Ravi Kallayil.   | 2022         | Wool                 | Plant-derived           |
| Ettitude                | CleanBamboo™               | USA | Phoebe Yu   | 2014         | Silk                 | Plant-derived           |
| Evrnu                   | NuCycl™                    | USA | Stacy Flynn, Christopher Stanev.  | 2020         | Silk                 | Recycled material       |
| Faborg                  | Weganool™                  | IND | Shankar Dhakshinamoorthy  | 2015         | Wool                 | Plant-derived           |
| Faircraft               | N/A                        | FRA | Haïkel Balti, Cesar Valencia Gallardo.  | 2020         | Leather/Exotic Skins | Cultivated animal cells |
| Fiquetex                | N/A                        | COL | Alejandro Moreno, Gabriel Moreno.   | 2017         | Leather/Exotic Skins | Plant-derived           |
| Flaura, cuir végétal    | Apple waste leather        | CAN | Fannie Laroche and Grégory Hersant  | 2022         | Leather/Exotic Skins | Plant-derived           |
| Flocus                  | N/A                        | NLD | Jeroen Muijsers   | 2014         | Down                 | Plant-derived           |
| Flora Fur               | N/A                        | USA | Isabella Bruski, Noah Silva.  | 2018         | Wool                 | Plant-derived           |
| Fruitleather Rotterdam  | N/A                        | NLD | Koen Meerkerk, Hugo de Boon.  | 2016         | Leather/Exotic Skins | Plant-derived           |
| Fruitonauts             | Fruitazing                 | POL | Peter Matuszewski, Lukas Piszczyk, Matt Toporowitz  | 2019         | Leather/Exotic Skins | Plant-derived           |
| GeneUs Biotech (Furoid) | LIQUIDWOOL™                | NLD | Mariya Zakurnaeva-Kunz, Henri Kunz.   | 2017         | Fur, Wool            | Cultivated animal cells |
| Gozen Bioworks          | Xylozen™                   | TUR | Ece Gözen Akin  | 2020         | Leather/Exotic Skins | Microbe-derived         |
| Gunas New York          | Mulbtex™                   | USA | Sugandh G. Agrawal  | 2009         | Leather/Exotic Skins | Plant-derived           |
| Hemp Black              | HEMP BLACK™/hide           | USA | N/A   | 2017         | Leather/Exotic Skins | Blend                   |
| House of Fluff          | BIOFUR™                    | USA | Kym Canter  | 2017         | Fur                  | Blend                   |
| Jacinto & Lirio         | N/A                        | PHL | Anne Krystle Yee, Noreen Bautista, Patricia Lalisan, Ryan Pelongco, Charm Cruz.                   | 2009         | Leather/Exotic Skins | Plant-derived           |
| KD New York             | Vegetable Cashmere         | USA | David Lee, Tricia Kaye.   | 1980         | Wool                 | Plant-derived           |
| Keel Labs               | N/A                        | USA | Tessa Callaghan, Aleks Gosiewski, Aaron Nesser.   | 2017         | Silk                 | Plant-derived           |
| Kintra Fibers           | Kintra                     | USA | Billy McCall, Alissa Baier-Lentz.   | 2018         | Silk, Wool           | Plant-derived           |
| La Tannerie Vegetale    | PHyli                      | FRA | Fanny Deleage   | 2019         | Leather              | Plant-derived           |
| Le Qara                 | N/A                        | PER | Jacqueline L. Cruz, Isemar Cruz.  | 2017         | Leather/Exotic Skins | Microbe-derived         |
| MABE Bio                | Angico Leather             | BRA | Marina Belintani and Rachel Maranhao  | 2022         | Leather/Exotic Skins | Plant-derived           |
| Malai Biomaterials      | Malai Biocomposite         | IND | Zuzana Gombosova & C. S. Susmith, Co-founders   | 2018         | Leather/Exotic Skins | Microbe-derived         |
| Metsä Spring Ltd.       | Kuura                      | FIN | N/A   | 2018         | Fur, Wool            | Plant-derived           |
| Miko                    | Dinamica®                  | ITA | Miko is part of the Sage Group Automotive Interiors, a subsidiary of the Asahi Kasei Corporation. | 2015         | Leather/Exotic Skins | Blend                   |

| Company                       | Material name(s)        | HQ  | Founders   | Year Founded | Biomimicry           | Main Input        |
|-------------------------------|-------------------------|-----|--|--------------|----------------------|-------------------|
| MINK                          | N/A                     | USA | Rebecca Mink   | 2000         | Leather/Exotic Skins | Plant-derived     |
| Modern Meadow/<br>BioFabbrica | Bio-Vera, Bio-Tex       | USA | Andras Forgacs, Gabor Forgacs, Karoly Jakab, Francoise Marga.                            | 2011         | Leather/Exotic Skins | Plant-derived     |
| Modern Synthesis              | N/A                     | GBR | Jen Keane, Ben Reeve   | 2020         | Leather/Exotic Skins | Microbe-derived   |
| Muush                         | Muush Material          | PRT | EDUARDO SYDNEY, LEANDRO OSHIRO, ANTONIO DE FRANCISCO                                     | 2019         | Leather/Exotic Skins | Mycelium          |
| MycaNova (Citribel)           | MycaNova®               | BEL | Alphonse Cappuyns  | 1929         | Leather/Exotic Skins | Plant-derived     |
| Mycel Project                 | Myco Leather            | KOR | Sungjin Sah, Sungwon Kim, Yunggon Park.  | 2020         | Leather/Exotic Skins | Mycelium          |
| MYCL   Mycotech Lab           | Mylea™                  | IDN | Annisa Wibi, Adi Reza Nugroho, Ronaldiaz Hartantyo, Arekha Bentangan, Robby Zidna Ilman. | 2015         | Leather/Exotic Skins | Mycelium          |
| Mycocycle, Inc                | MicoFill                | USA | Joanne Rodriguez   | 2018         | Down                 | Mycelium          |
| Mycofutures                   | Mycelium-based material | CAN | Stephanie Lipp, Leo Gillis.  | 2020         | Leather/Exotic Skins | Mycelium          |
| Mycoworks                     | Reishi™                 | USA | Philip Ross, Sophia Wang, Eddie Pavlu.   | 2013         | Leather/Exotic Skins | Mycelium          |
| Mylium                        | N/A                     | NLD | Iris Houthoff  | 2018         | Leather/Exotic Skins | Mycelium          |
| Nanollose                     | Nullarbor™              | AUS | Wayne Best   | 2014         | Silk                 | Microbe-derived   |
| Napee                         | Napee Vegan Leather     | ITA | Alessandro Fabbri, Giuseppe Guido.   | 2020         | Leather/Exotic Skins | Plant-derived     |
| NFW                           | Mirum®                  | USA | Luke Haverhals   | 2015         | Leather/Exotic Skins | Plant-derived     |
| NEFFA   New Fashion Factory   | MYCOTEX                 | NLD | Aniela Hoitink & Noline van Enter  | 2020         | Leather/Exotic Skins | Mycelium          |
| Newlight                      | AirCarbon™              | USA | Kenton Kimmel, Mark Herrema.   | 2003         | Leather/Exotic Skins | Microbe-derived   |
| NEXT-GEN LEATHER SL.          | BacLEATHER®             | ESP | Concha Garcia, L. A. Fernández.  | 2012         | Leather/Exotic Skins | Microbe-derived   |
| Nova Milan                    | N/A                     | CRI | Irma Orenstein, Karim Quazzani, Dror Weksler, Mycol Benhamou.                            | 2019         | Leather/Exotic Skins | Plant-derived     |
| NUVI                          | NUVI                    | DEU | Nina Rössler   | 2014         | Leather/Exotic Skins | Plant-derived     |
| Oceanium                      | N/A                     | GBR | Karen Scofield Seal and Dr Charlie Bavington   | 2018         | Leather/Exotic Skins | Plant-derived     |
| Ohoskin                       | N/A                     | ITA | Adriana Santanocito  | 2020         | Leather/Exotic Skins | Plant-derived     |
| Oleago                        | Oleatex™                | TUR | Eşref Açıık, Recep Eroğlu, Emre Eroğlu.  | 2021         | Leather/Exotic Skins | Plant-derived     |
| Ono Collaborations            | N/A                     | CHE | Bernadette Christina Bodenmueller.   | 2017         | Leather/Exotic Skins | Plant-derived     |
| Orange Fiber                  | N/A                     | ITA | Enrica Arena, Adriana Santanocito.   | 2014         | Silk                 | Plant-derived     |
| Osom Brand                    | Osomtex®                | USA | Patricia Ermecheo  | 2016         | Wool                 | Recycled material |
| Panama Trimmings              | Viridis®                | ITA | Giuliano Pinato  | 1981         | Leather/Exotic Skins | Plant-derived     |
| Pangaia                       | FLWRDWN™                | GBR | Jasmine Mullers, Rachna Bhasin, Nathalie Longuet.  | 2018         | Down                 | Plant-derived     |
| PEEL Lab                      | N/A                     | JPN | Jim Huang  | 2021         | Leather              | Plant-derived     |
| PersiSKIN                     | PersiSKIN Vegan Leather | ESP | Jaime Sanfelix   | 2020         | Leather/Exotic Skins | Plant-derived     |

| Company                  | Material name(s)    | HQ  | Founders  | Year Founded | Biomimicry                 | Main Input               |
|--------------------------|---------------------|-----|---|--------------|----------------------------|--------------------------|
| Planet of the Grapes     | Grape Leather       | FRA | Samantha Mureau.  | 2020         | Leather/Exotic Skins       | Plant-derived            |
| Polybion                 | Celium®             | MEX | Alexis Gómez-Ortigoza, Axel Gómez-Ortigoza, Bárbara González Rolón.         | 2015         | Leather/Exotic Skins       | Microbe-derived          |
| Ponda                    | BioPuff®            | GBR | Antonia Jara-Contreras, Neloufar Taheri, Julian Ellis-Brown, Finlay Duncan. | 2020         | Down                       | Plant-derived            |
| Portugaliacork           | Cork leather        | PRT | Ramiro Baptista   | 2005         | Leather/Exotic Skins       | Plant-derived            |
| Provenance Bio           | N/A                 | USA | Michalyn Andrews, Christian Ewton   | 2016         | Leather/Exotic Skins       | Microbe-derived          |
| Proyecto Menos es Más    | Bambuflex©          | ARG | Natalia Pérez   | 2010         | Leather/Exotic Skins       | Plant-derived            |
| Qorium                   | N/A                 | NLD | Rutger Ploem, Stef Kranendijk, Mark Post.                                   | 2015         | Leather/Exotic Skins       | Cultivated animal cells  |
| Really Clever            | N/A                 | GBR | Patrick Baptista Pinto & Matthew Millar                                     | 2021         | Leather/Exotic Skins       | Plant-derived            |
| Renewcell                | Circulose®          | SWE | Mikael Lindström, Christofer Lindgren, Malcolm Norlin, Gunnar Henriksson.   | 2012         | Silk                       | Recycled material        |
| Rubi Laboratories        | N/A                 | USA | Neeka and Leila Mashouf   | 2020         | Silk                       | Recycled material        |
| Revoltech                | LOVR                | DEU | Montgomery Wagner, Julian Mushövel, Lucas Fuhrmann.                         | 2021         | Leather/Exotic Skins       | Plant-derived/hemp waste |
| Save The Duck            | Plumtech®           | CAN | Nicolas Bargi   | 2012         | Down                       | Recycled material        |
| Scays Group              | WASTE A             | TUR | Erdem Dogan   | 2005         | Leather/Exotic Skins       | Plant-derived            |
| Sci-Lume Labs™           | Bylon™              | USA | Oliver Shafaat  | 2021         | Silk                       | Plant-derived            |
| ScobyTec                 | ScobyTec BNC        | DEU | Carolin Wendel, Bernhard Schipper, Carolin Schulze.                         | 2014         | Leather/Exotic Skins       | Microbe-derived          |
| Seevix Material Sciences | SVX™                | ISR | Shlomzion Shen, Shmulik Ittah.  | 2014         | Silk                       | Microbe-derived          |
| Slow Factory Labs        | Slowhide™           | USA | Céline Semaan, Colin Vernon.  | 2021         | Leather/Exotic Skins       | Microbe-derived          |
| SmartFiber AG            | SeaCell™, Smartcel™ | DEU | Subsidiary of Lenzing AG.   | 2005         | Silk                       | Plant-derived            |
| Soarce                   | Searamic-           | USA | Mason Mincey, Derek Saltzman.   | 2020         | Leather/Exotic Skins, Wool | Plant-derived            |
| SpadXTech                | N/A                 | GBR | Lina M. González, Connor Crawford   | 2020         | Leather                    | Microbe-derived          |
| Spiber                   | Brewed Protein™     | JPN | Kazuhide Sekiyama, Sugawara Junichi.  | 2007         | Silk, Wool                 | Microbe-derived          |
| Spidey Tek               | N/A                 | USA | Roberto Velozzi   | 2015         | Silk                       | Plant-derived            |
| Spinnova                 | N/A                 | FIN | Juha Salmela  | 2014         | Wool                       | Plant-derived            |
| Spora Biotech            | Sporatex™           | CHL | Hernán Rebolledo, José Miguel Figueroa.                                     | 2017         | Leather/Exotic Skins       | Mycelium                 |
| SQIM                     | Ephea               | ITA | Maurizio Montalti and Stefano Babbini                                       | 2015         | Leather/Exotic Skins       | Mycelium                 |
| Tandem Repeat            | Squitex             | USA | Gozde Senel-Ayaz, Benjamin Allen, Melik Demirel.                            | 2018         | Silk, Wool                 | Microbe-derived          |
| Tenbro                   | N/A                 | CHN | N/A   | 2002         | Silk                       | Plant-derived            |

| Company   | Material name(s)                             | HQ  | Founders   | Year Founded | Biomimicry           | Main Input                       |
|---|--|-----|--|--------------|----------------------|----------------------------------|
| The Center for Renewable Materials (UC San Diego) | N/A  | USA | Anastasia Bachykala, Michael Burkart, Luca Bonanomi, Naser Pourahmady. | 2020         | Leather/Exotic Skins | Microbe-derived                  |
| TômTex  | Series M                                     | USA | Uyen Tran  | 2020         | Leather              | Plant-derived                    |
| Ultrafabrics                                      | Ultraleather® Volar Bio                      | USA | Clay Andrew Rosenberg, Barbara Danielle Boecker-Primack.               | 1966         | Leather/Exotic Skins | Blend                            |
| Uncaged Innovations                               | N/A  | USA | Stephanie Downs  | 2020         | Leather/Exotic Skins | Plant-derived                    |
| Unreal Fur  | N/A  | AUS | Gilat Shan   | 2011         | Fur                  | Recycled material                |
| Vegatex   | Vegatex™                                     | CHN | N/A  | 2011         | Leather/Exotic Skins | Plant-derived                    |
| Vegea   | N/A  | ITA | Francesco Merlino, Gianpiero Tessitore, Valentina Longobardo.          | 2016         | Leather/Exotic Skins | Plant-derived                    |
| Vegeto  | Milkweed                                     | CAN | Louis Bibeau   | 2018         | Down                 | Plant-derived                    |
| VegSkin   | N/A  | FRA | Loïc Debrabander, Anaëlle Picavet.                                     | 2020         | Leather/Exotic Skins | Plant-derived                    |
| VitroLabs   | N/A  | USA | Ingvar Helgason  | 2016         | Leather/Exotic Skins | Cultivated animal cells          |
| von Holzhausen                                    | Banbū Leather, Technik-Leather™ Liquidplant™ | USA | Vicki von Holzhausen   | 2015         | Leather/Exotic Skins | Plant-derived, Recycled material |
| Werewool  | N/A  | USA | Chui-Lian Lee, Valentina Gomez   | 2018         | Silk                 | Microbe-derived                  |
| Zvnder  | Fungiskin                                    | DEU | Nina Fabert  | 2017         | Leather/Exotic Skins | Plant-derived                    |

□: Companies added to MII's database in 2023

The next-gen materials industry and the innovators within this ecosystem develop at a fast pace. All company references are purely illustrative. Please check our website for the latest company information. Our [website](#) also has a downloadable and sortable chart of this information in our [Innovator Database](#). Apply to add new companies to our Innovator Database or submit updates [here](#).



Image credit: Ecovative

### Exhibit 9. Corporations that have next-gen materials in their offerings (2023)

The list focuses on corporations that have disclosed they are developing next-gen materials as part of their offerings. Since these corporations typically have a much wider range of product offerings and business streams, we exclude these corporations from data presented in the Investors section. This is to avoid skewing the numbers with any investments that cannot be directly attributed to next-gen materials innovation.

| Company                 | Material name(s)  | HQ  | Biomimicry            | Main Input           |
|-------------------------|---|-----|-----------------------|----------------------|
| 3M                      | Thinsulate™ Insulation - Featherless                            | USA | Down                  | Recycled material    |
| Asahi Kasei Corporation | Lamous, Bemberg™  | JPN | Leather, Silk         | Blend, Plant-derived |
| Eastman                 | Naia™   | USA | Silk                  | Plant-derived        |
| Fiscatechx              | Ultra Wer; Fly Tela Eco, Rinnova, E-ULTRA®                      | ITA | Leather               | Blend; Plant-derived |
| General Silicones       | Compo-SiL® (Vegan Silicone Leather, launched in 2018)           | TWN | Leather               | Blend                |
| Gucci                   | Demetra   | ITA | Leather               | Plant-derived        |
| ISA TanTec              | COSM™ (Creation of Sustainable Materials) - HyphaLite, VeraLite | MAC | Leather               | Plant-derived        |
| Jord                    | Suberhide™  | USA | Leather               | Plant-derived        |
| Kuraray Co. Ltd.        | CLARINO™ Sustainable Collection                                 | JPN | Leather               | Blend                |
| Lenzing                 | Tencel™, Ecovero™   | AUT | Down, Fur, Wool, Silk | Plant-derived        |
| Mabel srl               | Uppeal™   | ITA | Leather/Exotic Skins  | Blend                |
| Pangaia Grado Zero      | Muskin™, BioGreen Padding                                       | ITA | Leather, Down         | Plant-derived        |
| Polartec                | Power Fill™   | USA | Down                  | Recycled material    |
| PrimaLoft               | PrimaLoft® Bio™   | USA | Down                  | Recycled material    |
| Sileather               | N/A   | USA | Leather               | Blend                |
| The LYCRA Company       | THERMOLITE® EcoMade T-DOWN                                      | USA | Down                  | Recycled material    |
| Thermore                | Ecodown®  | NLD | Down                  | Recycled material    |
| Toray Industries, Inc.  | Ultrasuede®   | JPN | Leather               | Blend                |
| Volkswagen              | N/A   | DEU | Leather               | Plant-derived        |
| Volvo                   | Nordico   | SWE | Leather               | Blend                |



Image credit: Modern Synthesis

# 4. INVESTORS



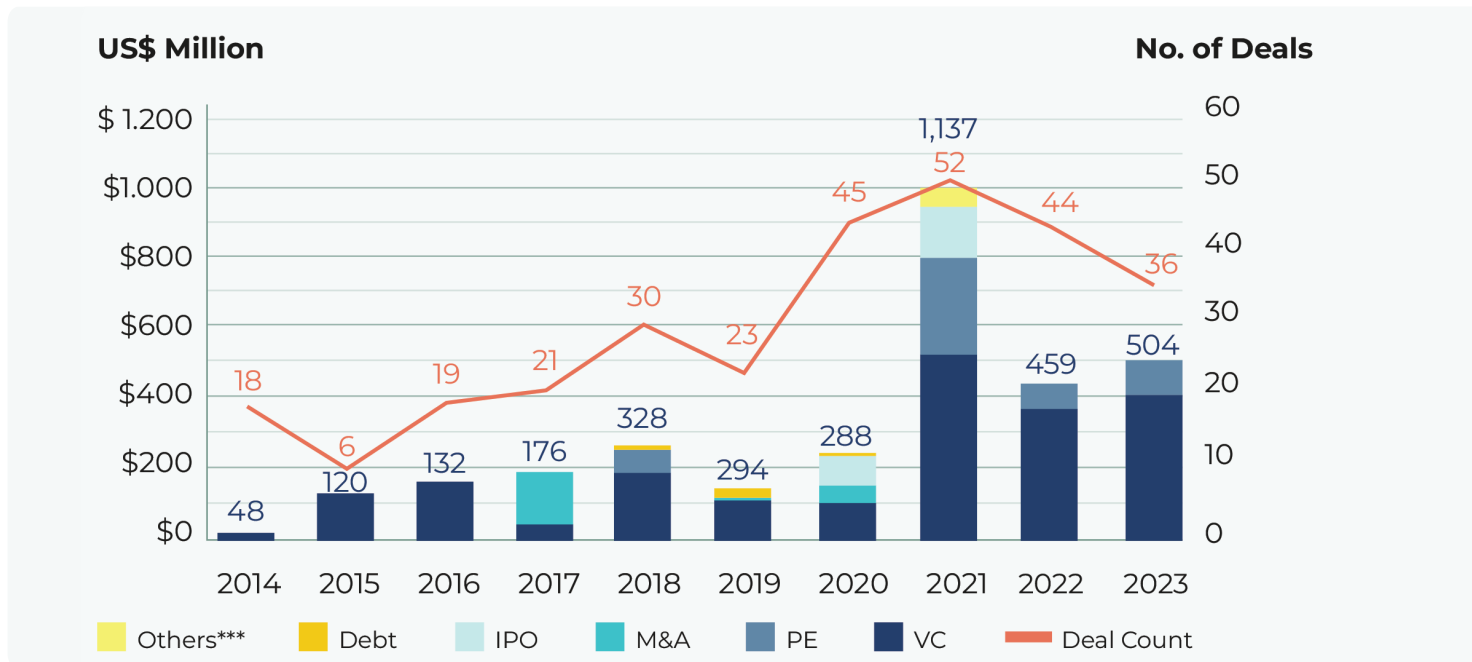
## Overview

This section provides an overview of investment activities in the next-gen materials industry.

The next-gen materials investment landscape saw a slight rebound in 2023, despite the global economic atmosphere. Just over US\$500 million was raised by the next-gen material companies listed in Exhibit 8 above, from 36 publicly disclosed deals. It is important to remember that this number does not include significant investments in the industry through

companies' internal investments in the development of next-gen materials. This type of investment holds significant promise for the development of next-gen materials due to the expertise and reach of the companies themselves. One such example is Gucci's investment in their Demetra next-gen leather which holds significant promise given Gucci's reputation, expertise in high quality leather, and available resources.

### Capital invested in next-gen material companies, 2014-2023



**Exhibit 10.** Capital invested in next-gen material companies, 2014-2023

\*\*\* "Others" includes deal types (i) Secondary Transactions - Private, & (ii) Corporate (Non-control transaction)

**Source:** MII analysis on investment activities in companies included in MII's company database, based on data from PitchBook and primary research.

The data collected and analyses conducted are based solely on MII's company database (list of companies in Exhibit 8). The list of investors, investment figures, and other data are limited by publicly disclosed information. Since corporate R&D investment (including but not limited to investments within the list of companies in Exhibit 9) and other undisclosed deals are not included, the investment figures presented in this section, whether in relation to the industry or to each individual company or investor, are underestimated.

## IN

In 2021 we saw an unprecedented spike in capital invested in next-gen materials companies, followed by a sharp decrease in 2022. An upward momentum re-appeared in 2023 ending at a total of just over US\$500 million raised in 36 publicly disclosed deals.

More notable fundings in 2023 include Newlight's US\$245 million Series G round. Other "usual suspects" in this field also raised further rounds in 2023. NFW raised over US\$40 million from venture capital; MycoWorks raised a private equity round of US\$34.4 million; and Ecovative raised a Series E of US\$13.8 million.

Bolt Threads brought in over US\$33 million with a PIPE offering after the company paused production of its alternative leather product Mylo. With the additional funding, Bolt Threads will refocus on its other product b-silk, which is an alternative spider silk with applications in fashion and skincare. Another company that had a PIPE offering in 2023 is Re:Newcell, raising over US\$20 million.

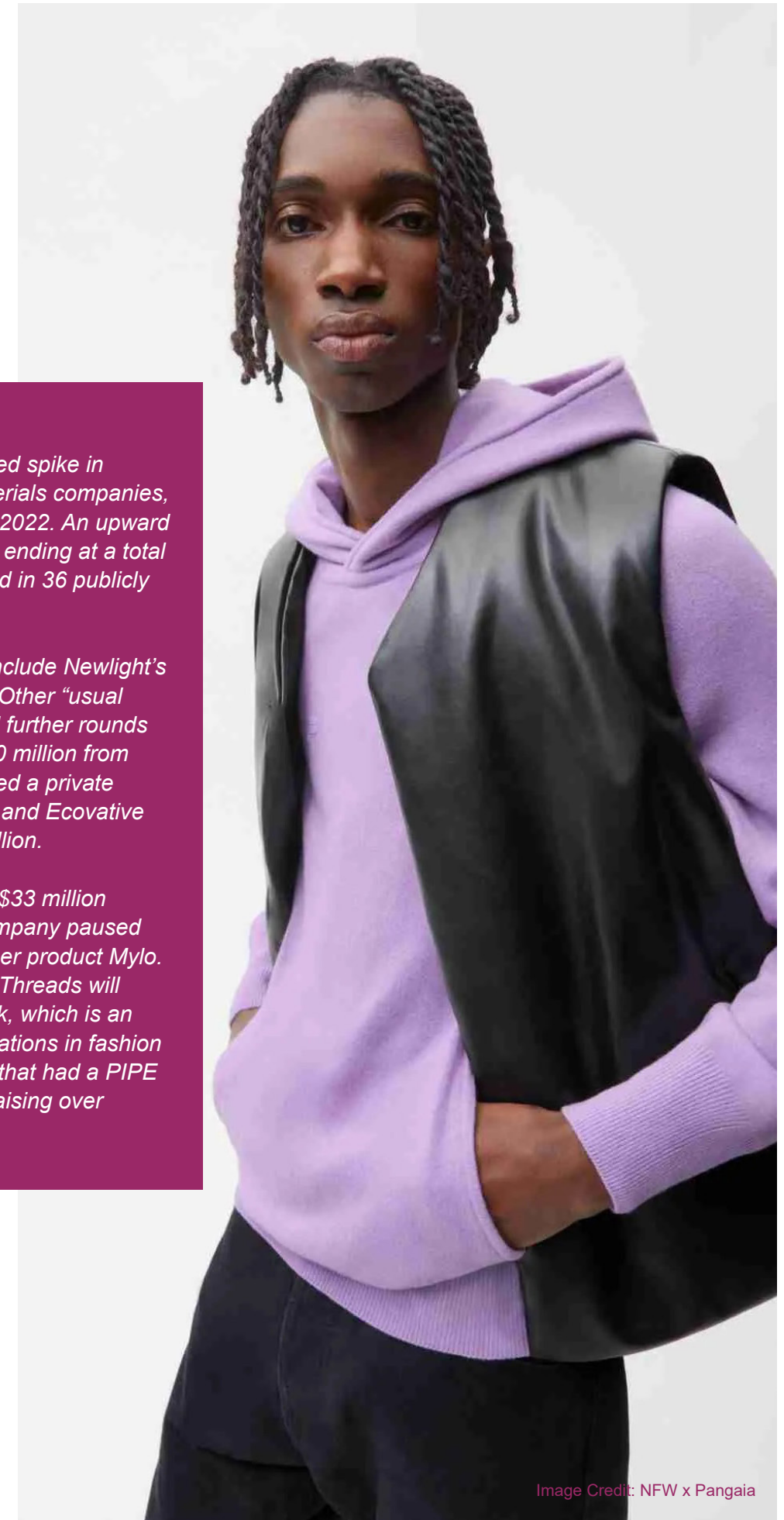


Image Credit: NFW x Pangaia

“The backdrop of 2023 was that global VC funding fell 42% and deal count fell 30% to reach a 6-year low.<sup>4</sup> The global downturn that we had seen from 2022 has accelerated further, to say the least.

Back in 2022, in the next-gen materials space we also saw a sharp decrease in funding compared to an unprecedented spike in 2021; again this is against the backdrop of a spike in global VC funding which more than doubled from 2020 to 2021 then had a sharp decline from 2021 to 2022, followed by over 40% further drop in 2023.

The broader economic atmosphere aside, there were market signals such as Bolt Threads announcing to halt production of their alternative leather Mylo due to lack of funding to scale, and also “gotcha” media coverage questioning how sustainable these materials really are (without much background data, we should add). These signals point to this nascent industry perhaps going through the Trough of Disillusionment in Gartner’s Hype Cycle, where innovation typically progresses through a pattern of overenthusiasm followed by disillusionment then eventually productivity.

As a team that helped incubate two industries, we have lived the Cycle multiple times with the innovators, investors, and brands we support. We have seen the sign that an industry is sliding into the trough as the same few stories of early success have been repeated over and over and the market starts to get impatient with the lack of

realized scaled production and availability of the new products. However, for the next-gen materials industry, by the end of 2023 we were pleasantly surprised by an upward trend in investments once again. And the next-gen materials space may come out of the trough faster than we thought.

One thing working in favor of next-gen materials, amidst an economic downturn, is that the buyers creating the demand the most are top industry brands, the likes of Nike, IKEA, and Volvo that purchase materials in thousands of tonnes per year. And what drives their demand for shifting from incumbent to next-gen materials, is primarily the pressure upon them (including from consumers and regulations) to make progress in sustainability and decrease their environmental footprint. End consumers’ sentiment matters, but the multiple laws and regulations coming into force globally, such as the EU’s corporate sustainability due diligence directive, France’s AGEC law, and the New York Fashion Act, are replacing the once voluntary system with mandatory targets to meet and consequences for non-compliance.”



**Elaine Siu**  
Advisor, MII

This list includes only the investors who invested in the next-gen material companies (listed in Exhibit 8) in the year of 2023. Only publicly disclosed information is included.

#### Exhibit 11. Investors in next-gen material companies in 2023

| Investor                        | Total No. of Investments in next-gen material companies | Investments in 2023 | Next-gen material companies invested in                  | Investor Type                              | HQ Location            |
|---------------------------------|---|---------------------|--|--|------------------------|
| Astanor Ventures                | 3   | 2                   | Biofluff, Modern Meadow                                  | Impact Investing                           | Kirchberg, Luxembourg  |
| Golden Arrow Merger (NAS: GAMC) | 2   | 2                   | Bolt Threads   | Special Purpose Acquisition Company (SPAC) | New York, NY           |
| IndieBio                        | 7   | 3                   | Biofluff, Bucha Bio, Gozen, MycoWorks, TômTex            | Accelerator/Incubator                      | San Francisco, CA      |
| SOSV                            | 11  | 3                   | Biofluff, Bucha Bio, Gozen, Keel Labs, MycoWorks, TômTex | Venture Capital                            | Princeton, NJ          |
| Abhijeet Birewar                | 1   | 1                   | Newlight   | Angel (individual)                         |                        |
| Accelerating Asia               | 1   | 1                   | PEEL Lab   | Accelerator/Incubator                      | Singapore              |
| Accelr8 (Impact Fund Investing) | 1   | 1                   | Gozen  | Impact Investing                           | Boston, MA             |
| AiiM Partners                   | 3   | 1                   | Ecovative, NFW   | Venture Capital                            | Palo Alto, CA          |
| Alumni Ventures                 | 2   | 1                   | Mycocycle  | Venture Capital                            | Manchester, NH         |
| Alwyn Capital                   | 4   | 1                   | Bucha Bio, House of Fluff, Uncaged Innovations           | Venture Capital                            | Roslyn, NY             |
| Anthropocene Ventures           | 2   | 1                   | Mycocycle  | Venture Capital                            | San Francisco, CA      |
| Antler                          | 2   | 1                   | MABE Bio   | Venture Capital                            | Singapore, Singapore   |
| Asahi Kasei (TKS: 3407)         | 1   | 1                   | NFW  | Holding Company                            | Tokyo, Japan           |
| Astor Management                | 1   | 1                   | Gozen  | Venture Capital                            | Zug, Switzerland       |
| AT Newtec                       | 3   | 1                   | AMSilk   | Venture Capital                            | Munich, Germany        |
| Athos (Family Office)           | 3   | 1                   | AMSilk   | Family Office                              | Munich, Germany        |
| Brightlands Venture Partners    | 2   | 1                   | Qorium   | Venture Capital                            | Geleen, Netherlands    |
| Cargill                         | 2   | 1                   | AMSilk   | Corporation                                | Minneapolis, MN        |
| Carrier-ok                      | 1   | 1                   | TômTex   | Holding Company                            | New Castle, DE         |
| CDP Venture Capital             | 1   | 1                   | SQIM   | Venture Capital                            | Rome, Italy            |
| Clean Growth Fund               | 1   | 1                   | Arda Biomaterials  | Impact Investing                           | London, United Kingdom |
| Climate Capital                 | 4   | 3                   | Modern Synthesis, Tandem Repeat, TômTex                  | Venture Capital                            | San Francisco, CA      |
| CNX Resources (NYS: CNX)        | 1   | 1                   | Newlight   | Corporation                                | Canonsburg, PA         |
| Cool Climate Collective         | 1   | 1                   | Mycocycle  | Angel Group                                | CA                     |

| Investor                          | Total No. of Investments in next-gen material companies | Investments in 2023 | Next-gen material companies invested in                   | Investor Type             | HQ Location            |
|-----------------------------------|---|---------------------|---|---------------------------|------------------------|
| CPT Capital                       | 4   | 1                   | Arda Biomaterials, Bolt Threads, Modern Meadow, VitroLabs | Venture Capital           | London, United Kingdom |
| D-Camp                            | 1   | 1                   | Mycel Project   | Accelerator/Incubator     | Seoul, South Korea     |
| Earth Venture Capital             | 1   | 1                   | TômTex  | Venture Capital           | Vietnam                |
| ECBF Management                   | 1   | 1                   | SQIM  | Venture Capital           | Bonn, Germany          |
| Entrepreneur First                | 5   | 1                   | Arda Biomaterials, FairCraft                              | Venture Capital           |                        |
| Fashion For Good                  | 4   | 1                   | Keel.Labs, Kintra Fibers, Mycotech Lab, NFW               | Accelerator/Incubator     | Amsterdam, Netherlands |
| Federal Grants                    | 1   | 1                   | Tandem Repeat   | Government                |                        |
| FoodHack                          | 1   | 1                   | Tandem Repeat   | VC-Backed Company         | Lausanne, Switzerland  |
| FootPrint Coalition Ventures      | 1   | 1                   | Ecovative   | Corporate Venture Capital | Beverly Hills, CA      |
| FuzeHub                           | 1   | 1                   | Uncaged Innovations                                       | Corporation               | Albany, NY             |
| GenZero                           | 1   | 1                   | Newlight  | Impact Investing          | Singapore, Singapore   |
| Gershon Capital                   | 1   | 1                   | Gozen   | Venture Capital           | Sion, Switzerland      |
| Glass Wall Syndicate              | 1   | 1                   | Uncaged Innovations                                       | Angel Group               | Leawood, KS            |
| Global Fund for Coral Reefs       | 1   | 1                   | Carbonwave  | Accelerator/Incubator     | Geneva, Switzerland    |
| Global Public Offering Fund       | 1   | 1                   | Newlight  | Growth/Expansion          | New York, NY           |
| Greentown Labs                    | 2   | 1                   | Bucha Bio, SpadxTech                                      | Accelerator/Incubator     | Somerville, MA         |
| Hack Capital                      | 1   | 1                   | Uncaged Innovations                                       | Venture Capital           |                        |
| Happiness Capital                 | 2   | 2                   | Gozen, TômTex   | Corporate Venture Capital | Hong Kong, Hong Kong   |
| Horizons Ventures                 | 6   | 1                   | Keel.Labs, Modern Meadow                                  | Venture Capital           | Hong Kong, Hong Kong   |
| Hoxton Ventures                   | 2   | 1                   | Really Clever   | Venture Capital           | London, United Kingdom |
| Hult Prize                        | 1   | 1                   | Banofi  | Other                     | Boston, MA             |
| Ideaship                          | 1   | 1                   | ESG Brands  | Venture Capital           | Portland, OR           |
| InMotion Ventures                 | 1   | 1                   | Uncaged Innovations                                       | Corporate Venture Capital | London, United Kingdom |
| Jaguar Land Rover Innovation Labs | 1   | 1                   | Uncaged Innovations                                       | Accelerator/Incubator     | Portland, OR           |
| Jeff Brannon                      | 1   | 1                   | Newlight  | Angel (individual)        |                        |
| Jeff Elliott                      | 1   | 1                   | Newlight  | Angel (individual)        |                        |
| Katapult Ocean                    | 1   | 1                   | Carbonwave  | Venture Capital           | Oslo, Norway           |
| Kent Mabalay                      | 1   | 1                   | Newlight  | Angel (individual)        |                        |
| Kering (PAR: KER)                 | 2   | 1                   | SQIM, VitroLabs   | Corporation               | Paris, France          |
| Key Partners Capital              | 2   | 1                   | Modern Meadow   | Venture Capital           | Berlin, Germany        |

| Investor  | Total No. of Investments in next-gen material companies | Investments in 2023 | Next-gen material companies invested in   | Investor Type             | HQ Location            |
|---|---|---------------------|---|---------------------------|------------------------|
| Louis Dreyfus Company Ventures                    | 1   | 1                   | NFW   | Corporate Venture Capital | Rotterdam, Netherlands |
| Mark Anderson                                     | 1   | 1                   | Newlight  | Angel (individual)        | Irvine, CA             |
| Material Impact Fund                              | 1   | 1                   | Werewool  | Venture Capital           | Boston, MA             |
| Meliorate Partners                                | 1   | 1                   | TômTex  | Asset Manager             | Mercer Island, WA      |
| MIG AG  | 5   | 1                   | AMSilk  | Venture Capital           | Munich, Germany        |
| MiH Ventures                                      | 1   | 1                   | TômTex  | Venture Capital           | New Delhi, India       |
| Mirova  | 1   | 1                   | Carbonwave  | Asset Manager             | Paris, France          |
| Morro Ventures                                    | 1   | 1                   | Carbonwave  | Venture Capital           | San Juan, PR           |
| New Canaan Impact Capital                         | 1   | 1                   | Tandem Repeat   | Merchant Banking Firm     | Campobello, SC         |
| Novo Holdings                                     | 5   | 1                   | AMSilk, MycoWorks   | Asset Manager             | Copenhagen, Denmark    |
| Occidental Petroleum (NYS: OXY)                   | 1   | 1                   | Newlight  | Corporation               | Houston, TX            |
| Oxy Low Carbon Ventures                           | 1   | 1                   | Newlight  | Corporation               | Houston, TX            |
| Paul Raver  | 1   | 1                   | Newlight  | Angel (individual)        |                        |
| Pegasus Capital Advisors                          | 1   | 1                   | Carbonwave  | PE/Buyout                 | Stamford, CT           |
| Plug and Play Tech Center                         | 8   | 1                   | Arda Biomaterials, Biophillica, Keel.Labs, Mycotech Lab, NEFFA, Ohoskin, Orange Fiber, Provenance Bio | Accelerator/Incubator     | Sunnyvale, CA          |
| Popular (NAS: BPOP)                               | 1   | 1                   | Carbonwave  | Corporation               | New York, NY           |
| Prithvi Ventures                                  | 3   | 1                   | Bucha Bio, Tandem Repeat  | Venture Capital           | New York, NY           |
| Progress Tech Transfer                            | 2   | 1                   | SQIM  | Impact Investing          | Luxembourg, Luxembourg |
| Pulsalys SAS                                      | 1   | 1                   | La Tannerie Vegetale  | Accelerator/Incubator     | France                 |
| Rice Alliance for Technology and Entrepreneurship | 1   | 1                   | Banofi  | Accelerator/Incubator     | Houston, TX            |
| Sabita Singh                                      | 1   | 1                   | Newlight  | Angel (individual)        |                        |
| Satgana   | 1   | 1                   | Arda Biomaterials   | Venture Capital           | Luxembourg, Luxembourg |
| Serpentine Ventures                               | 1   | 1                   | Arda Biomaterials   | Venture Capital           | Zurich, Switzerland    |
| Sofinnova Partners                                | 2   | 1                   | Qorium, Werewool  | Venture Capital           | Paris, France          |
| Standard Investments                              | 2   | 1                   | Ecovative   | Venture Capital           | New York, NY           |
| Stray Dog Capital                                 | 3   | 1                   | Uncaged Innovations, VitroLabs  | Venture Capital           | Leawood, KS            |
| Tamarack Capital Partners                         | 1   | 1                   | Evrnu   | Hedge Fund                | Lake Oswego, OR        |
| Telescopic Ventures                               | 1   | 1                   | Mycocycle   | Venture Capital           | Oakland, CA            |



| Investor                       | Total No. of Investments in next-gen material companies | Investments in 2023 | Next-gen material companies invested in | Investor Type         | HQ Location            |
|--------------------------------|---|---------------------|---|-----------------------|------------------------|
| Telus Pollinator Fund for Good | 2   | 1                   | Mycocycle                               | Venture Capital       | Vancouver, Canada      |
| The GS Challenge               | 1   | 1                   | Mycel Project                           | Accelerator/Incubator | Seoul, South Korea     |
| Tsai CITY                      | 1   | 1                   | Banofi                                  | Accelerator/Incubator | New Haven, CT          |
| VegInvest                      | 3   | 1                   | Uncaged Innovations, VitroLabs          | Venture Capital       | New York, NY           |
| Viking Global Investors        | 2   | 1                   | Ecovative                               | Hedge Fund            | Greenwich, CT          |
| Viridios Capital               | 1   | 1                   | Carbonwave                              | Impact Investing      | Mosman, Australia      |
| Volpini Ventures               | 1   | 1                   | Really Clever                           | Family Office         | London, United Kingdom |

**Source:** MII analysis on investment activities in companies included in MII's company database, based on data from PitchBook and primary research.



Image Credit: Mara Hoffman x Circ

If you are an investor interested in the next-gen material industry, opt in to [MII's Investor Database](#) to receive deal flow updates.

The following are the 10 top-funded next-gen material companies listed in Exhibit 8, according to publicly disclosed data.

**Exhibit 12.** Top 10 most funded next-gen material companies (in descending order by total amount raised) (2023)

| Company                        | Description  | Largest Round Size (USD Million) | Largest Round Deal Date | Total Amount Raised | Latest Round        |
|--------------------------------|--|----------------------------------|-------------------------|---------------------|---------------------|
| <b>Spiber</b>                  | Produces spider silk proteins via precision fermentation to create next-gen silk primarily for the fashion industry.   | 265.77                           | Sep-21                  | 588.15              | PE Growth/Expansion |
| <b>Newlight</b>                | Uses natural ocean microorganisms to make PHB from greenhouse gasses to produce next-gen leather primarily for the fashion industry.   | 245.09                           | Aug-23                  | 366.43              | Later Stage VC      |
| <b>Bolt Threads</b>            | Grows mycelium to produce next-gen leather (currently paused production) and uses precision fermentation to produce spider silk proteins for next-gen silk and skincare products.  | 214.29                           | Sep-21                  | 340                 | PIPE                |
| <b>MycoWorks</b>               | Grows mycelium to produce next-gen leather primarily for the fashion industry.   | 110.34                           | Mar-22                  | 352.4               | PE Growth/Expansion |
| <b>Modern Meadow*</b>          | Uses precision fermentation to grow collagen to create animal-free leather primarily for the fashion industry.   | 109.02                           | Apr-21                  | 238.01              | Later Stage VC      |
| <b>Re:Newcell (STO: RENEW)</b> | Renewcell's technology dissolves used cotton and other cellulose fibers and transforms them into the biodegradable raw material (pulp) that is used by the textile industry to make viscose, lyocell, modal, acetate, and other types of regenerated fibers. | 80.9                             | Nov-20                  | 228.73              | PIPE                |
| <b>Spinnova (HEL: SPINN)</b>   | Uses FSC-certified wood and waste streams to produce next-gen wool primarily for the fashion industry.   | 115                              | Jun-21                  | 168.01              | IPO                 |
| <b>NFW</b>                     | Uses fabricated compressed and/or discarded fiber sources coated with plant-based oil resin to produce next-gen leather primarily for the fashion industry.  | 77.33                            | Apr-22                  | 164.09              | Later Stage VC      |
| <b>AMSilk</b>                  | Supplier of vegan silk biopolymers. Created Biosteel® fibers for textiles and industrial applications worldwide. Biosteel® fiber is made of spider silk protein produced by genetically engineered microbes and spun into fiber.                             | 42.2                             | Jan-06                  | 160.5               | Later Stage VC      |
| <b>Ultrafabrics</b>            | Ultrafabrics manufactures leather-free performance fabrics for a variety of applications in the automotive, aviation, health care, hospitality, and home goods industries.   | 140.87                           | Feb-17                  | 150                 | Merger/Acquisition  |

\*Modern Meadow has formed a new joint venture, BioFabbrica LLC, with Limonta, an Italian textile and materials supplier, to focus on development of next-gen leather.

**Source:** MII analysis on investment activities in companies included in MII's company database, based on data from PitchBook and primary research.



Image Credit: ISA Next-Gen Materials

## Funding history of top 10 funded next-gen material companies

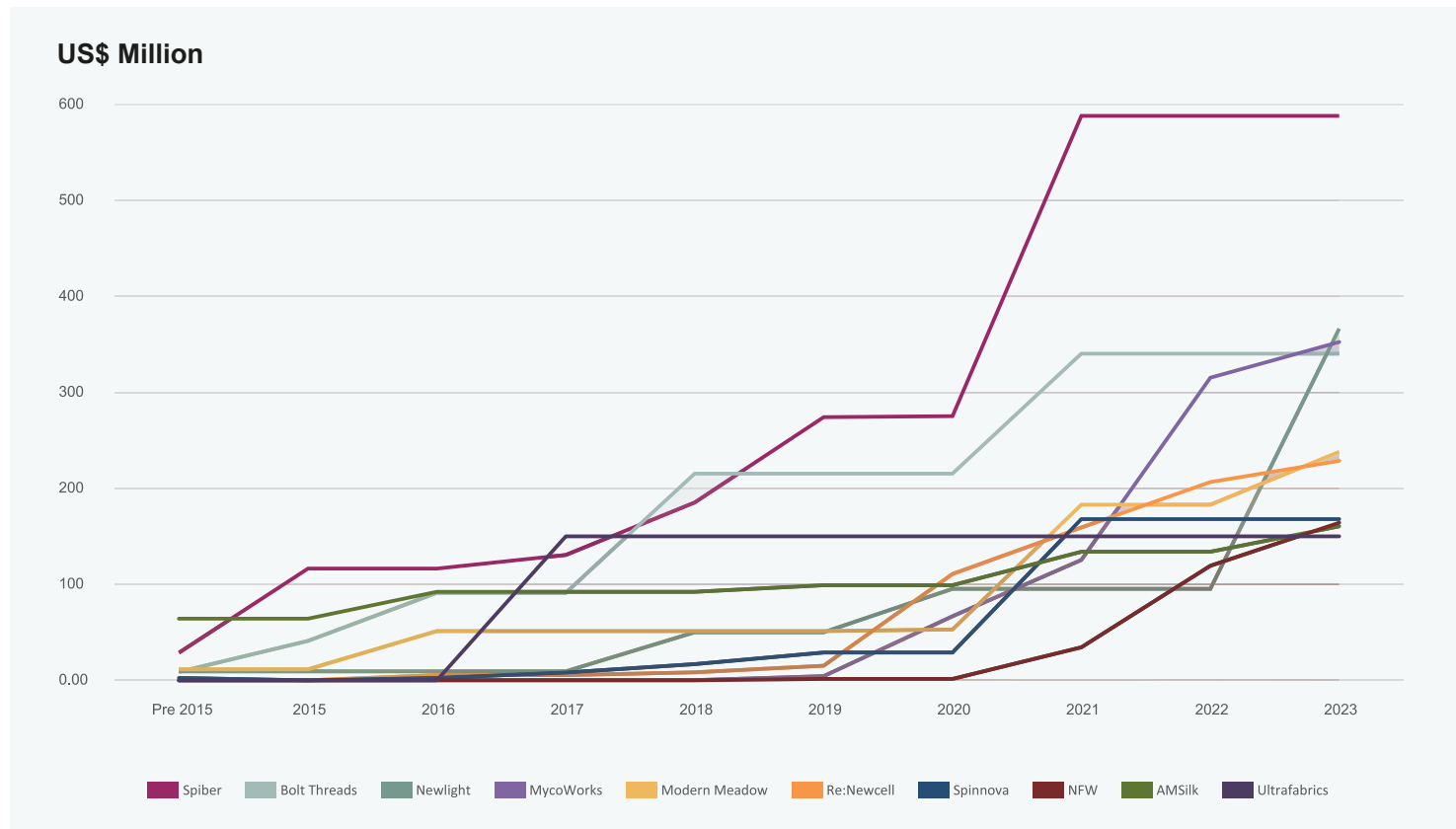


Exhibit 13. Funding history of top 10 funded next-gen material companies

Source: MII analysis on investment activities in companies included in MII's company database, based on data from PitchBook and primary research.



Image Credit: Renewcell

## 5. INDUSTRY BRANDS

### Overview

This section provides an overview of industry brands' involvement in the next-gen materials industry.

Industry brands are established companies in fashion, automotive, and home goods that are the biggest buyers and users of materials. Although consumer preference has driven brands in these industries to move towards more sustainable practices, material innovators seldom have a direct relationship with consumers. The success of transitioning from animal-based materials to next-gen materials largely depends on the innovators' ability to work with industry brands.

### First-Mover Brands

Creating with Next-Gen Materials

Below is a list of brands that publicly disclosed collaborations with next-gen materials innovators in 2023. This is not an exhaustive list of brands using next-gen materials.

|  |  |   |  |
|--|--|---|--|
| <p><b>A</b></p> <p>A. ROEGE HOVE<br/>ACIÉN<br/>Adidas<br/>Anita Dongre<br/>Apparis<br/>Aritzia</p>                   | <p><b>F</b></p> <p>Felder Felder<br/>Forca Studio<br/>Frank and Oak<br/>FUTUREFEAR</p> | <p>Mara Hoffman<br/>Meyers Manx<br/>Moleskin<br/>Monique Lhuillie</p>                         | <p><b>S</b></p> <p>Saucony<br/>Sofia Ilmonen<br/>Stella McCartney<br/>Supriya Lele<br/>Svlim</p> |
| <p><b>B</b></p> <p>Balenciaga<br/>Brave Gentleman</p>  | <p><b>G</b></p> <p>Ganni<br/>Goldwin<br/>Gucci</p>                                     | <p><b>N</b></p> <p>Nick Fouquet<br/>Nicklas Skovgaard</p>                                     | <p><b>T</b></p> <p>Tobia and Afra Scarpa<br/>Tory Burch<br/>Toyota</p>                           |
| <p><b>C</b></p> <p>Camper<br/>Camperlab<br/>Caroline Herrera<br/>Cat Footwear<br/>Clae<br/>Cococo Home<br/>Cupra</p> | <p><b>H</b></p> <p>H&amp;M<br/>Hublot<br/>Hyundai</p>                                  | <p><b>O</b></p> <p>Object<br/>OkaTerra by Common<br/>Objects<br/>OS20</p>                     | <p><b>U</b></p> <p>United Pets</p>   |
| <p><b>D</b></p> <p>Deadwood<br/>Devo Home<br/>Drew Veloric</p>   | <p><b>J</b></p> <p>Johannes Warnke</p>   | <p><b>P</b></p> <p>PANGAIA<br/>Panthera<br/>Patrick McDowell<br/>Peet Dullaert<br/>Puma</p>   | <p><b>V</b></p> <p>Vince<br/>Volkswagon<br/>Volvo<br/>von Holzhausen</p>                         |
| <p><b>E</b></p> <p>Ettitude</p>  | <p><b>K</b></p> <p>Kalika Studio<br/>Koio</p>  | <p><b>R</b></p> <p>Rabanne<br/>Ralph Lauren<br/>Rashki<br/>Reformation<br/>Risto Kirjonen</p> | <p><b>W</b></p> <p>Ward Vissers<br/>Wiederhoeft</p>  |
|  | <p><b>L</b></p> <p>Levi's<br/>Lies Mertens<br/>Lost Woods</p>                          |   | <p><b>Y</b></p> <p>YUIMA NAKAZATO</p>  |
|  | <p><b>M</b></p> <p>Mansur Gavriel</p>  |   | <p><b>Z</b></p> <p>Zac Posen<br/>Zara</p>  |

Exhibit 14. Non-exhaustive list of brands with publicly disclosed next-gen material collaborations in 2023

Industry brands can play multiple important roles in the ecosystem, including funding both internal and external innovation initiatives, switching to next-gen materials as their raw materials, and collaborating with next-gen material startups to create new products. All this leads to acceleration of commercialization and scale-up production of next-gen materials to replace their conventional counterparts.



Image Credit: Risto Kirjonen x Fluff Stuff

IN

*“One of my favorite parts of my job is helping to bridge the gap between brands and innovators. I would like to take this opportunity to highlight some key messages I think both brands and material innovators need to understand when working with each other:*

- ★ *Partnerships during R&D are extremely valuable. They provide critical knowledge to innovators on what brands need and provide brands a deeper understanding of the deliverable timeline and process.*
- ★ *Honesty is critical for both sides. Don't overpromise and underdeliver.*
- ★ *Very few materials are “plug and play” and getting them to market takes time and creativity. But the planet is worth it (and the regulations are coming)!*
- ★ *Prices are higher now but will come down over time. Brands, if you have the ethos and financial capacity to offer products at these higher prices, do it – and take the credit for being a leader.*
- ★ *Don't sacrifice on quality but also rethink your material performance metrics. Remember you are delivering a product at a quality your consumers expect. But many traditional materials are “overengineered” and don't need the performance metrics many brands require. Reevaluate your performance metrics to meet your true needs – this will help lower the environmental impact of your materials.*

*I am also always asked: “which material company or technology is going to be the winner?” Remember, the materials industries we are working to replace are huge, with thousands of suppliers. Relying on one or even two suppliers is a risky business decision, especially with the changing climate landscape. It is more likely that you will need multiple suppliers to serve your different material needs for different products. This will take more time early on but again, the planet is worth it!”*



**Nicole Rawling**  
Co-Founder & CEO, MII

Highlights of Brand Partnerships in 2023

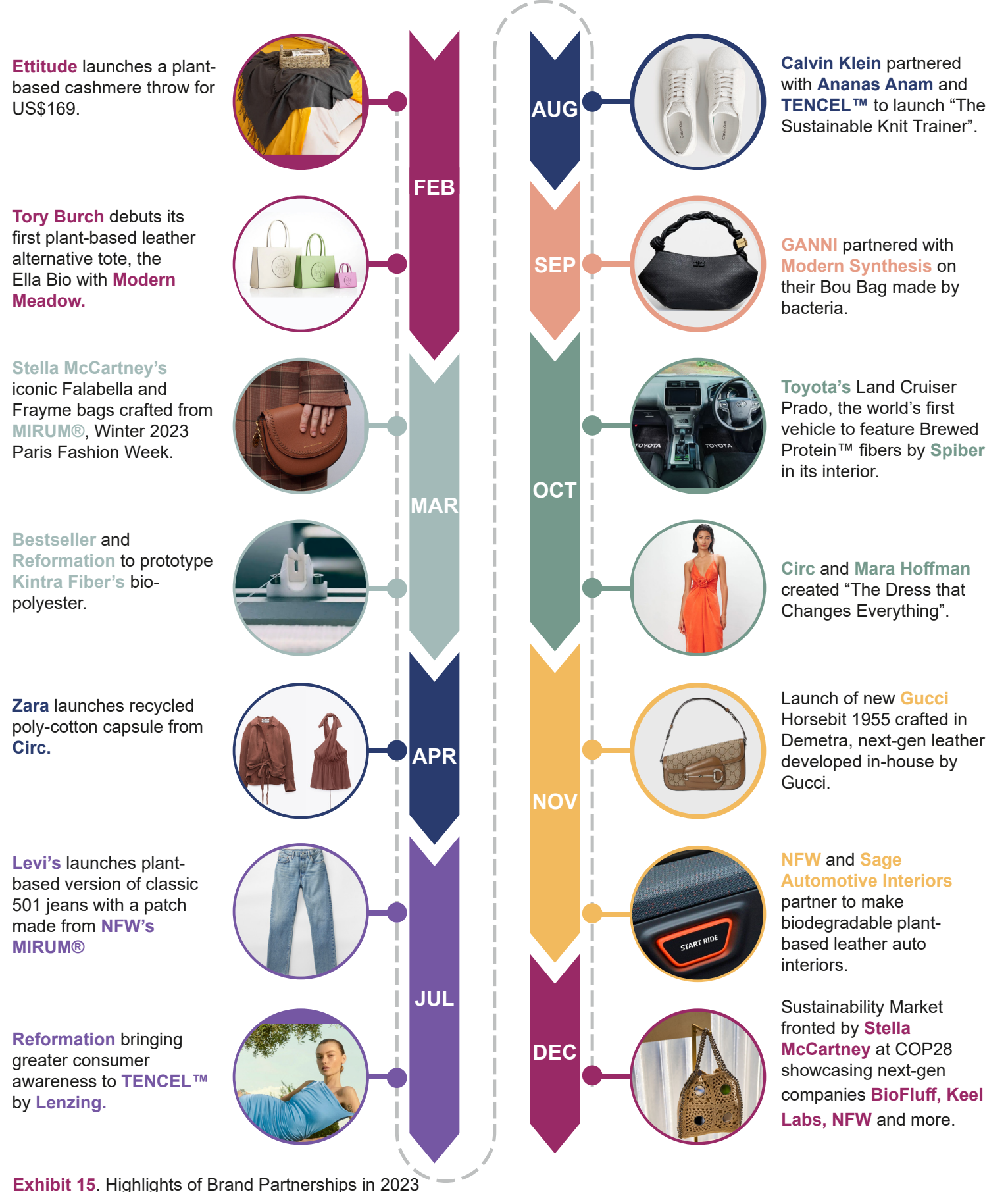


Exhibit 15. Highlights of Brand Partnerships in 2023

Partnerships between industry brands and material innovators continued to accelerate in 2023. For a comprehensive review, download our 2023 Brand Engagement Report [here](#).

# 2023 News Highlights

Style / Fashion

## 'Laws need to change': Stella McCartney calls for new tariffs on leather and polluting materials

By Christy Choi, CNN (interview by Becky Anderson, CNN)  
© 4 minute read · Published 10:58 PM EST, Thu December 7, 2023



Stella McCartney in conversation with (from left to right) King Charles III, British Prime Minister Rishi Sunak and US Special Presidential Envoy for Climate John Kerry during a reception at Buckingham Palace ahead of last year's UN climate change summit. Jonathan Brady/PA Wire/AP

Stella McCartney showcased her favorite material innovators at Cop28, in an exhibit backed by LVMH, including Radiant Matter's bio-based sequins, Keel Labs's seaweed-based fiber, Kelsun, and NFW's plastic-free leather alternative, Mirum.

During the conference, the brand also announced collaborations with AirCarbon, a carbon-negative alternative to leather, and Mango Material, which creates biodegradable alternatives to plastic, as well as unveiling its first coat made from Savian, a plant-based faux fur made from a mixture of cellulose, hemp cellulose and linen.

*"I've been a fashion designer for my whole life, and I'm not as interested in what the next silhouette is, or what the next color is in 2024 and '25," McCartney told CNN. "I'm like, 'What's the next material? What's the next solution that we can give to the world to make it, a better planet?"*

## Billie Eilish Is The First To Get Her Hands On Gucci's New Vegan Horsebit Bag

BY EMILY CHAN  
30 October 2023



Tyrell Hampton/Courtesy of Gucci

Gucci is releasing two asymmetrical designs using the next-gen material: one in black and another monogrammed version, which also contains certified hemp and Econyl's recycled nylon. It marks a major milestone for the brand's sustainability efforts, given animal leather's large carbon footprint.

Demetra, which has been developed in-house at Gucci, is 75 percent plant-based, comprising responsibly sourced viscose, wood pulp, and non-GMO corn-based plastic – meaning that it has a lower impact when it comes to climate change and water usage. While the rest of the material is currently made from fossil fuel-derived synthetics (including the coating), Gucci is now looking at ways of increasing the percentage of bio-based inputs without reducing its durability.

FASHION > TRENDS & SHOPPING GUIDES

## Mansur Gavriel and Apparis Designed Chic Vegan Coats—With Bags to Match

Bazaar has an exclusive first look at the colorful, bio-based collaboration

BY HALIE LESAVAGE PUBLISHED: OCT 05, 2023 7:00 AM EST

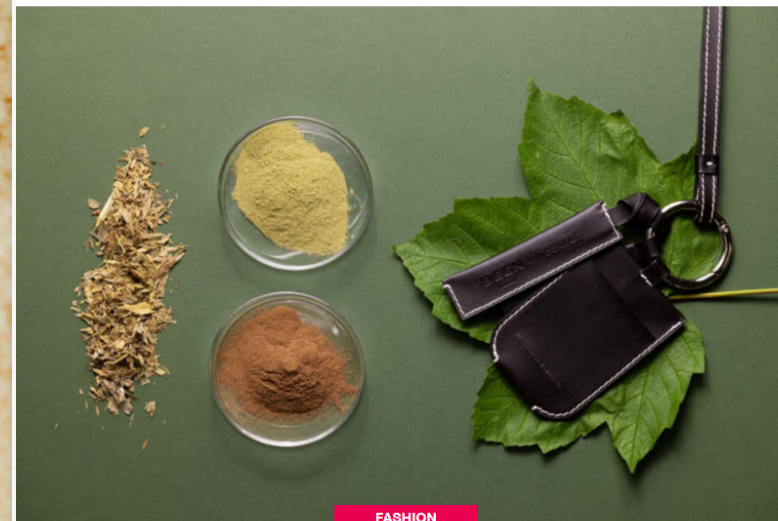
SAVE ARTICLE



Mansur Gavriel didn't have a cake to celebrate its 10th birthday at New York Fashion Week in September. Instead, the accessories brand took over a Lower Manhattan street for a farm-to-table block party. Long tables filled with bite-size fruits and veggies channeled the spot on Mansur Gavriel's mood board dedicated to fresh produce. ("We're very inspired by nature, fruits and vegetables, and food," co-founder Rachel Mansur told Bazaar.) Unbeknownst to the fashion editors invited over for snacks and a live runway show, the event also gave an edible hint about a bigger project. Today, Bazaar can exclusively reveal that Mansur Gavriel is releasing a capsule of vegan fall coats and color-coordinating bags with Apparis.

Home / News / Fashion / Been London teams up with Biophilica to craft fully home compostable concept collection

## Been London teams up with Biophilica to craft fully home compostable concept collection



A compostable concept collection made with Treekind Credits: Been London

Accessories brand Been London has partnered with biotechnology company Biophilica to create a collection of fully home compostable products using the plastic-free leather alternative Treekind. The collection includes a tote and small leather goods like a keyring and coin purse, all designed with their end-of-life considerations in mind. Been London has been testing Biophilica's Treekind over the last two years to develop the world's first fully home-compostable bag.

*Through their partnership, Been London and Biophilica aim to showcase the potential of designing fully compostable products in an industry often associated with waste.*

## 2023 News Highlights



EUROPEAN BIOTECHNOLOGY » UP TO DATE » LATEST NEWS »

AMSILK SCALING UP THROUGH EVONIK COLLABORATION

LATEST NEWS

### AMSilk scaling up through Evonik collaboration



*Fermentation expert Evonik SE has entered into an agreement with the German recombinant silk producer AMSilk to produce industrial quantities of innovative, sustainable silk proteins.*

Just one week after AMSilk inked a collaboration agreement on protein engineering of its silk protein to target new applications with Brain Biotech AG, the German company has teamed up with Evonik to scale up silk protein production at Evonik's CDMO's silk protein fermentation site in Slovakia.

AMSilk is the world's first industrial supplier of smart biotech materials by applying an outstanding technology platform based on silk proteins. AMSilk turns man-made proteins into silk formulations including fiber, hydrogels and silk powder for applications in the textile industry as well as for medical devices and consumer goods. All AMSilk materials are created with an end of life in mind, being completely vegan, biodegradable, and using renewable plant-based carbon, with no microplastics.



SUBSCRIBE

10-17-23

### Mara Hoffman's gorgeous new dress can be recycled again and again and again

The luxury brand's new dress is made from waste fabric. It's proof that circular fashion is already reality.



[Photos: courtesy Mara Hoffman]

There's a lot that needs to be done before Circ, and fabric recycling, become mainstream. But Majeranowski believes that change can happen quickly. He points out that paper recycling only began in the 1990s. In a matter of decades, more than 40% of all paper is recycled, which is the equivalent of more than a hundred million tons of recycled paper annually. "The collaboration with Mara Hoffman shows that the solution is here," says Majeranowski. "Now it's time to scale."

The designer Mara Hoffman offers an alternative vision for the future. Today, she unveils a new poppy-colored dress, dubbed This Dress Changes Everything, that is made from textile waste, but looks and feels like it is made from top-notch silk. At the end of its life, the brand will take back the dress and recycle it back into another dress again, and again, and again.

*"This fabric is centered on materials that are already on this planet, and doesn't require extracting new resources," says Hoffman.*



## Mycelium technology company Ecovative raises over \$30M

Published June 7, 2023 • Updated June 8, 2023

## NFW and Sage Automotive Interiors Partner to Revolutionize Cars with Biodegradable Plant-Based Leather

November 14, 2023

# 2023 News Highlights


JustStyle  

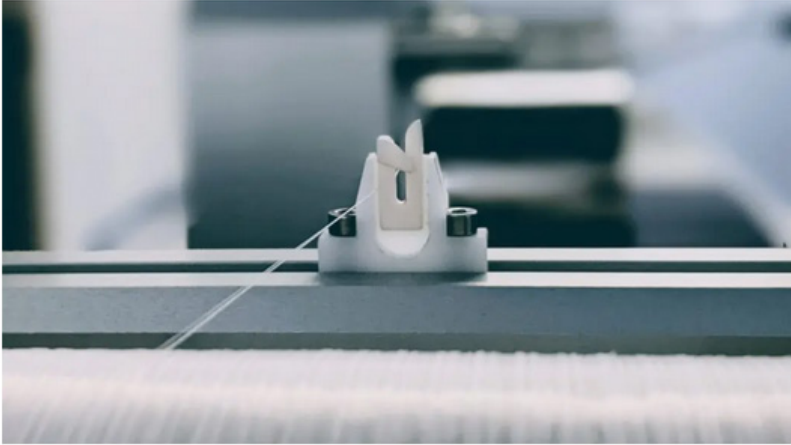
News

## Fashion brands to road-test prototype for bio-based polyester

The bio-based polyester has been developed by Kintra Fibers, which after a successful US\$8m series A funding round, claims to be able to scale its resin and yarn production capacities.

Isatou Ndure | April 12, 2023

[Share this article](#) 



Fashion for Good, Bestseller, Inditex and Reformation have joined forces to prototype Kintra's materials in their product lines driven by a shared goal to explore more sustainable materials and processes.

With a successful \$8m Series A funding round in December, Kintra Fibers is positioned to scale its resin and yarn production capacities in line with the volume demands of their brand partners. The funding was led by H&M Group, with participation from Bestseller, Invest FWD, Fashion for Good, New York Ventures, TRE Ventures, Tech Council Ventures, FAB Ventures, and a selected group of angel investors from the fashion industry.

*"By utilizing bio-based inputs and designing a biodegradable material from the outset, Kintra addresses the environmental impact caused by traditional polyester at every stage, from production to usage and end-of-life, providing a comprehensive solution for a truly circular fashion industry"* said Alissa Baier-Lentz, Chief Operating Office & Co-Founder of Kintra Fibers.

  SUBSCRIBE FOR \$0.25/WEEK

## In England, Plants From a Royal Estate Become a Gown

London designers working on sustainable fashion created a dress from the leaves of giant butterbur plants gathered at one of the king's homes.

[Share full article](#)  



The Vin + Omi show during London Fashion Week in September featured this column gown of fabric made from giant butterbur leaves. via Vin + Omi

A bride, decked in wedding finery, is traditionally the last model to appear during a live fashion show. But at Vin + Omi, the finale of its spring 2024 show in September during London Fashion Week, was a floor-length, long-sleeve column gown made from the giant butterbur plants grown on the Sandringham estate of King Charles III.

It has "a wonderful feel of silk," said Vin Cara, who was joined by Omi Ong on a recent video call from Spain, where they were filming a documentary on sustainable innovations around the world. "It's very regal."

 United States 

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Story from DESIGNERS >



## How Mara Hoffman Created A Fashion Brand With A Conscience

ALYSSA HARDY  
LAST UPDATED NOVEMBER 6, 2023, 7:52 PM

Mara Hoffman, the brand frequently worn by celebrities and conscious fashion lovers, is inseparable from Mara Hoffman, the eponymous designer from Buffalo whose distinctive style has made her a fashion fixture in New York fashion since the early '00s. With her name on every single piece of clothing she sells, Hoffman considers her brand a reflection of her impact on the world. That comes with responsibility.

FASHIONUNITED

## Stella McCartney hosts Sustainable Market alongside SS24 PFW show


# 2023 News Highlights

**FF FIBRE2FASHION** Search Sign In English

TEXTILES

## Eco-couture by Austria's TENCEL, RCGD Global grabs spotlight at Oscars

13 Mar '23 • 5 min read



Austria-based Lenzing's flagship textile brand, TENCEL, and RCGD Global (formerly known as Red Carpet Green Dress) have joined hands for the fourth consecutive year to spotlight eco-couture at the 95th Academy Awards (also known as 'the Oscars'). Adhering to this year's Oscars sustainable style guide, produced by RCGD Global, rising talents Bailey Bass and Chloe East showed up at the Oscars red carpet with bespoke sustainable occasion wear made of TENCEL branded fibres and TENCEL LUXE filament yarn.

Chloe East (L) in a custom Monique Lhuillier gown and Bailey Bass in a Zac Posen ethereal couture piece at the Oscars. Pic:

**VOGUE**  
BUSINESS

## France has laid down the law on sustainability: What does it mean for fashion?

Brands selling into France are getting a taste of changes to come, as a new wave of sustainability legislation calls for greater transparency and traceability. Experts say the industry isn't ready.

BY BELLA WEBB  
January 23, 2023

**NEW YORK STATE**

**GOVERNOR KATHY HOCHUL**



**Economic Development** **Agriculture** **Environment**

SEPTEMBER 13, 2023 | Albany, NY

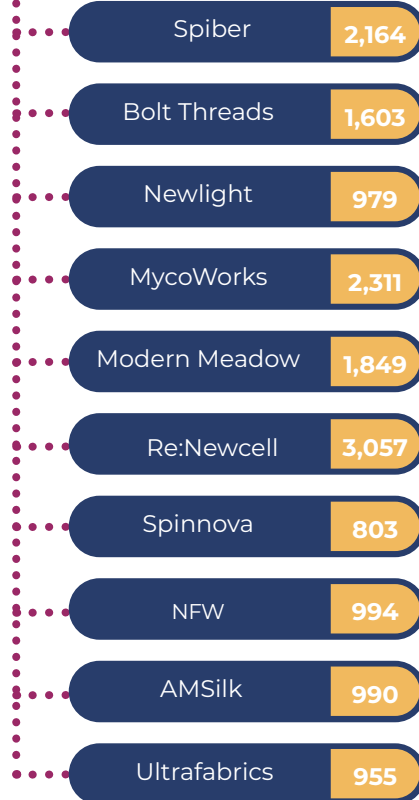
## During New York Fashion Week, Governor Hochul Announces Consortium of Universities, Businesses, and Industry Leaders to Manage New York's Fashion Innovation Center

Governor Kathy Hochul today announced that a consortium of six universities, businesses, farmers, fashion industry leaders, and non-profit organizations, led by the Rensselaer Polytechnic Institute, has been selected to manage New York's Fashion Innovation Center. The consortium, headquartered in the Capital Region and comprised of RPI, the Fashion Institute of Technology, Hudson Valley Textile Project, Field to Fiber, SUNY Morrisville, and Made X Hudson, will conduct research to bolster the Center's mission of building a smarter, more sustainable fashion industry.

## Next-gen in the media

Number of times the top 10 most funded next-gen innovators (2023) were mentioned in verified media publications worldwide:

15k+



Number of articles mentioning “next-gen materials” in verified news outlets:

1,293

Number of articles mentioning “next-gen materials” in verified major fashion and fashion business publications:

94

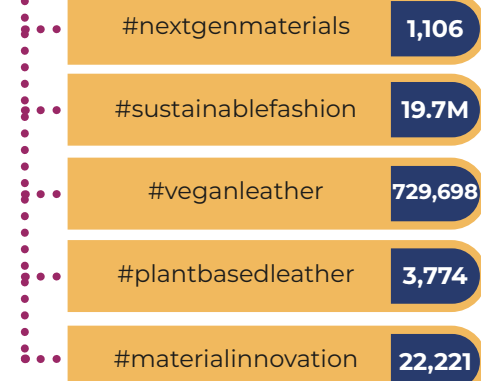
Number of MII Media Mentions:

71

Number of times these keywords appeared in verified media outlets



Number of times these hashtags have been used on Instagram:



## PART C

# Fresh Viewpoint



Image Credit: Ryan Duffin for Keel Labs



# 6. RIDING THE HYPE CYCLE

## The Elephant in the Room: Bolt Threads' Pause on Mylo Production

One of the biggest talked about next-gen industry news items in 2023 was Bolt Threads' decision to pause production of Mylo, its leather alternative material. Bolt Threads has consistently been amongst the top 3 highest funded next-gen material companies, with around \$340 million invested in it since its inception in 2009, increasing the gossip and speculation surrounding their decision. The company was also a unicorn (over one billion valuation), and had a consortium with Stella McCartney, Kering, Adidas and Lululemon. The majority of the news which followed was conservatively optimistic, quick to argue "that doesn't mean the end of mushroom leather as an industry."<sup>5</sup> We agree. The tough decision Bolt had to make in ending production of Mylo does not spell doom for the rest of the industry nor even speak to the success of its remaining material offerings.

By the autumn of 2023, we heard of Bolt Threads' plan to go public in a [Special Purpose Acquisition Company](#) ("SPAC") deal that values the company at \$250 million.<sup>6</sup> The new company keeps the current CEO and CTO in their roles. The deal is expected to close in 2024, providing Bolt with the capital needed to refocus on scaling its other product: b-silk in beauty and personal care. It's in fact a re-refocus because the origin of Bolt had been to crack the code on growing artificial spider silk (thus, Bolt Threads!). Its previous pivot to focus more on Mylo, its alternative leather, was because of consistent industry requests for an animal-free leather alternative.

While the story of Bolt is still evolving, other companies are also on their own paths of ups and downs. 2023 has been a challenging year for most industries, mature or nascent. As the hype dissipates, there is ample headspace for discernment of new technologies and businesses for what they really are, individual companies with their own technology, strategies, teams, and story. It is important for the industry to understand Bolt's story as part of the typical cycle of new industries, explained well through Hype Cycle analysis.



Image Credit: Stella McCartney x Bolt Threads

## The Gartner Hype Cycle

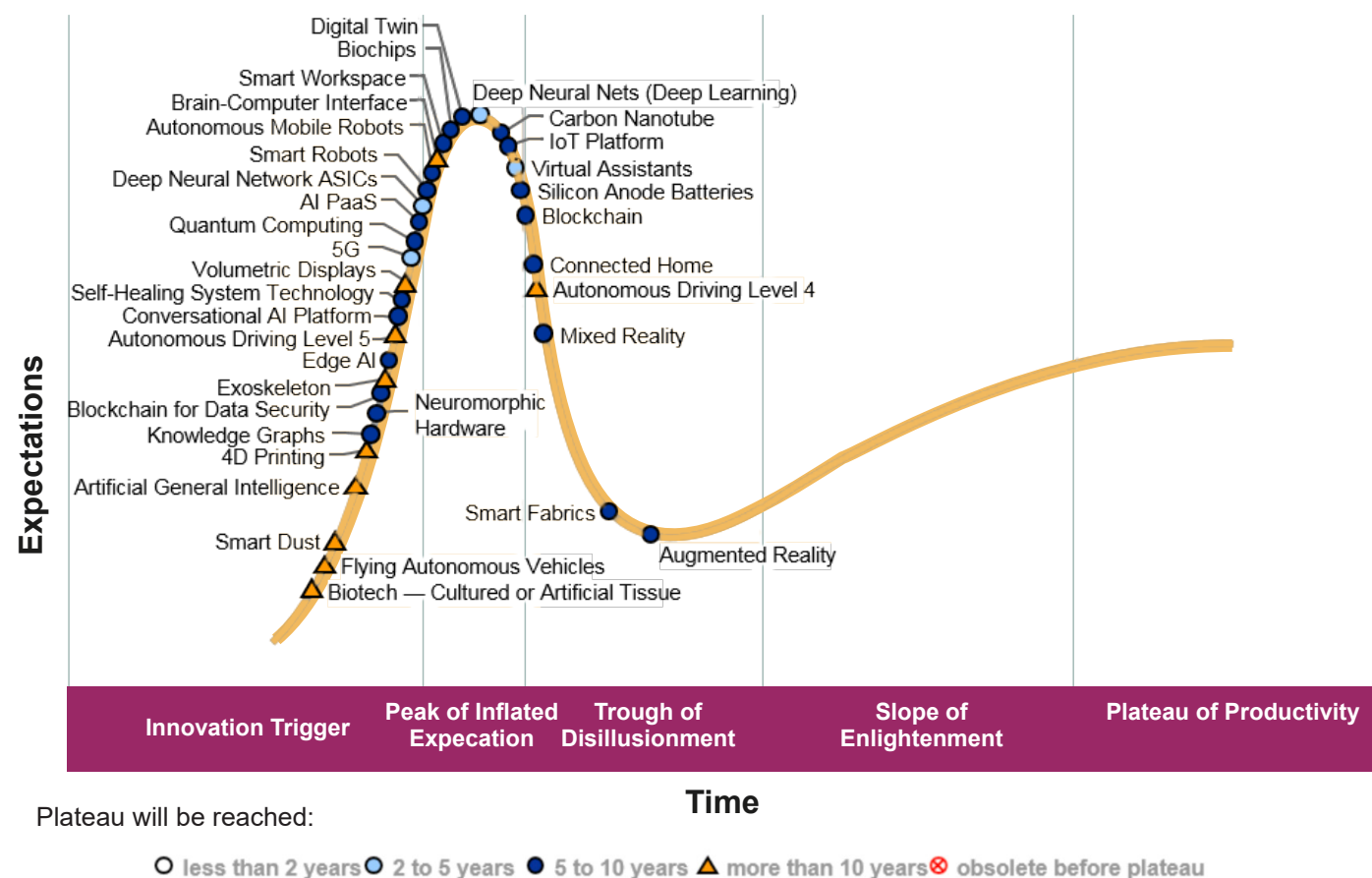
The Gartner Hype Cycle is a graphical representation of technology life cycle stages.<sup>7</sup> Hype Cycles characterize the typical progression of innovation, from overenthusiasm through a period of disillusionment to an eventual understanding of the innovation's relevance and role in a market or domain. It establishes the expectation that most innovations, services and disciplines will progress through a pattern of overenthusiasm and disillusionment, followed by eventual productivity.

### High expectations and low maturity lead to the drop into the Trough of Disillusionment.

Each Hype Cycle drills down into the five key phases of a technology's life cycle.

- **Innovation Trigger:** A potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven.
- **Peak of Inflated Expectations:** Early publicity produces a number of success stories — often accompanied by scores of failures. Some companies take action; many do not.
- **Trough of Disillusionment:** Interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.
- **Slope of Enlightenment:** More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers. More enterprises fund pilots; conservative companies remain cautious.
- **Plateau of Productivity:** Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability and relevance are clearly paying off.

p **Hype Cycle for Emerging Technologies 2018**



**Exhibit 16.** Hype Cycle for Emerging Technologies (as of 2018) Source: Gartner, Inc

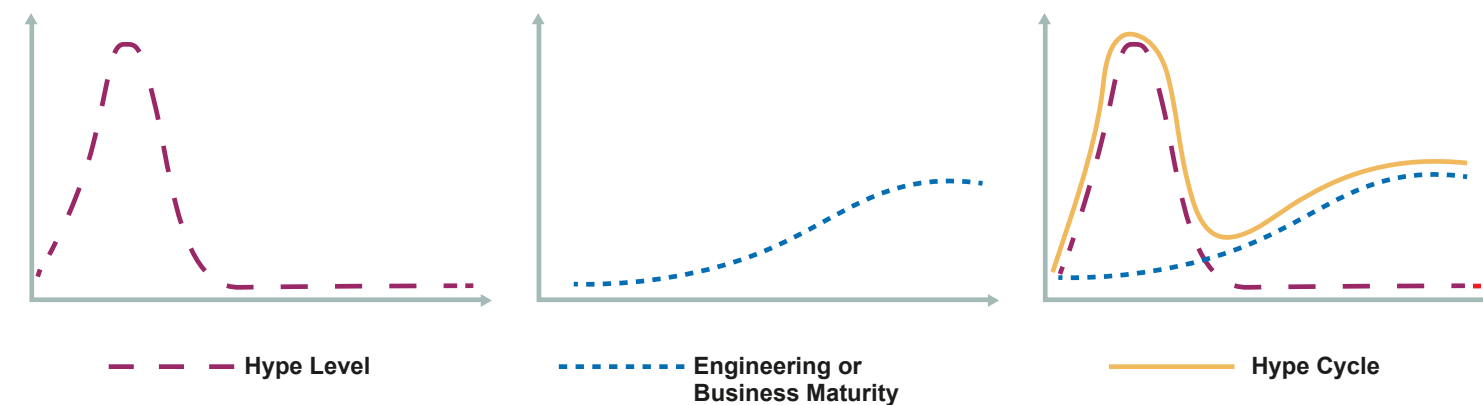
This illustration from Gartner as of 2018 puts Biotech - Cultured or Artificial Tissue at the stage of Innovation Trigger, with more than 10 years to foreseeably reach the Plateau of Productivity, while Conversational AI Platform was at the Innovation Trigger phase with a projected 5-10 years towards achieving the Plateau of Productivity. It is probably fair to say that by 2023, 5 years after 2018, Conversation AI Platform was definitely at the Peak of Inflated Expectation.

The Hype Cycle shows two stages of upward direction (that is, increasing expectations). The first is the rise up to the Peak of Inflated Expectations. This rise is due to the excitement about the new opportunities the innovation will bring, driven mostly by market hype. Excitement occurs in a rush, rises to a peak and dies

down when early expectations are not met rapidly enough (see the first curve in Exhibit 17).

The reason that expectations are not met is that the innovation's maturity is usually still low when excitement is peaking (see the second and third curves in Exhibit 17). High expectations and low maturity lead to the drop into the Trough of Disillusionment. The second rise of increasing expectations is driven by the increase in maturity of the innovation, which leads to real value and fulfilled expectations, eventually the rise up to the Slope of Enlightenment.

**Components of the Hype Cycle**



**Exhibit 17** Components of the Hype Cycle. Source: Gartner, Inc.

**IN**

“Although Hype Cycles are nothing new, the fashion industry may find itself unprepared for this natural progression. After decades of minimal technological innovation and a low appetite for risk (“The Textile Dark Ages”), the industry finds itself entering “The Next-Gen Material Renaissance” where novel materials and sustainable product launches are growing at break-neck speed. Along the way, there will be some bumps, potholes, and even some crash-and-burns. These are not signs of the end-of-days, but signs of a maturing industry.

My advice to the next-gen material decision-makers, i.e., brands, mills, and investors, in navigating the Hype Cycle, is to avoid discounting an entire technological area based on specific experience with one material or innovator. For example, just because NewCo A’s algae-based fiber didn’t meet adoption criteria when trialed in 2022, does not mean that next-gen materials are a bust, or that the algae material space is a bust, or that NewCo A is a bust. A lot can happen in the course of only a few months of material development, and premature judgements will only lead to missed opportunities down the line. It pays to stay vigilant, and ensure that you see the forest for the trees.

Both brands and innovators will do well to hedge their bets by investigating multiple partnerships across different verticals and product categories - it may take a few tries to identify the optimal product-market-fit. All supply chain stakeholders will need to stay current with the latest trends in technology and scaling to avoid the Trough of Disillusionment and enter the Plateau of Productivity.”



**Sydney Gladman**  
Ph.D., Advisor, MII

# Which Phase is the Next-Gen Materials Industry Entering?

As an organization that helped incubate the next-gen materials industry, we have lived through the cycle thus far with the innovators, investors, and brands we support.

## Phases of the Hype Cycle

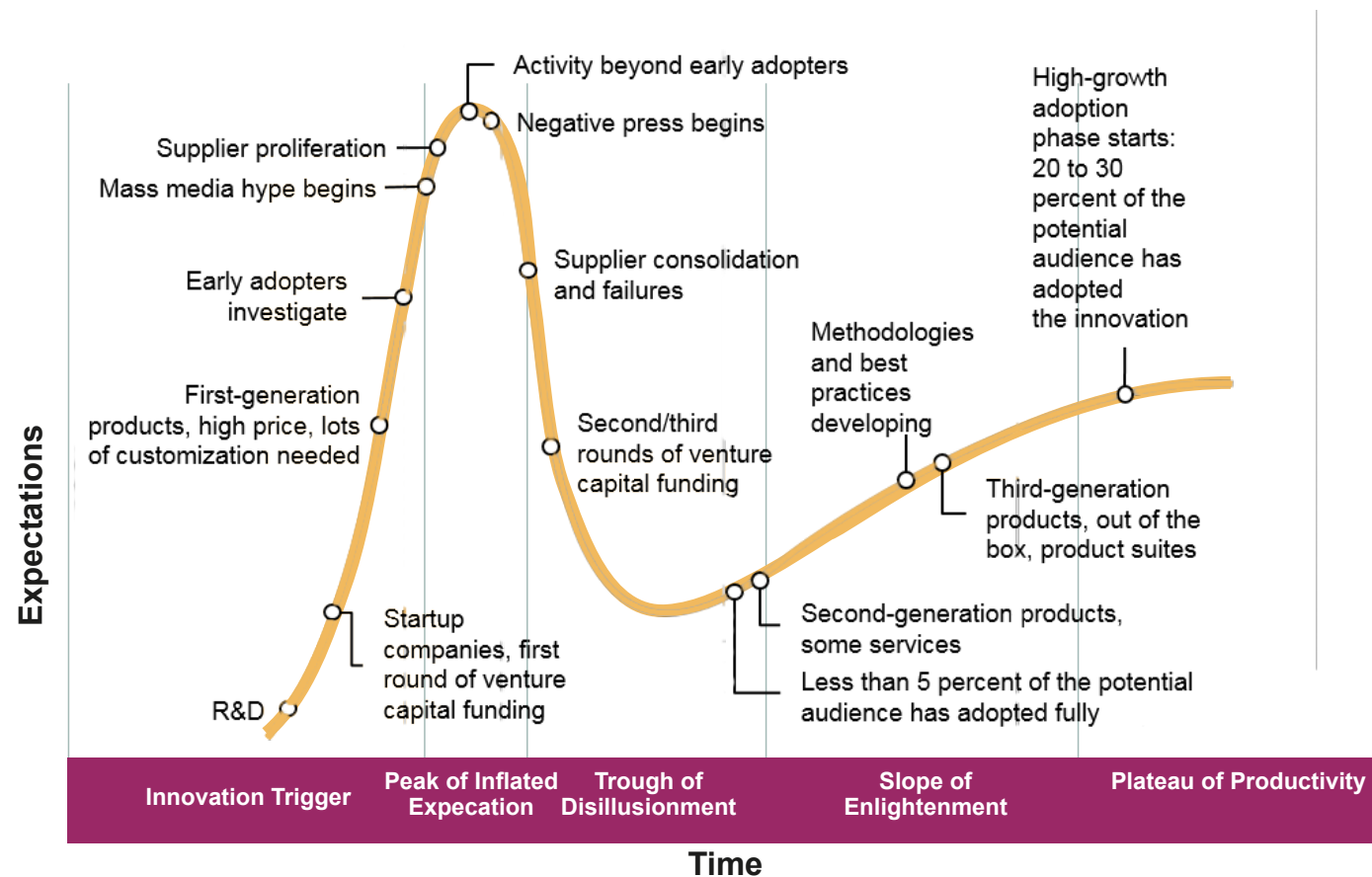


Exhibit 18 Phases of the Hype Cycle. Source: Gartner, Inc.

Many of the common indicators of phase change have indeed come, and gone:

- **Innovation Trigger / On the Rise:** As per our reporting (see Exhibit 10) many startups had their first round of venture capital funding around 2018. The gap between trigger and peak is often quite short. As Gartner projected, for an innovation that takes 10 years from trigger to plateau, the rise from trigger to peak might take only one to two years.
- **Peak of Inflated Expectations / At the Peak:** We saw the mass media hype begin around 2020, next-gen material was the hot green topic all

over business, industry, and fashion magazines and blogs. Companies started using “next-gen materials”, “apple/cactus/mushroom leather” as the latest buzzwords in their marketing to signal their sustainability commitments.

Investors seized early opportunities to get “one of those” in their portfolio, which encourages the proliferation of companies with similar offerings. The spike in investment funding we reported in 2021 was astonishing, at a total of \$980 million representing an investment amount of the previous 4 years combined.

Brands that like to be ahead of current thinking adopt next-gen materials before their competitors. See our Brand Engagement Reports (2021, 2022, 2023) over the past few years to see the list of these early adopters including Reformation, adidas, and Volkswagen.

**One of the main challenges for fashion brands, for example, is that innovative materials may take years to be ready for commercialization while the industry is used to sourcing materials within weeks.**

A bandwagon effect kicked in, and the innovation was pushed to its limits as brands tried it out typically in small capsule collections. We have seen it first hand being the advisor and bridge between innovators and brands, seeking to minimize the friction when the gap in understanding and expectations between the two was vast. One of the main challenges for fashion brands, for example, is that innovative materials may take years to be ready for commercialization while the industry is used to sourcing materials within months. There is also a lack of realization that different intended applications can have huge implications on performance requirements and how rigorously the material has to be tested (e.g., a wristwatch band versus the seat of a car) and will significantly affect the realistic development and delivery timeline.

- **Trough of Disillusionment / Sliding Downwards:** We saw the sign that the industry is sliding into the

trough as the same few stories of early success were repeated over and over, and the market started to get impatient with the lack of realized scaled production and availability of these innovative materials. Negative press started to emerge, especially surrounding greenwashing and calling all vegan leather “plastics.” The innovation was discredited for not living up to the early, overinflated expectations of being the “perfectly sustainable” solution to the grand challenges faced by the fashion industry. Accompanied with the unprecedented pandemic disrupting everything from supply chain to funding availability, we reported a sharp decline in investment into next-gen material companies in 2022.

## Climbing the Slope of Enlightenment

It is clear that the industry has been going through the Trough of Disillusionment in 2023. While the length of the trough is one of the most variable parts of the Hype Cycle, amid the disillusionment, innovations continue. We continue to work with many companies that are doing the hard work: improving their products based on early feedback; tackling the scaling challenges (some with funding, some with smart strategy and positioning); and breaking out of the existing paradigm around what to innovate and what are the possible applications.

So, here is our call to action. Let’s take this journey up the slope together!

# 7. Rising Stars

MII continues to support material innovators through our work on research, knowledge-sharing, and fostering connections. These are just a few of the companies that we have known for some years and are excited about progress they have made in 2023.

For more information on material innovators, check out our [Innovator Database](#) which is regularly updated with the newcomers and rising stars!



COMPANY NAME: **Tandem Repeat**

MATERIAL NAME: **Squitex**

BIOMIMICRY: **Silk, Wool**

CATEGORY: **Microbe-derived**

HEADQUARTERS: **USA**

YEAR FOUNDED: **2018**

ABOUT:

Tandem Repeat is a synthetic biology and materials science company that eliminates plastic pollution and minimizes the dependence on animal-based products with a unique all-natural performance fabric that is friendly to existing manufacturing processes. Tandem Repeat found a way to mimic the proteins found in squid, and using fermentation, they have developed Squitex: a silken, protein blend fiber with unique stretch, strength, and self-healing properties. It is also sustainable and thermally responsive.



Image Credit: Tandem Repeat

## STAR QUALITIES:

- ★ We are excited about synthetic squid protein made from fermentation and the versatility in blending it with other materials to create new, functional fibers!
- ★ Nailed project timeline producing the first garment made from Squitex, blended with cotton.
- ★ Addressable market size: According to Tandem Repeat, what they are tackling is the worldwide clothing fiber market of approximately 120 million tons (\$3T/yr), of which 62% are petrochemical-based synthetic fibers. Squitex has unique stretch, strength, and self-healing properties to replace oil-based fibers.

IN

*“There are three main reasons why blending natural and synthetic fibers can be advantageous. Firstly, combining different fibers can offer a blend of benefits and drawbacks, making the resulting fabric more versatile. Secondly, synthetic fibers can enhance certain qualities such as strength, elasticity, water resistance, and stain resistance in natural fibers. Finally, blending synthetic fibers with natural ones can reduce the overall cost of the fabric, making it more affordable for consumers.*”

*We are a startup company in the early stages of development. When we first created our dress and denim prototypes last year, we were only able to produce small quantities in kilograms. To make the garment, we had to mix squitex with cotton because we didn't have enough material. However, this year we are scaling up our production and plan to make 100% squitex garments.*

*Our techno-economic analysis shows that we can make our protein fibers cost-competitive and even cheaper than natural protein fibers: wool and silk.”*



**Prof. Dr. MELIK DEMIREL**  
Co-Founder, Tandem Repeat  
Huck Endowed Chair Professor,  
Penn State University

# VON HOLZHAUSEN

COMPANY NAME: **von Holzhausen**

MATERIAL NAME: **Banbū Leather, Technik-Leather™, Liquidplant™**

BIOMIMICRY: **Leather/Exotic Skins**

CATEGORY: **Plant-derived**

HEADQUARTERS: **USA**

YEAR FOUNDED: **2015**

ABOUT:

Vicki von Holzhausen launched her company in 2015 to create sustainable accessories. Using her experience as an automotive designer, she continues to innovate in the animal-free leather space. The company produces Banbū Leather – a high-performing premium leather alternative made from bamboo, and Technik-Leather™ – a 100% animal-free performance fabric created from recycled fibers and plants.

IN

*“The barrier to creating low-carbon materials: the durable topcoat; plastic is pervasive because it has been the only option for durability and performance. After 2.5 years of research and development, we’re excited to have launched Liquidplant™. It is the world’s first 100% plant-based, performance topcoat derived from corn sugar, castor oil, and flaxseed oil, making plastic-free materials a reality. This innovation uses processes to ensure there are no harmful toxins or microplastics left in the environment.*”

*Liquidplant™ can be used within a wide range of applications, like footwear, clothing, car interiors, and furniture upholstery instead of petroleum based topcoats to make these materials durable and more sustainable. Liquidplant™ is the topcoat of the future, taking us one step closer to declaring petroleum obsolete in the fashion industry and beyond.”*



**Vicki von Holzhausen**  
Founder, von Holzhausen

## STAR QUALITIES:

- ★ Not only has von Holzhausen innovated in new materials, it also innovated in new components. Needless to say, that significantly expands its potential addressable market.
- ★ The company has developed a 100% biobased topcoat (Liquidplant™) that can offer alternatives to fossil-derived coatings in the textile industry.



Image Credit: von Holzhausen



Image Credit: Keel Labs

# KEEL.LABS

COMPANY NAME: **Keel Labs**

MATERIAL NAME: **Kelsun**

BIOMIMICRY: **Silk**

CATEGORY: **Plant-derived**

HEADQUARTERS: **USA**

YEAR FOUNDED: **2017**

### ABOUT:

Keel Labs is a New York-based biomaterial company that creates degradable yarns from seaweed, specifically kelp and other similar types of algae. A substance called alginate is combined with other renewable biopolymers for further processing, resulting in biodegradable fiber that can be knitted into a textile or used in 3D printing processes. The dyeing process is chemical-free. The company's goal is to eventually replace petroleum-based materials and become a zero-waste fabric suitable for clothing and footwear.

Jersey knit made out of 70 percent Kelsun seaweed-based yarn and 30 percent cotton, and the logo is printed using algae-based Living Ink.

### STAR QUALITIES:

- ★ We are excited about all-things-algae. Kelsun is derived from kelp, which can grow between 12-18 inches per day.
- ★ Commitment to scaling. Keel Labs has its own production facilities in North Carolina, and works with its network of yarn spinners to create Kelsun blended yarn. It successfully raised funds in 2022 to scale - albeit that being the most difficult year to fundraise in recent years.
- ★ Important partnerships that range from high-end, such as Stella McCartney, to mass brands. Several collaborations are in the works to fit into existing lines of production to create the most impact industry-wide.



Keel Labs launched its first partnership with Stella McCartney last fall, with the Kelsun fiber being used in the spring '24 collection.

### IN

*"This launch is about so much more than creating a T-Shirt—it's our mission come-to-life, offering the industry a product that can be produced at scale. In partnership with Aditi Mayer, we're demonstrating to the fashion industry and consumers alike that next-gen material solutions are here, and they're able to be implemented in brands' and their partners' supply chains today."*



**Aleks Gosiewski**  
Co-Founder and COO, Keel Labs



COMPANY NAME: **Kintra Fibers**

MATERIAL NAME: **Kintra**

BIOMIMICRY: **Silk, Wool**

CATEGORY: **Plant-derived**

HEADQUARTERS: **USA**

YEAR FOUNDED: **2018**

ABOUT:

Kintra Fibers is a materials science company that has developed a proprietary bio-based and biodegradable polyester. With the ability to fine-tune resin and yarn performance properties, Kintra yarns are applicable in a wide range of knit and woven textile applications. Some of the fabrics they have created to date include a satin which has a silk-like hand feel, and a knit with a cashmere-like hand feel. Additional applications include using Kintra as an alternative to traditional PET polyester, and Nylon.



Image Credit: Kintra Fibers

#### STAR QUALITIES:

- ★ Did anyone hear that Kintra is a biobased, biodegradable polyester?
- ★ Made on standard equipment as PET. Being able to “plug and play” in existing machineries and industry infrastructure is a huge advantage to scaling quickly and competitively.

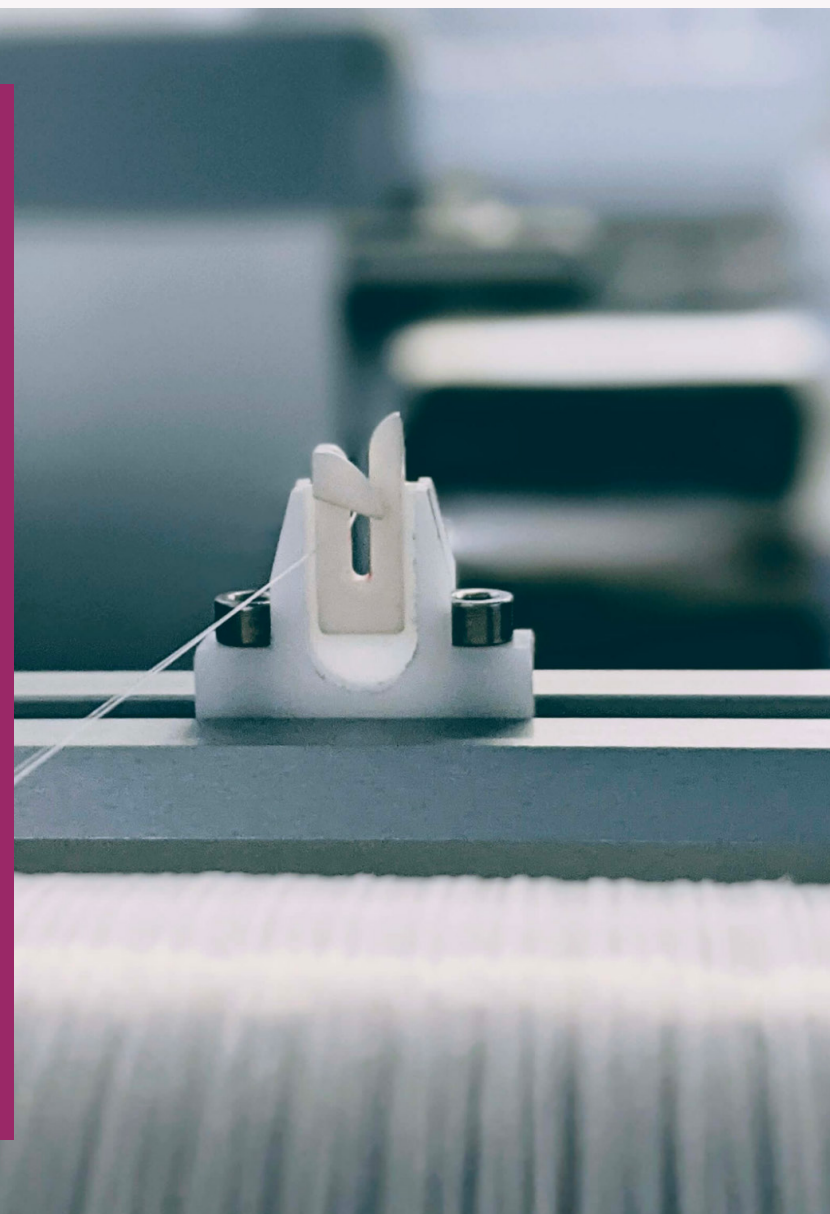
#### IN

“Our yarns pass the ASTM D6400 / ISO 14855-1 tests for aerobic biodegradation in controlled compost conditions. We intentionally designed Kintra to biodegrade in aerobic environments as this has strong potential to address microfiber pollution within wastewater treatment facilities, mimicking how natural fibers biodegrade. The compost study for our yarns was our first step in understanding how we can help solve the microfiber pollution issue posed by PET. Our next step towards our goal of keeping the oceans clean is to study the biodegradation of Kintra microfibers within the aerobic conditions of wastewater treatment facilities.”



**Billy McCall**  
CTO and Co-Founder, Kintra Fibers

Image Credit: Kintra Fibers



# Support The Next-Gen Movement

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We'd also like to thank the leading next-gen material companies, industry stakeholders, and investors for their generous input and support.

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## WANT TO ACCELERATE THE ENTIRE NEXT-GEN MATERIALS INDUSTRY?

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Help drive material change year round by joining our family of donors and advocates.

### About MII

The Material Innovation Initiative is a nonprofit think tank that accelerates the development of high-performance, animal-free, and environmentally preferred materials with a focus on replacing silk, wool, down, fur, and leather and their synthetic alternatives. We advance the next-gen materials revolution by connecting science and big ideas. We focus on research, knowledge-sharing, and fostering connections to fast-track the development of environmentally preferable and animal-free materials.

We work to cultivate a global market for next-gen materials across the fashion, automotive, and home goods industries. We work for materials that can do more while requiring less of the planet, animals, and people involved at every stage.

We imagine a circular future where the default choice for your sweater, sneaker, or seat is humane and sustainable. A future where animals are allowed to live free and thrive, the planet is saved from pollution and degradation, and workers are treated fairly and with respect.

Please consider a tax-deductible gift, or join us as a monthly-sustainer, and thank you.

Support Our Work

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