



apparel  
impact  
institute



# **UNLOCKING THE TRILLION-DOLLAR FASHION DECARBONISATION OPPORTUNITY:**

Existing and  
innovative solutions

**NOVEMBER 2021**

# Table of Contents

---

## UNLOCKING THE TRILLION-DOLLAR FASHION DECARBONISATION OPPORTUNITY:

Existing and  
innovative solutions

About us	3
Glossary	4
Executive Summary	5
<b>PART 1: THE URGENCY TO DECARBONISE THE FASHION INDUSTRY</b>	9
The Fashion Industry's Carbon Challenge	9
<b>GHG Emissions in the Fashion Industry - Understanding the Scopes and Tiers</b>	10
<b>PART 2: MAPPING THE SOLUTIONS TO REDUCE SCOPE 3 EMISSIONS</b>	13
Existing Solutions	16
Innovative Solutions	22
<b>PART 3: SIZE OF THE PRIZE: THE TRILLION-DOLLAR FASHION DECARBONISATION OPPORTUNITY</b>	27
<b>PART 4: THE ROLE OF FINANCE IN DECARBONISING THE FASHION SUPPLY CHAIN</b>	29
Types of Funders	29
Breaking Down the Size of the Prize by Type of Funder	38
The Role of Finance in Existing Solutions	40
The Role of Finance in Innovative Solutions	46
<b>PART 5: BARRIERS TO FINANCING THE LOW-CARBON TRANSITION OF THE FASHION SUPPLY CHAIN</b>	51
Overarching	52
Specific to Existing Solutions	53
Specific to Innovative Solutions	53
<b>PART 6: KEY INDUSTRY ACTIONS AND RECOMMENDATIONS</b>	54
APPENDICES	56
Appendix I - Methodology and Calculations	56
Appendix II - Endnotes	64



# Credits

---

## AUTHORS

**Katrin Ley**

Managing Director  
Fashion for Good

**Rogier van Mazijk**

Investment Director  
Fashion for Good

**Rory Hugill**

Innovation Associate  
Fashion for Good

**Lewis Perkins**

President  
Apparel Impact Institute

**Ryan Gaines**

Finance Director  
Apparel Impact Institute

## ACKNOWLEDGEMENTS

The authors would like to thank the following industry experts, interviewees, reviewers and others who contributed their time and expertise to this report: Alex Perera (World Resources Institute), Amanda Poernig (HSBC), Arun Gupta (Skyven Technologies), Ashley Gill (Textile Exchange), Baptiste Carriere-Pradal (Sustainable Apparel Coalition), Beth Jensen (Textile Exchange), Bob Assenberg (Good Fashion Fund), Bryant LaPres (Apparel Impact Institute), Carrie Whitney (PennHouse Productions), Cash East (Higg), Catherine Tubb (Planet Tracker), Charlotte Borst (Fashion for Good), Chris Goode (HSBC), Dolly Vellanki (Fashion for Good), Earl Singh (Fashion for Good), Emily McGarvey (Apparel Impact Institute), Eske Scavenius (Rubio Impact Ventures), Evan Scandling (Allotrope Partners), Frank Waechter (PUMA Group), Gita Bartlett (HSBC), Harald Cavalli-Björkman (Renewcell), Inbal Nachman (Skyven Technologies), Jana van den Bergen (Fashion for Good), Jeremy Levin (International Finance Corporation), Johanna Björk (J.Björk), Kim Hellstrom (H&M), Laurent Aucouturier (Gherzi), Liam Salter (RESET Carbon), Linda Greer (Institute for Public and Environmental Affairs/NRDC), Matthew Guenther (TAL Apparel), Michael Sadowski (The Circular Initiative), Michael Schragger (The Sustainable Fashion Academy), Navdeep Sodhi (Gherzi), Niklas Lollo (Higg), Punit Lalbhai (Arvind Ltd.), Robert Santler (BECIS), Simon Kew (Alchemie), Susanna Wilson (HSBC), Suzanne Shaw (PennHouse Productions), Thomas Mason (OCA), Zhou An (Apparel Impact Institute), Zoe Knight (HSBC).

## SUPPORTED BY

HSBC is one of the world's largest banking and financial services organisations. They serve more than 40 million customers through their global businesses: Wealth and Personal Banking, Commercial Banking, and Global Banking & Markets. Their network covers 64 countries and territories in Europe, Asia, the Middle East and Africa, North America and Latin America.



# About Us

---

**Apparel Impact Institute (Aii)** is a nonprofit collective founded in 2017 by four industry leaders: the Sustainable Apparel Coalition (SAC), the Sustainable Trade Initiative (IDH), Natural Resource Defense Council (NRDC) and Target Corporation. The organisation emerged organically as a result of a real need that apparel brands and retailers self-identified. Gap Inc., PVH Corp., Arvind Mills, HSBC, GIZ, Stichting Doen and Schmidt Family Foundation joined the founders in the first three years of start-up and organisational development.



Aii identifies, funds, and scales proven quality solutions to accelerate positive impact in the apparel and footwear industry. Aii programmes focus on areas that result in positive environmental impact from the production of apparel and footwear products to improve the industry.

To learn more about Aii, visit [apparelimpact.org](https://apparelimpact.org).

**Fashion for Good (FFG)** is a global platform for innovation, made possible through collaboration and community.



At the core of Fashion for Good is their innovation platform. Based in Amsterdam with a satellite programme in Asia, the global accelerator programmes gives promising start-up innovators the expertise and access to funding they need to grow. The platform also supports innovators through its scaling programme and foundational projects, driving pilots and supply chain implementation with partner organisations. The Good Fashion Fund catalyses access to finance to shift at scale to more sustainable production processes.

As a convener for change, Fashion for Good houses the world's first interactive museum dedicated to sustainable fashion and innovation, a Circular Apparel Community co-working space, and creates open-source resources and reports.

Fashion for Good's programmes are supported by founding partner Laudes Foundation, co-founder William McDonough and corporate partners adidas, C&A, CHANEL, BESTSELLER, Galeries Lafayette Group, Kering, Levi Strauss & Co., Otto Group, PVH Corp., Stella McCartney, Target, and Zalando, and regional and affiliate partners Arvind Limited, Birla Cellulose, HSBC, Norrøna, vivobarefoot, Welspun and W. L. Gore & Associates.

To learn more about Fashion for Good, visit [fashionforgood.com](https://fashionforgood.com)



# Glossary

---

**Bank debt** - A direct agreement between a bank and a borrower, under which the borrower receives money from the bank and agrees to repay the money over a specified period of time.

**Blended capital** - A mix of public, private or non-profit grants, equity, and debt.

**Carbon footprint** - Measures impact of activities on carbon dioxide (CO<sub>2</sub>) produced through the burning of fossil fuels.

**CO<sub>2</sub>eq.** - Carbon dioxide equivalent is a metric measure that converts amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

**Coal phaseout** - Stopping the burning of coal, the most carbon-intensive fossil fuel.

**Corporate bonds** - An agreement between a bond issuer and institutional investors, which specifies a fixed amount that the issuer is obliged to pay at specific intervals.

**Creditworthiness** - The extent to which a company or individual is considered suitable to receive financial credit based on their reliability of paying the money back in the past.

**Debt financing** - Debt financing involves the borrowing of money and paying it back with interest. The most common form of debt financing is a loan.

**Decarbonisation** - Reduction of greenhouse gas emissions.

**Economies of scale** - A decrease in cost per unit of output and increased scale in operations, leading to cost advantages.

**Energy efficiency** - Reduced amount of energy needed to provide products and services, that can also reduce carbon emissions and effects on environmental pollution.

**Equity Financing** - Process of raising capital by selling shares in a company.

**ESG investing** - Consideration of environmental, social, and governance factors alongside financial factors in the investment decision-making process.

**Feed-in tariffs** - Policy mechanism that aims to accelerate investments in renewable energy technologies through long-term contracts with renewable energy producers.

**Financing mix** - A combination of debt and equity structures of a company.

**Green banks** - Public institutions that accelerate the transition to clean energy through innovative financing techniques and market development tools in partnership with the private sector.

**Greenhouse Gas (GHG) emissions** - The release of carbon and other greenhouse gases (GHG) into the atmosphere, the main contributor to climate change.

**Hedging** - Tactical action of an investor to insure against the risk of losing money.

**Materials efficiency** - Using less material to make a product or provide a service.

**Negative cash flows** - When a business spends more than it earns within a given period.

**Net-zero pathway** - A plan to reach a state of net-zero carbon emissions, achieved through balancing, elimination, or absorption of carbon emissions.

**Next generation materials** - Innovative and new materials required to drastically decarbonise the industry in the longer term.

**Paris Agreement** - The international treaty adopted in 2015 to tackle climate change mitigation, adaptation, and finance.

**Private equity** - Private financing where funds and investors directly invest in companies or engage in buyouts of such companies.

**Renewable electricity** - Electricity collected from renewable sources that are carbon neutral such as sunlight, wind, rain, tides, waves, and geothermal heat.

**Return on investment** - A performance measure that evaluates the efficiency of an investment through a ratio between income earned from the investment compared to capital invested.

**Scope 1 emissions** - Direct carbon emissions that occur from sources controlled or owned by an organisation.

**Scope 2 emissions** - Indirect carbon emissions related to purchase of electricity, steam, heat or cooling.

**Scope 3 emissions** - All indirect carbon emissions that occur in and across a company's value chain.

**Sustainability premium** - An increase in cost due to implementation of sustainable materials or services, which is funded by stakeholders in the value chain (i.e. customer, brand, governments, etc.).

**Underwriting** - The process by which financial institutions guarantee payment and accept financial risk in case of damage or financial loss.

**Unit economics** - A measurement of the profitability or value for the company on a per unit basis.

**Venture capital (VC)** - Form of private equity financing that is provided to startups, early-stage, and emerging companies.

**Wet processing** - Processing stage where textile is treated with colourants, chemicals, and water.

# Executive Summary

---

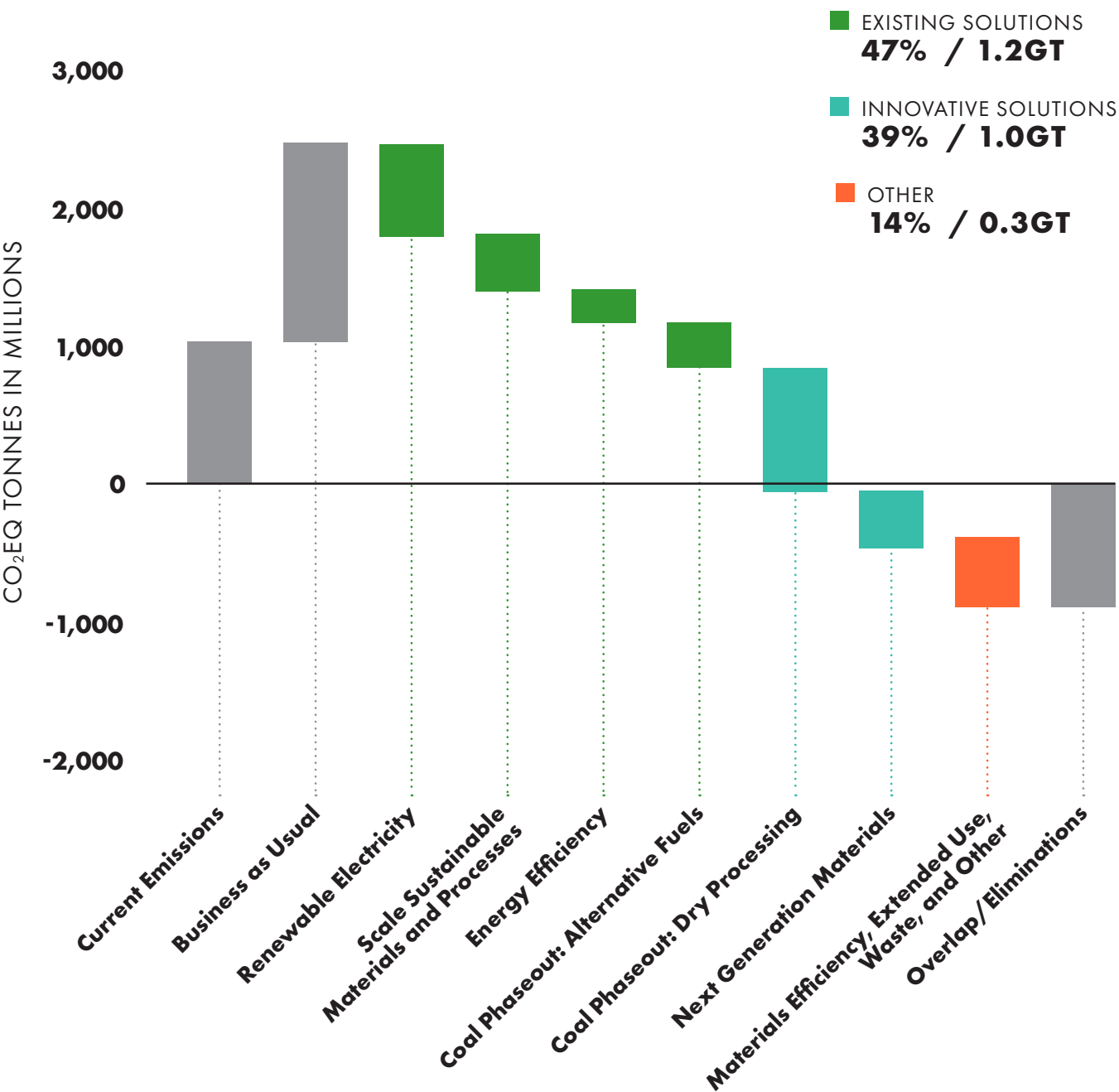
The carbon footprint of the fashion industry is globally significant, evidenced by a growing number of studies, most recently World Resources Institute (WRI) and Aii (2021).<sup>1</sup> The report estimates that the industry's share comprises 2% (1.025 gigatonnes CO<sub>2</sub>eq) of annual global greenhouse gas (GHG) emissions, with most impact taking place in the raw material and processing steps of the supply chain.<sup>2</sup>

Over the last decade, the transformation to a sustainable industry has become of higher priority. What has been an attractive way of working for decades is now increasingly pressured by regulation, media attention, consumer awareness, exposure to supply chain risks, scarcity of commodity materials, and shareholders' ESG demands.

This growing problem and the inevitability of a radical transformation over the next decades has spawned a wide variety of actionable opportunities across the industry's \$2 trillion supply chain.<sup>3</sup> The solution categories in scope of this report enable a net-zero industry to be achieved by 2050. With a combined GHG emissions reduction potential of 2.5 Gt CO<sub>2</sub>eq, of which 1.2 Gt (47% of combined solution categories) will be contributed by solutions already existing today, 1.0 Gt (39%) by innovative solutions, and 0.3 Gt (14%) by other solutions including materials efficiency and reducing overproduction.



PATHWAY TO NET-ZERO: REDUCTION POTENTIAL BY 2050

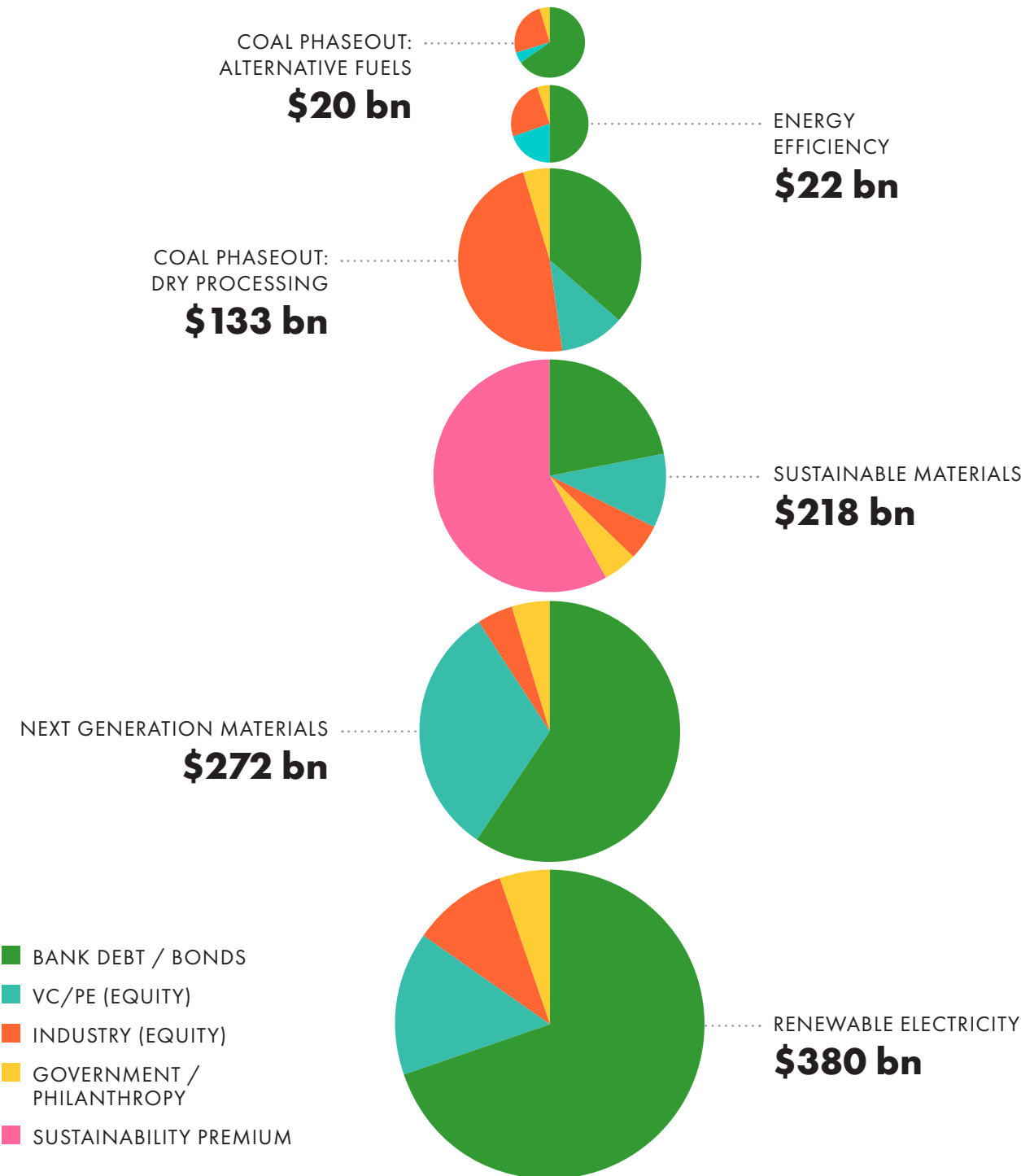


**Figure 1.** Solution categories that enable a net-zero fashion industry by 2050. Source: Aii and FFG analysis (2021).



The total investment required to fund the entire range of solutions shown above amounts to just over \$1 trillion — according to analysis by Aii and Fashion for Good. 61% of the financing is required to implement the existing solutions, with the remaining 39% of funding required to further develop, scale and implement the key innovative solutions. However, given that each decarbonisation solution has a unique risk-return, the funder type differs across the board.

# INVESTMENT BY FUNDER TYPE



**Figure 2.** Financing mix across solution categories. Source: Aii and FFG analysis (2021).

Given these large investment amounts, current levels of commitment and financing are insufficient to succeed in adequately decarbonising the industry before 2050. It is unlikely that the industry will achieve the necessary transformation without a significant change in financing flows to accelerate the adoption of a wide range of efficiency and emissions reduction solutions.

Structural barriers to achieving sufficient levels of financing to support the required transformation exist, which are different for existing solutions than for innovative solutions.

To reach net-zero, solutions to decarbonise Scope 3 emissions are imperative. Net-zero can be achieved, however it requires an aggressive acceleration in the implementation of currently existing solutions and a substantially higher focus on driving innovative solutions, together triggering a \$1 trillion financing opportunity across financing types.

To mobilise \$1 trillion and to overcome barriers, a concerted effort is needed by five key stakeholder groups: financiers (debt and equity), manufacturers, brands, philanthropy and governments. The recommendations to stakeholders are centered around the conditions required to enable a larger flow of financing towards these projects — it is critical to create an environment where investors are presented with projects that are (1) attractive from a risk-return perspective, (2) impactful and (3) understandable.

**Reaching net-zero by 2050 will require all of these stakeholder groups to work together and implement these necessary changes in order to transform the apparel industry.**



# The Urgency to Decarbonise the Fashion Industry

---

## THE FASHION INDUSTRY'S GREENHOUSE GAS CHALLENGE

The global fashion industry is a multi-trillion dollar industry, producing over 100 billion garments annually. Given its size and nature, the industry faces a number of social and environmental challenges. The key environmental challenges are complex and interrelated, but most broadly fall under: land use, water use, chemical use, biodiversity loss and greenhouse gas (GHG) emissions. This paper focuses on the latter — GHG emissions.

With the global average temperature projected to rise by, or even exceed, 3°C this century — well beyond the 1.5°C goal of the Paris Agreement, drastically curbing industry GHG emissions is an unequivocal and necessary action that must be taken in order to limit global warming.

The recent [Intergovernmental Panel on Climate Change \(IPCC\) 2021](#) report found that unless there is a rapid and large-scale reduction in GHG emissions, unprecedented in both speed of implementation and scale, limiting warming to 1.5°C will be beyond reach.<sup>4</sup> Beyond the 1.5°C limit, the prevalence of extreme weather patterns will drastically increase and the effects will be catastrophic and irreversible.

Recent publications have estimated the GHG emissions associated with the fashion industry — with figures ranging from between 2% - 8% of annual global emissions.<sup>5/6/7</sup> Whilst methodology differences lead to wide ranging estimates — one thing is for certain: the fashion industry supply chain is a significant contributor to global GHG emissions. [The Net-Zero Challenge: The supply chain opportunity](#) report by World Economic Forum (WEF) and Boston Consulting Group (BCG) (2021) placed fashion as third in the 'Big Eight' industry-emitting supply chains, behind food and construction, with similar emissions to Fast Moving Consumer Goods (FMCG).<sup>8</sup>

The GHG emissions of the fashion industry are globally significant and evidence has shown that change is required at an unprecedented rate and scale; however, the decarbonisation opportunities in the fashion industry are wide-ranging and diverse. Recent analysis from The World Resources Institute (WRI) and Apparel Impact Institute (Aii) (2021) has mapped solutions to decarbonise the industry and guide the industry to align with a 1.5°C pathway by 2030. Leveraging the industry expertise of Aii and Fashion for Good, coupled with the vast financing knowledge of HSBC, this report builds off previous analysis to map the solutions required to a net-zero pathway by 2050 and estimates the financing required to get the industry there.<sup>9</sup>

Understanding the financing opportunities and sources for implementing the decarbonisation solutions is absolutely pivotal to map a pathway for the future. Financing opportunities are divided by type of financier — illustrating the need for engagement for stakeholders across the finance industry. Sector-specific financing barriers are outlined, before presenting calls to action across each stakeholder within the industry to help to overcome these challenges and help the fashion industry achieve a net-zero future.



# GHG Emissions in the Fashion Industry

## UNDERSTANDING THE SCOPES AND TIERS

As with other industries, GHG emissions in the fashion industry are divided and measured — in keeping with the Greenhouse Gas Protocol’s Corporate Accounting and Reporting Standard, across three Scopes; direct emissions, indirect emissions and indirect value chain emissions respectively.<sup>10</sup>

SCOPE 1 Direct Emissions	SCOPE 2 Indirect Emissions	SCOPE 3 Indirect Value Chain Emissions
Emissions from owned or controlled facilities (e.g. offices, distribution centres)	Emissions from the generation of purchased energy, steam, heat and/or cooling	Emissions that occur in the value chain of the company (not included in Scope 2 emissions), including both upstream and downstream emissions. Examples of upstream emissions are: emissions of purchased goods and services, transport of supplies, and business travel. Examples of downstream emissions are: transportation of products, use of sold products, and product disposal

**Figure 3.** Division of Greenhouse Gas Emissions. Source: GHG Protocol (2015)

Given Scope 1 and 2 — direct and indirect emissions, are under direct control of an organisation, they are easier to measure and report. However, the complex and fragmented nature of fashion supply chains means that Scope 3 — Indirect Value Chain emissions, which represent the vast majority of emissions, have, up until recently, been somewhat overlooked and are typically the least reported.<sup>11</sup>

### Scope 1 and 2 Emissions — Under Direct (Brand) Control

Emissions in Scope 1 and 2 only account for approximately 3% - 5% of an organisation's total GHG emissions. Though the challenge to reduce these emissions is significant, there are a range of initiatives that are working to address them — primarily through the transition to renewable electricity, and other energy efficiency improvements in stores, offices and distribution centres (DCs).

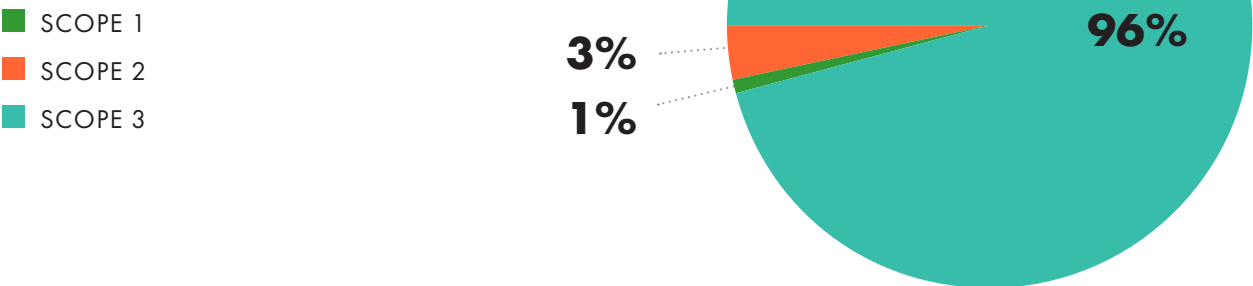
One such example is [The Fashion Pact](#), with signatories of the global coalition of companies in the fashion and textile industry having committed to achieving 50% provision of renewable electricity across their own operations by 2025, and 100% by 2030.<sup>12</sup> Their [recent progress report](#) (2020) revealed that signatories had achieved on average between 40% - 45% provision of renewable electricity across their own operations — just shy of the 2025 target with 5 years to go. However, this figure is partially due to some very large players achieving high rates of renewable electricity provision; with only approximately one third of the 70 companies achieving the goal. As with many climate related endeavours, the Fashion Pact suggests it is crucial that members collaborate, share learnings and work together to drive the adoption of renewables in their owned and operated facilities on an industry-wide level.<sup>13</sup>

For greater detail on Scope 1 and 2 emissions in the (branded) fashion industry — including information on setting reduction targets and methods to reduce emissions, the [United Nations Framework Convention on Climate Change \(UNFCCC\) playbook](#) provides extensive guidance for brands, retailers and manufacturers.<sup>14</sup>

### Scope 3 — In Need of Attention

In many industries, Scope 3 often represents an organisation's most significant greenhouse gas impact. The fashion industry is no different; on average, 96% of emissions stem from Scope 3 across those fashion brands with approved science based targets (SBTs).<sup>15</sup> Within Scope 3 emissions, over 78% come from upstream emissions — purchased goods and services, with the remaining 22% from downstream emissions.<sup>16</sup>

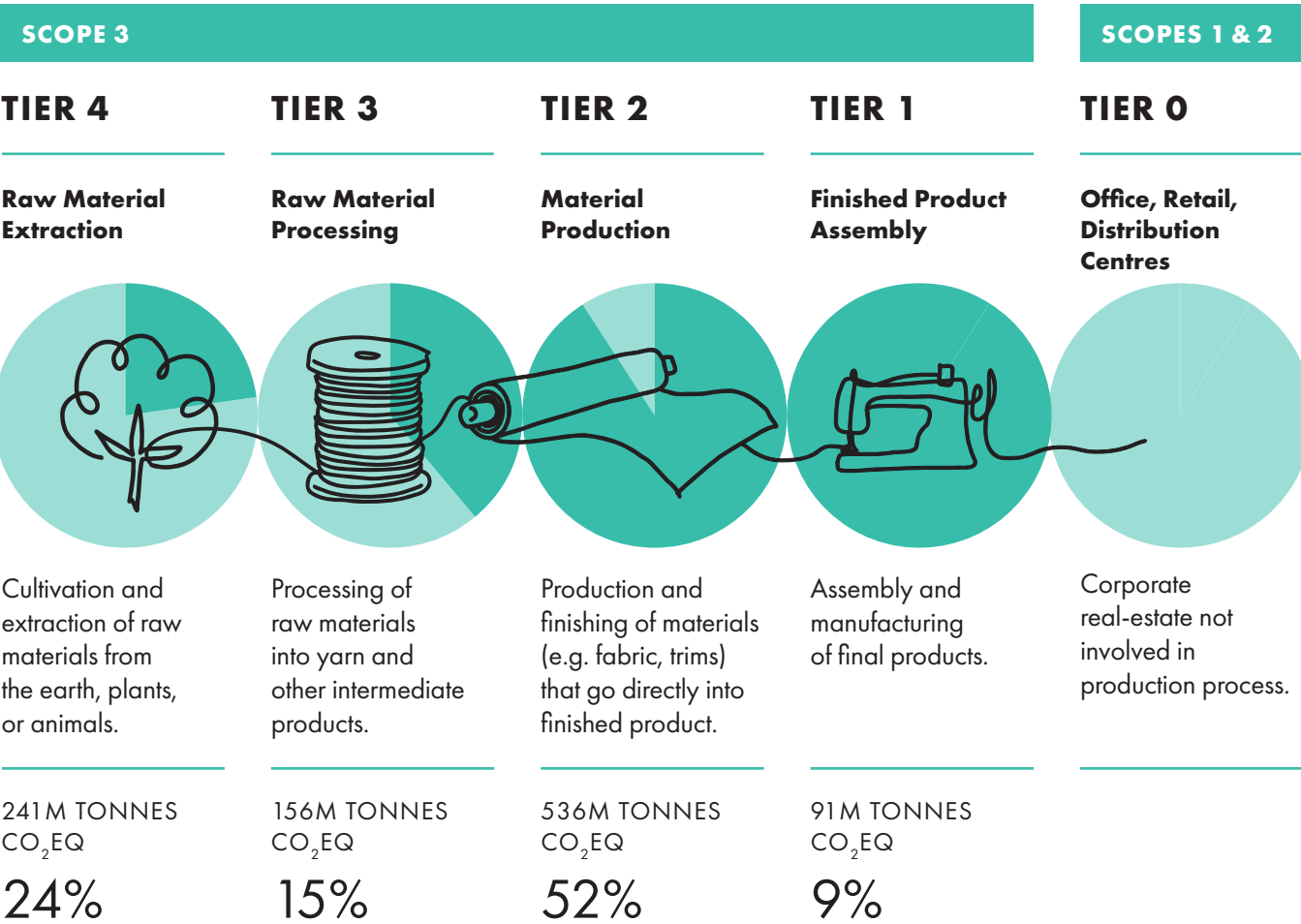
### % OF TOTAL EMISSIONS, BY SCOPE



**Figure 4.** Total Emissions (%) by Scope for Apparel Companies with an Approved SBT. Source: WRI and Aii (2021).

Although attempts have been made to quantify the total emissions generated at an industry-level, different methodologies and analyses have led to different estimations of the total GHG emissions — ranging from 2% - 8% of global emissions.<sup>17/18/19</sup> For the purpose of this report, the World Resources Institute (WRI) and the Apparel Impact Institute (Aii) estimates 1.05 gigatonnes of CO<sub>2</sub>eq (Gt CO<sub>2</sub>eq) generated by the industry — roughly 2% of total global emissions — will be used.<sup>20</sup>

Another common and useful way of representing the apparel industry’s supply chain is in four Tiers. Tiers provide a more granular way of presenting Scope 3 emissions — dissecting the supply chain to its key steps and allowing for a greater understanding of emissions *within* Scope 3. This view can be reconciled to the 3 Scope model in Figure 5.



**Figure 5.** Four Tier Supply Chain Model and GHG Emissions per Tier. Source: WRI and Aii (2021).

Figure 5 splits GHG emissions across each of the tiers of the supply chain. Clearly, the two biggest sources of emissions lie in Tier 4 — raw material extraction, and Tier 2 — material production. As such, many of the solutions to reduce emissions presented in this report focus on these tiers.

# CONCLUSION

Identifying and understanding the sources, opportunities, and volume of financing for apparel industry decarbonisation is a crucial step in mapping a clear path of action for the future. This report segregates the financing opportunity by type of financier — illustrating the need for engagement for stakeholders across the finance industry. Sector-specific financing barriers are then cited, before presenting calls to action across each stakeholder within the industry to help to overcome these challenges and help achieve a net-zero future.



# Mapping the Solutions to Reduce Scope 3 Emissions

The recently published [WRI and Aii \(2021\)](#) report identifies six solutions the fashion industry can adopt to deliver the GHG reductions needed to stay within the 1.5°C pathway by 2030.<sup>21</sup> Additionally, for the purpose of this analysis, this report makes two changes to the interventions proposed by WRI and Aii (2021):

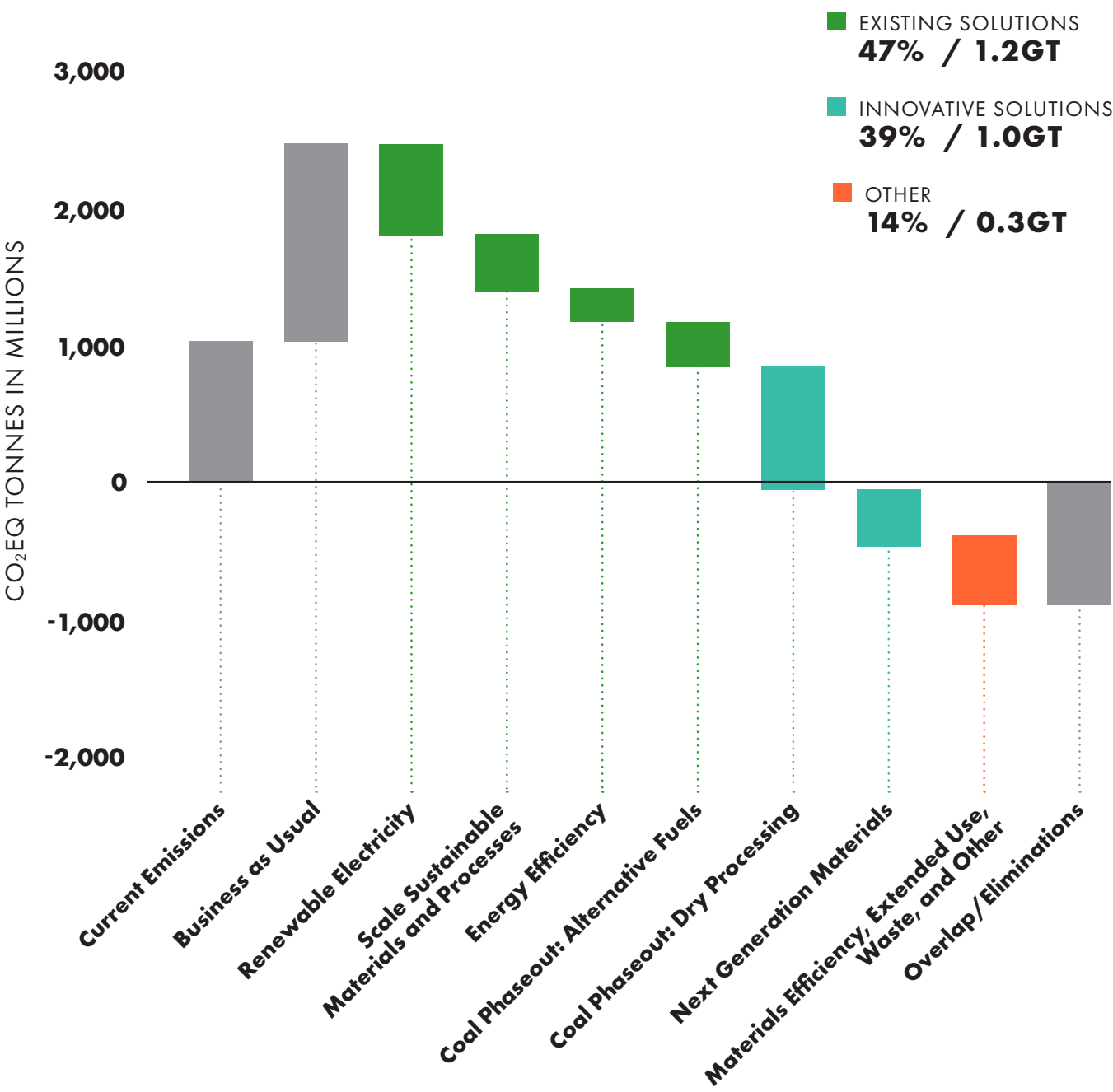
- i) Split 'Phase Out Coal' into two parts — one through switching to alternative fuel sources and the other through transitioning to dry processing technologies
- ii) Combine materials efficiency with extending useful life and reduction in overproduction. These are reflected in Figure 6 below:

ACTIVITY	DESCRIPTION
<b>EXISTING SOLUTIONS</b> (REQUIRING MINIMAL NEW INNOVATION)	
SHIFT TO RENEWABLE ELECTRICITY	▶ Deploy renewable electricity across the supply chain.
SCALE SUSTAINABLE MATERIALS AND PROCESSES	▶ Increase the use of lower-carbon fibres (e.g. recycled polyester) and practices (e.g. conservation tillage for cotton).
MAXIMIZE ENERGY EFFICIENCY	▶ Expand energy efficiency efforts across manufacturing facilities.
COAL PHASEOUT: ALTERNATIVE FUEL SOURCE	▶ Replace coal as an energy source for apparel manufacturing, by switching to alternative fuel sources (e.g., natural gas or biomass).
<b>INNOVATIVE SOLUTIONS</b> (REQUIRING ADDITIONAL INNOVATION TO REACH SCALE)	
ACCELERATE NEXT GEN MATERIALS	▶ Ramp up investment in "next generation" preferred materials including textile recycling, bio-based materials, and plant-based leather.
COAL PHASEOUT: DRY PROCESSING	▶ Replace coal by replacing current processes with innovative new dry processing technologies that require very little to no amounts of water.
<b>OTHER</b> (FALLING OUTSIDE OF THE EXISTING AND INNOVATIVE SOLUTIONS)	
MATERIALS EFFICIENCY, EXTENDED USE, WASTE, AND OTHER	▶ Includes extending the useful life of garments, re-commerce, increasing rentals, improvements in materials efficiency, and reduction in overproduction.

**Figure 6.** Seven Solutions to Stay within 1.5°C pathway by 2030. Source: WRI and Aii (2021), Aii and FFG analysis.

Figure 7 below maps the solutions presented above by their emission reduction potential — thus showing the pathway to a net-zero industry by 2050:

PATHWAY TO NET-ZERO: REDUCTION POTENTIAL BY 2050<sup>22</sup>



**Figure 7.** Solution categories that enable a net-zero fashion industry by 2050. Source: Aii and FFG analysis (2021).

The solution categories in the scope of this report enable a net-zero industry to be achieved by 2050, with a combined GHG emissions reduction potential of 2.5 Gt CO<sub>2</sub>eq, of which 1.2 Gt (47% of combined solution categories) will be contributed by solutions already existing today, 1.0 Gt (39%) by innovative solutions, and 0.3 Gt (14%) by other solutions including materials efficiency and reducing overproduction.

Given that some of the solution categories are targeting similar problem areas in the supply chain, there are significant overlaps between these solution categories if implemented at scale. For example, “phasing-out coal” has less potential if those processes have been optimised through “Wet to Dry Processing”. In Figure 7, a final category indicatively accounts for such overlaps, resulting in a net-zero state for the industry by 2050.

The following section provides more information and the potential impact of each solution.





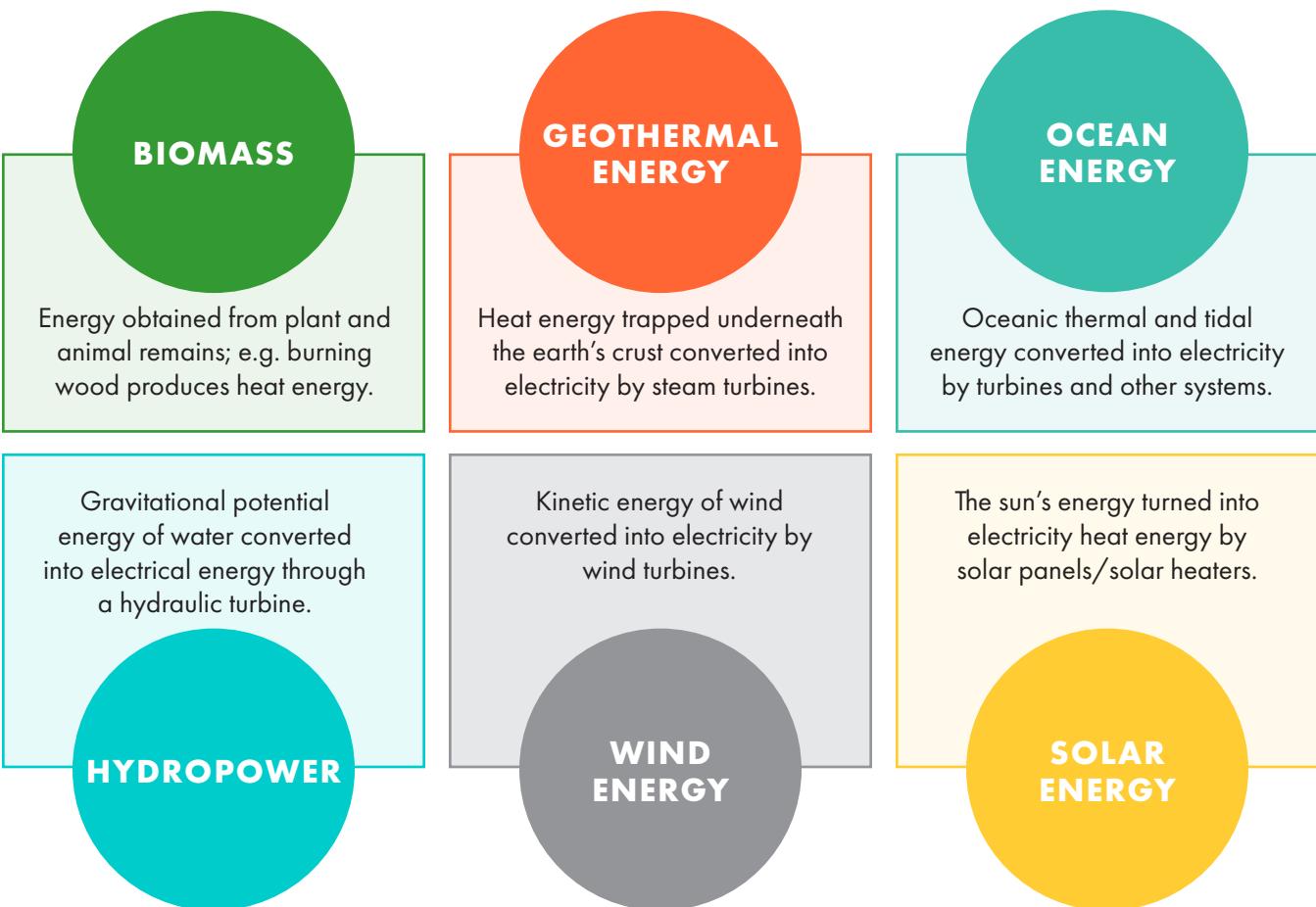
# Existing Solutions

## SHIFT TO 100% RENEWABLE ELECTRICITY

### What is renewable electricity?

Renewable electricity is generated from natural, carbon-free resources, such as wind and solar, and can replace conventional sources of electricity generation, such as natural gas or coal. Renewable electricity projects can either be located off-site and feed into the grid or located at the manufacturing site and deliver electricity directly to the manufacturer. On-site renewable electricity projects typically use rooftop solar technology, although wind and other technologies are possible for on-site installations as well. Renewable electricity costs have fallen dramatically in the last decade — solar prices decreased more than 80% from 2010 to 2020<sup>23</sup> — and in many cases, it now costs less to generate electricity from renewable sources than from conventional fossil fuel sources.<sup>24</sup> This report primarily refers to rooftop solar projects as the source of renewable electricity, since rooftop solar is the most established and cost effective technology in many regions of the world. However, off-site solar and other technologies are viable and frequently used as well.

### TYPES OF RENEWABLE ELECTRICITY GENERATION<sup>25</sup>



**Figure 8.** Types of renewable electricity generation. Source: Science Facts (2020).

**Potential Impact**

The importance of transitioning to renewable electricity cannot be underestimated. The analysis in this report suggests that switching production to renewable electricity across the fashion supply chain abates ~27% of all emissions. Other reports, such as the [WEF and BCG \(2021\)](#) report, have estimated renewable electricity's potential impact to be even higher.<sup>26</sup> Therefore, while there are many industry-specific actions that should be pursued (which will be covered in greater detail throughout this report), the need to transition to renewable electricity underpins all actions.

However, though the goal is simple, achieving it is much more challenging. First, the prominent type of energy used differs from tier-to-tier in the supply chain — with Tier 3 being powered almost entirely by electricity, while Tier 2 is reliant on thermal energy, mostly generated from coal, for dyeing and finishing processes.<sup>27</sup> Although product and facility dependent, it has been estimated that thermal energy is responsible for between 75 - 90% of Tier 2 energy consumption.<sup>28/29</sup> Therefore, a different approach is required to replace thermal energy with renewable sources (see 'Coal Phase Out' on pg. 21). Moreover, countries have a very specific set of policy and infrastructural conditions, which vastly influence the provision of renewables — including the cost and the abundance. For more information on this, see the [UNFCCC playbook](#) (pg. 66) and the [Net-Zero Standard](#) report.<sup>30/31</sup>



# SCALE SUSTAINABLE MATERIALS AND PROCESSES

## What Are Sustainable Materials and Processes?

Sustainable materials and processes are those with lower GHG emissions on a per unit basis compared with conventional alternatives. In this section, the impact of scaling existing sustainable materials and processes is examined (see 'Innovative Solutions' on pg. 24 for discussion on Next Generation Sustainable Materials).

For the purposes of this report, the following five types of existing sustainable materials and processes are included:

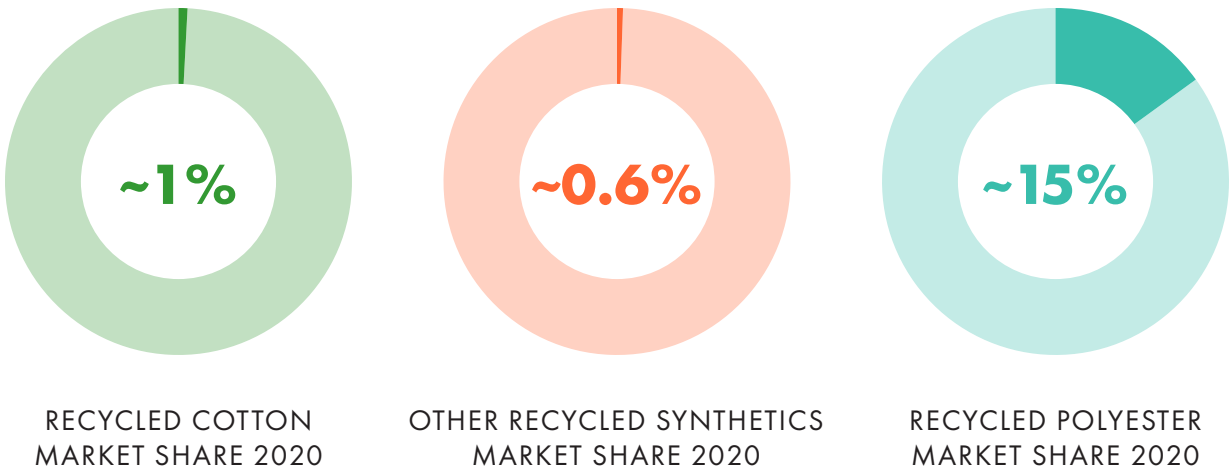
- Mechanically-recycled Polyester
- Mechanically-recycled Nylon
- Organic/preferred Cotton
- Mechanically-recycled Cotton
- Viscose sourced from sustainable fibres

## Potential Impact

The analysis in this report assumes that existing sustainable materials and processes will reach 46% market share by 2050 compared to 17% in 2020 (not including an additional 41% market share of nature-based and next generation materials).<sup>32</sup> At 46% market share this solution alone could reduce total emissions within the apparel industry by 16% (400 million tonnes CO<sub>2</sub>e per year). For more information on this, see the [UNFCCC playbook](#) (pg. 44) and [WRI and Aii report](#).<sup>33/34</sup>

## RECYCLED FIBRES MARKET SHARE

A key driver of sustainable materials and processes is through recycling old fibres into new uses. This will require an increase in recycling rates and infrastructure. Furthermore, many recycled synthetic fibres (e.g. polyester) are made from recycled plastic bottles which are in high demand for a variety of other recycling applications beyond apparel. Recycled materials currently make up a relatively small portion of total material production:



**Figure 9.** Recycled fibres market share. Source: Textile Exchange (2021).



## MAXIMISE ENERGY EFFICIENCY

### What Are Energy Efficiency Improvements?

Energy efficiency improvements are readily implementable changes that can be made in facilities to reduce the energy required to perform the same process. For example by metering, optimising and fixing broken equipment, and re-using byproducts.

### Potential Impact

The impact potential of energy efficiency varies by programme, facility size and tier. However, savings typically average ~15% of total energy use with current techniques.<sup>37/38</sup> Although not within the scope of this report, energy efficiency improvements typically result in similar reductions in water and chemicals usage as well. Energy efficiency is one of the 'low-hanging fruit' of GHG reduction strategies as it can result in significant savings with a relatively low investment and high ROI. Additionally, energy efficiency improvements are particularly well suited for Tier 2 facilities, which comprise 52% of total emissions and are otherwise challenging to address due to their reliance on thermal energy.

However, whilst there may be long-term carbon and economic benefits to be gained, manufacturers may not have the initial capital required to invest in efficiency, nor the technical expertise to identify and implement opportunities. Two such programmes that are helping to overcome those barriers by building capacity and providing funding are PaCT and Clean by Design.

### PARTNERSHIP FOR CLEANER TEXTILES (PaCT)<sup>36</sup>

A notable example of energy efficiency is led by the International Finance Corporation (IFC). The PaCT programme is a collaboration amongst brands, textile factories, and others to improve the environmental performance of textile mills. In addition to identifying best practices for reducing negative impacts, PaCT also aims to address regulatory gaps and facilitate investments in resource efficient technologies. To date, over \$100 million has been invested through the programme.



Ethan Bodnar / Unsplash





### CLEAN BY DESIGN<sup>39</sup>

Clean by Design, created by the Natural Resources Defense Council (NRDC) and now a programme of the Apparel Impact Institute, is a turnkey green supply chain programme which improves the energy, water, and chemicals usage in textile mills. Clean by Design programmes deliver a 10-20% reduction in energy, water and chemicals usage on average. Clean by Design has identified ten best practices for reducing environmental impacts and operating costs at mills:

1. METERING AND LEAK DETECTION
2. COOLING WATER REUSE
3. HEAT RECOVERY FROM HOT WATER
4. MAINTAIN HEAT TRAPS AND SYSTEMS
5. HEAT RECOVERY FROM EXHAUST GAS AND HEATING OIL
6. IMPROVE BOILER EFFICIENCY
7. IMPROVE INSULATION
8. CONDENSATE COLLECTION AND RECOVERY
9. OPTIMISE COMPRESSED AIR
10. PROCESS AND WASTEWATER REUSE

For more information, see 'Clean by Design Demonstrates an Attractive ROI From Energy Efficiency Investments' on pg. 44

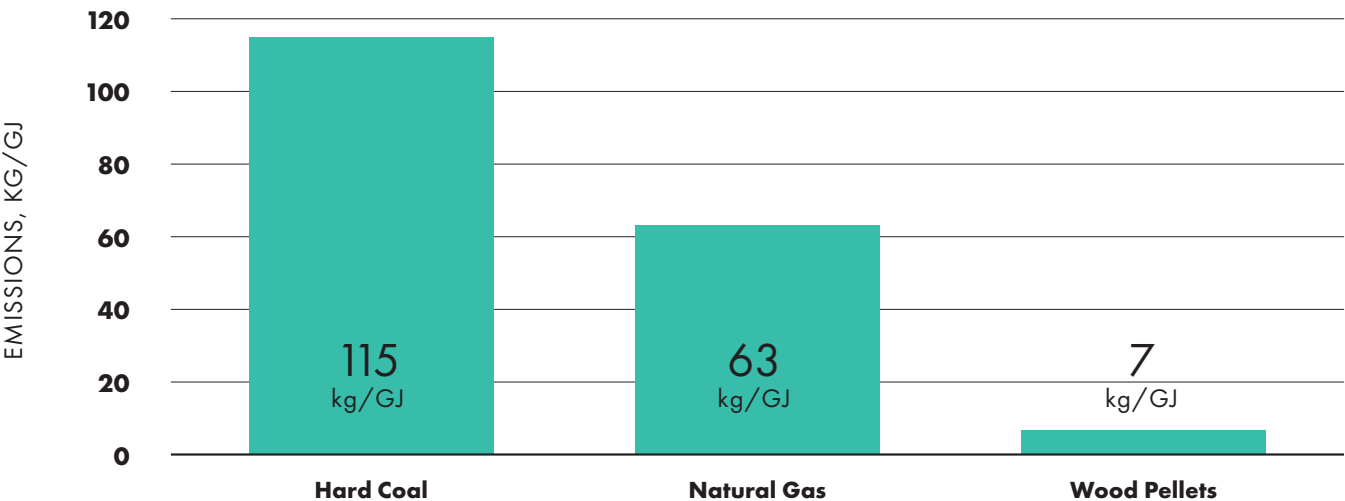
For an exhaustive list of energy efficiency practices that manufacturers can pursue, see the UNFCCC playbook and adidas' Environmental Good Practice Guide & Toolkit.<sup>40/41</sup>

# PHASE OUT COAL WITH ALTERNATIVE FUEL SOURCES

## What Does Phasing Out Coal with Alternative Fuel Sources Entail?

Coal is a commonly used fuel in textile mills and other manufacturing facilities for thermal processes such as heating water for dyeing fabric and generating steam. Coal is a preferred fuel for thermal energy given its high heat content, availability, and cost, but produces greater GHG emissions than alternative fuel sources (see Figure 10).

## CARBON EMISSIONS OF DIFFERENT FUEL SOURCES<sup>42</sup>



**Figure 10.** Comparing emissions of coal, natural gas, and biomass. Source: Forest Research (2021).  
 Note: kg/GJ is kilograms per Gigajoule

While availability varies by region, natural gas and/or biomass offer lower GHG emissions than coal and may be an intermediate step toward achieving carbon-free thermal energy. Other low-carbon fuel sources that are not commercially viable today (at the scale and heat level required for fabric dyeing), but may be viable in the future, include hydrogen, concentrated solar, and nuclear. For the purposes of this analysis, the cost of switching from coal to natural gas is examined. While natural gas is not available in all regions and is not a carbon-free fuel source, the expected capital cost of switching to natural gas is likely similar to that of other fuel sources. It is also important to note that in some regions, switching from coal to natural gas will result in operating cost savings, whereas in other regions it may result in an increase in operating costs. This has implications for the availability of financing and the total cost of a project over its lifecycle.

## Potential Impact

Assuming a full phase out of coal use for thermal energy production at Tiers 1 and 2, emissions can be reduced by 13% (326 million tonnes CO<sub>2</sub>eq per year) compared to the business as usual case. This is a known solution that could be implemented immediately. However, even further emissions reductions can be achieved by removing the need for the energy intensive wet dyeing process entirely (See 'Phase Out Coal through Dry Processing' on pg. 22).

# CONCLUSION

To avoid passing a point of no return with climate change, and achieve at least a 45% reduction in emissions compared to 2019 levels, these four existing, proven solutions should be implemented as quickly as possible. These four solutions represent an estimated 47% of the emissions reductions required to reach net-zero by 2050. In order to close the gap to net-zero, further impact is needed in the form of two additional innovative solutions, covered in the following chapter, which comprise 39% of the impact in scope of this report.

# Innovative Solutions

## PHASE OUT COAL THROUGH DRY PROCESSING

### What is Dry Processing?

WRI and Aii (2021) estimate that 52% of emissions stem from Tier 2 processes.<sup>43</sup> Given its significance, this report will dive into the traditional wet processes causing these high emissions, and the innovative almost dry processes that can drastically reduce the emissions at this stage of the supply chain. During the processing stage, fibres, yarns, fabrics or garments go through multiple steps to achieve the performance and aesthetic properties desired by the industry. These steps can be broadly categorised into pretreatment, dyeing, printing and finishing, which are explained in Figure 11.

ACTIVITY		DESCRIPTION	EXAMPLE PROCESS
PRETREATMENT	▶	Pretreatment is done before a dyeing and printing process. It is mainly done to clean the fibre and make the dyeing or finishing step more efficient.	Plasma Supercritical CO <sub>2</sub>
DYEING / PRINTING	▶	Dyeing / Printing is the application of dyestuff on textile materials such as fibres, yarns and fabrics with the goal of achieving colour with desired colour fastness.	Digital Spray Digital (Gravure) Printing Supercritical CO <sub>2</sub> Ultrasonic Foam
FINISHING	▶	In textile finishing, a treatment is applied to a textile to give it a specific desirable quality or functionality, making it more suitable for its intended end use.	Plasma Digital Spray Ultrasonic Ozone Laser

**Figure 11.** Dry processing steps. Source: Fashion for Good analysis (2021).

Traditionally, all these processing steps take place in very large tanks or baths filled with water that is constantly kept at a high temperature.<sup>44</sup> This is the root cause of Tier 2's relatively high GHG emissions. The (petroleum derived) chemistry used in these processes, such as synthetic dyes, are also a key contributor.

The key solutions to drastically reducing energy, as well as water use, in Tier 2 lies within moving from wet processes to almost dry processes. In other words, moving away from processing in heated baths and tanks filled with huge volumes of water, to completely different processing technologies that require very little to no water — and subsequently also significantly less energy to heat up the entire process. Figure 11 provides an overview of the important dry processes in the pretreatment, dyeing/printing, and finishing space identified by Fashion for Good.

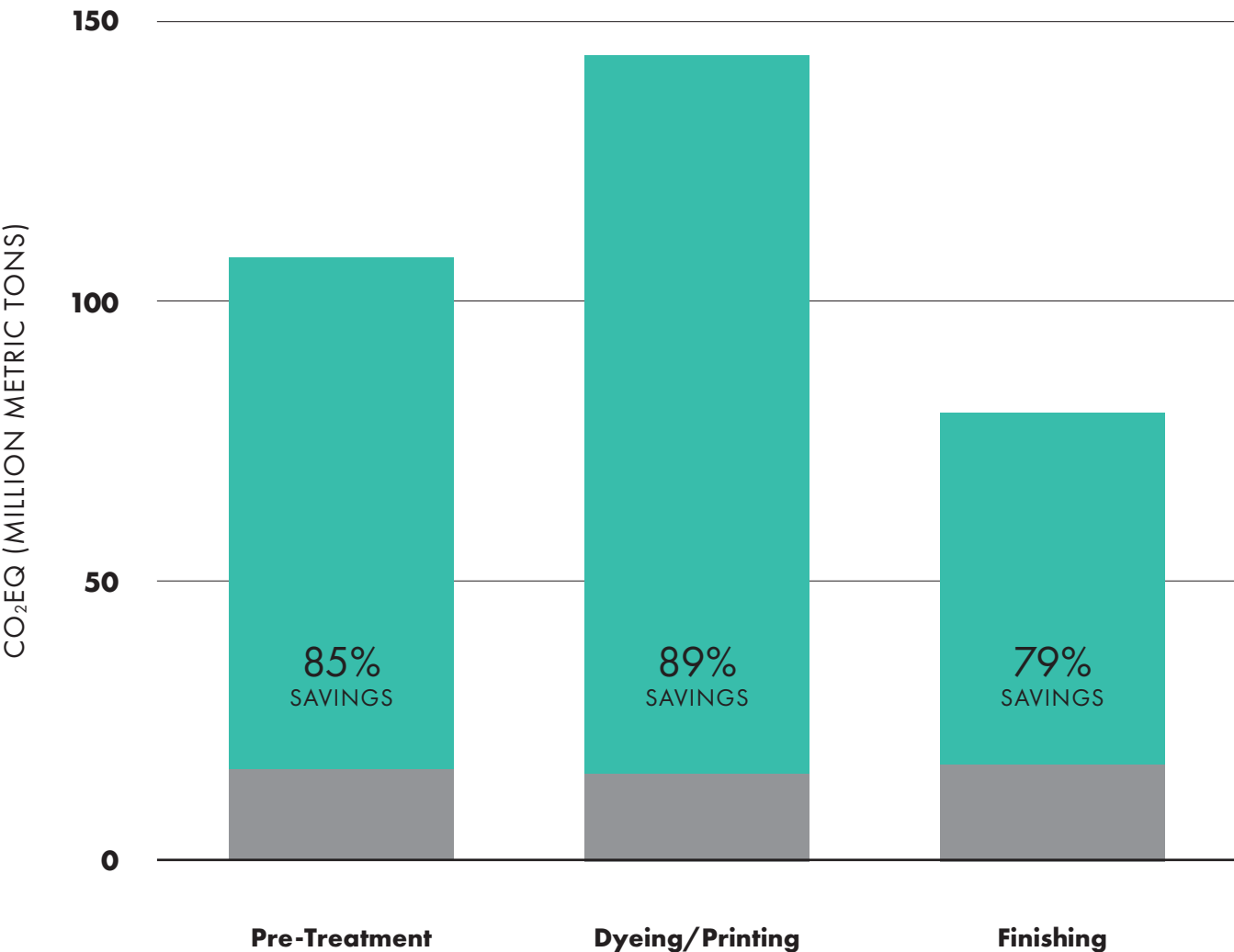
### Impact potential

To heat up the large amounts of water used in the processing baths and tanks used in wet processes, a massive amount of thermal energy and coal is used. By transitioning to new innovative almost dry processes, Tier 2 emissions could potentially be reduced by 79% - 89%, as shown in Figure 12. Given Tier 2's significant contribution to total GHG emissions, transitioning to almost dry processing has the potential to abate over a quarter (26%) of total GHG emissions required in the industry.

## CO<sub>2</sub>eq EMISSION REDUCTION POTENTIAL OF DRY PROCESSING

■ CO<sub>2</sub>eq EMISSIONS BEFORE IMPACT

■ CO<sub>2</sub>eq EMISSIONS AFTER IMPACT



**Figure 12.** Impact Potential of GHG Emissions in Dry Processing. Note: Impact data was self-reported by select innovators and represents an impact potential scenario. CO<sub>2</sub>eq reduction figures are based on 2020 emission levels. Source: Fashion for Good analysis (2021).



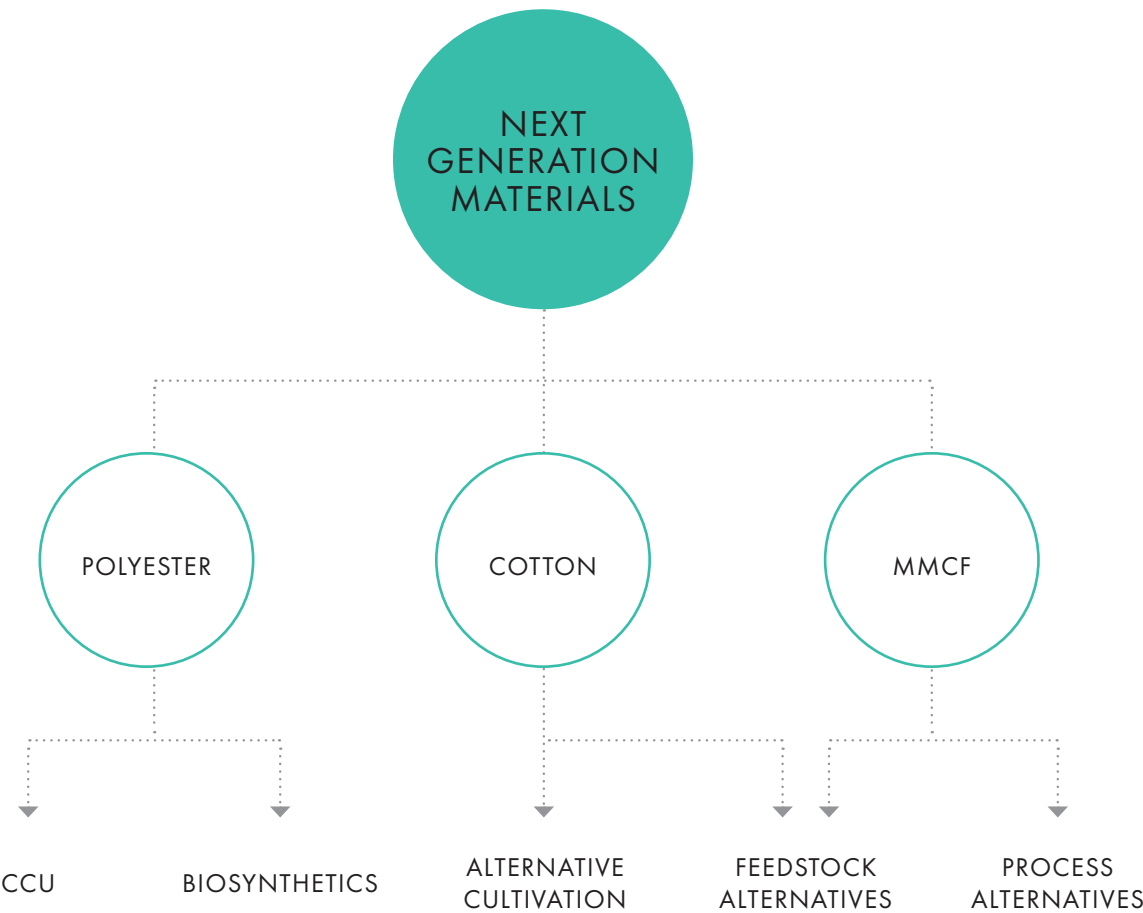
# ACCELERATE DEVELOPMENT OF NEXT GENERATION MATERIALS

## What are Next Generation Materials?

The raw material stage includes the extraction of all unprocessed inputs to create the final products derived from the most commonly used materials — cotton, polyester, and Man Made Cellulosic Fibres (MMCF) which, according to the [Textile Exchange's Preferred Fiber & Materials Market Report 2021](#) (2021), made up over 80% of the global fibre market in 2020.<sup>45</sup>

As outlined earlier in this chapter, optimisation of the raw material stage based on existing solutions can have a significant impact. However, to drastically decarbonise the industry in the longer term, the next generation of new materials are required.

Key raw material areas can be distinguished to demonstrate the different innovation areas.



**Figure 13.** Innovation Areas for Key Raw Materials. Source: Fashion for Good analysis (2021).  
 Note: this is a non-exhaustive list of material innovation categories.

### Polyester-focused innovation

Two main key innovation areas can be categorised into Carbon Capture and Utilisation, and the use of biomass derived polymers — guided by [Nova Institute's Renewable Carbon Framework](#).<sup>46</sup>

- **Carbon Capture and Utilisation (CCU)** — This emerging field of innovation is the process of capturing CO<sub>2</sub>EQ to be recycled and converted for further use as feedstock for chemicals or polymers. While CCU mainly addresses carbon, other GHG, such as methane can be captured and utilised as well.
- **Biosynthetics** — Biosynthetic materials include the production of chemicals for “synthetic” polymers, such as precursors for nylon and polyester, for example, those obtained via catalytic conversion of biomass or bio-fabricated using living microbes in fermentation processes. Biomass can consist of food crops, non-food crops, agricultural by-products or biogenic waste (i.e. sewage sludge, fermentation residues). Example biosynthetic fibres are: Bio-PET (Polyethylene terephthalate), Bio-PA (Polyamide e.g. nylon) and polyhydroxyalkanoates (PHA).<sup>47</sup> For more information on biosynthetics and other biomaterials in the fashion industry — see [Fashion for Good and Biofabricate's 2020 Report](#).

### Cotton-focused innovation

The key innovation area to reduce the GHG impact of cotton production lies in alternative cultivation methods and the use of innovative processing of alternative feedstocks. These are exemplified by the following:

- **Alternative cultivation methods:**

- **Soil treatment:** the use of safe, biodegradable mulch to improve water retention and create a micro-climate. Or, regenerative practices such as agroforestry which promise to increase the organic carbon content in soil.
- **Seed treatment:** draws on beneficial microbes that live inside plants to improve their natural resistance to disease.
- **Precision agriculture:** improved drip irrigation instead of flood-or-furrow irrigation

**Alternative feedstocks:** alternative natural fibres such as bast or agricultural waste derived fibres (e.g. rice straw and hemp) can be processed in innovative ways (for example, through cottonisation) to resemble cotton's properties. For more information on the potential of agricultural residues as textile fibre feedstock — see [Laudes Foundation report 'Spinning Future Threads'](#).

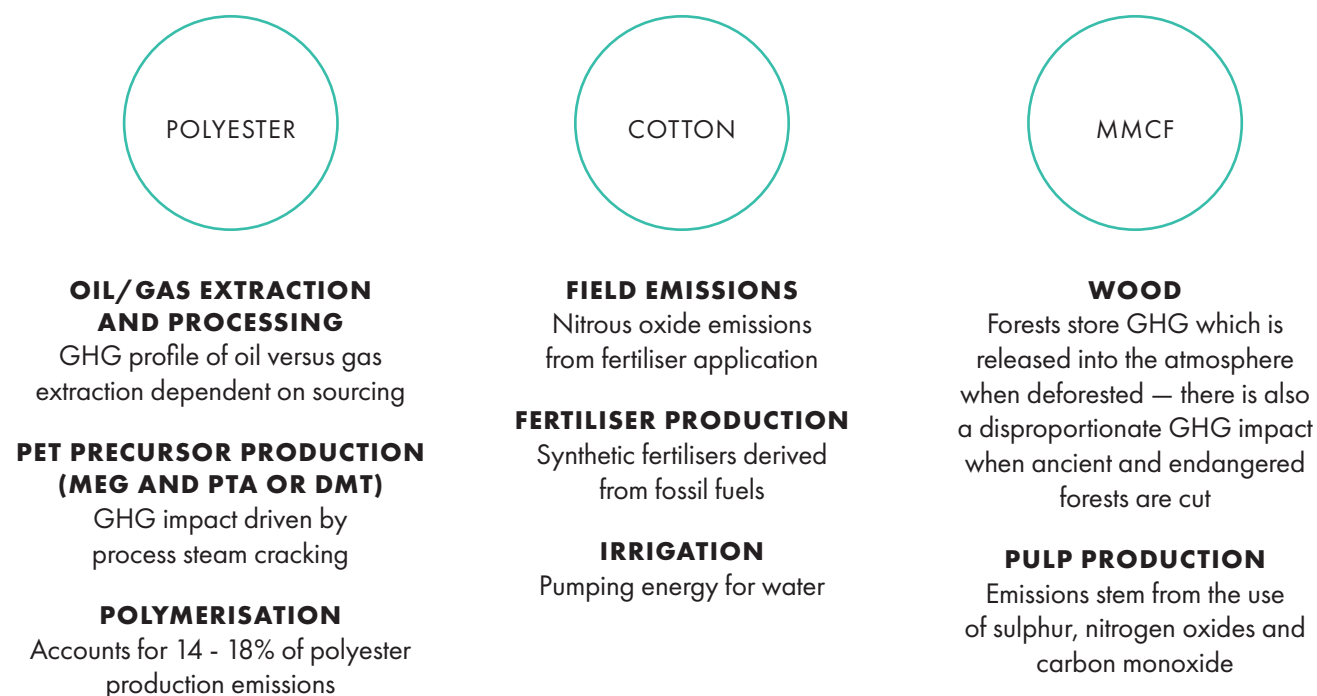
### MMCF-focused innovation

The cellulosic fibre industry has begun to implement closed loop systems to reuse chemicals, as traditional processes are chemically and energy intensive. Therefore, the next generation innovation areas are *alternative feedstocks* replacing tree-based cellulose sources with waste feedstocks. Secondly, *alternative processes* can achieve significant reductions in chemical as well as energy and water use.

- **Alternative feedstocks:** next generation MMCF fibres can be made from a variety of feedstocks, replacing the need for conventional wood. These include, but are not limited to: food waste, bamboo, agricultural or hemp waste and algae.
- **Alternative processes:** Process innovation can drastically reduce the emissions associated with the production of next generation MMCFs. For example, mechanophysical processes can use only water, heat and pressure in the production process — replacing the need for any GHG emitting chemicals.

### Potential impact:

The [WRI and Aii \(2021\)](#) report highlights the significant impact of the raw material stage, with just under a quarter of all emissions in the supply chain stemming from Tier 4.<sup>48</sup> Scaleable next generation materials have the potential to displace a significant amount of the GHG emissions coming from the most widely used fibres. While it is true that some of the solutions listed above could even result in negative emissions, the impact calculation in this report is based on a 75% displacement of the emissions in Tier 4 — 13% (433 million tonnes CO<sub>2</sub>eq) of the total industry emission reduction by 2050. Figure 14 demonstrates where the most impact steps from in current raw material production — across the most common fibre types.



**Figure 14.** Main impact areas from current raw material production. Source: UNFCCC (2021).

### Fibre to Fibre Chemical Recycling

While emerging chemical recycling solutions are not included in the emission saving reduction calculation (for reasons explained below), they are a potentially important innovation area from a GHG emissions perspective, and therefore worth discussing. Chemical recycling refers to the use of chemicals as solvents, reactants or as catalysts to separate and/or recycle target materials. From a process perspective, chemical recycling can break down textile waste into its chemical building blocks and then rebuild them into new fibres of similar quality. By putting textile waste back into the system and reducing reliance on virgin resources, these technologies have the potential to significantly reduce the amount of solid textile waste generated by the fashion industry each year. Chemical recycling solutions are being developed and scaled across polyester, cotton, nylon and polycotton blended garments.

### Potential impact

Although the impact on waste and the use of new resources is more straightforward, the impact from a process perspective is less clear. Given its infancy as an innovation area and advanced technology, all innovators are still scaling up their processes and therefore their current process emissions are not representative of what will occur in the future — with economies of scale and process optimisation. For that reason, chemical recycling is excluded as a solution category shown in Part 2 of this report, but is acknowledged as a potential key innovation lever in the race to net-zero.

## CONCLUSION

While much work is needed to get the aforementioned innovative solutions to scale — their importance cannot be overstated. Innovative solutions account for 39% of the total emission reduction potential and therefore play a crucial role in reducing the industry's impact. The above examples demonstrate the wealth of exciting and impactful innovative solutions being developed — now the industry needs to collaborate to accelerate their development and implementation to drastically reduce the industry's carbon footprint.

# Size of the Prize: The Trillion-Dollar Fashion Decarbonisation Opportunity

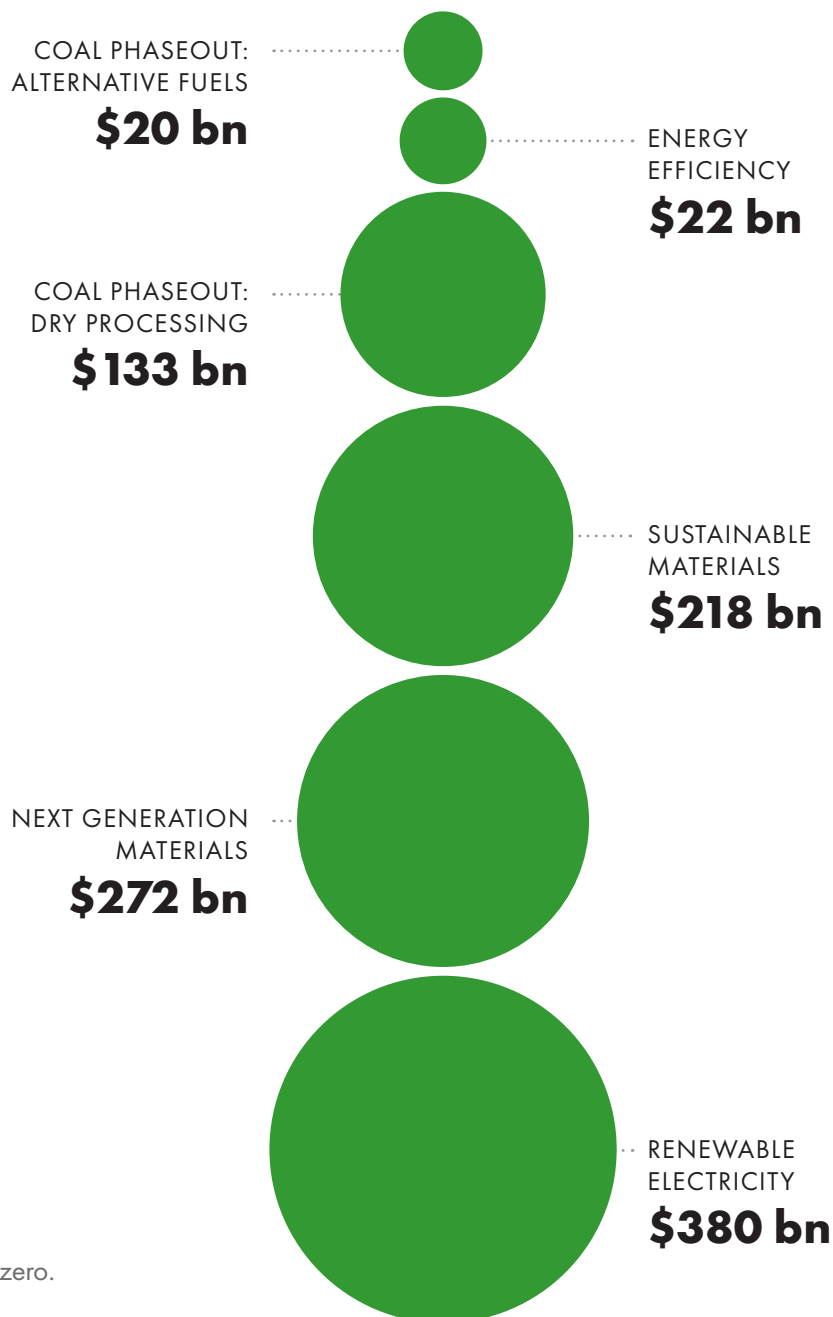
For each existing and innovative solution category in the scope of this report, the total funding requirement across all stakeholders is estimated as outlined below:

## RESULTS:

TOTAL FUNDING FOR  
EXISTING SOLUTIONS:  
**\$639 BILLION**

TOTAL FUNDING FOR  
INNOVATIVE SOLUTIONS:  
**\$405 BILLION**

TOTAL INVESTMENT NEEDED:  
**\$1.04 TRILLION**



**Figure 15.** Investments required to reach net-zero.  
Source: Aii and FFG analysis (2021).



Given the breadth of these solutions, different methodologies have been used to arrive at each dollar value reported in Figure 15:

**Renewable Electricity:**

Higg FEM and the Open Apparel Registry were used to calculate the global electricity use of the apparel industry, which was multiplied by the average capital cost per MW for solar electricity installations.

**Sustainable Materials and Processes:**

Textile Exchange's forecast of global textiles volumes was multiplied by the cost of collection and processing facilities that will be required to increase preferred materials volumes, along with the associated cost premium of sustainable materials to conventional materials.

**Energy Efficiency:**

The average cost to implement energy efficiency per facility was estimated using previous results from facilities that have completed the Clean by Design programme. This figure was then multiplied by this report's estimate for the number of global facilities (149,792 global facilities by 2050).

**Coal Phase Out: Alternative Fuels:**

The total thermal energy use of the apparel industry was estimated and multiplied by EPA estimates for switching to natural gas.

**Coal Phase Out: Dry Processing & Next Generation Materials:**

The total number of innovators in Fashion for Good's database in each innovation category was multiplied by an estimate for the capex cost required to scale each innovation.

Please see Appendix I for further information and a detailed methodology for these calculations.

While an investment in excess of \$1 trillion over the next 30 years is certainly a large amount, the majority of this spend is for projects that offer an attractive financial, as well as environmental, return on investment. Part 4 of this report details the types of funders and financing mechanisms that will be required to reach this goal.



# The Role of Finance in Decarbonising The Fashion Supply Chain

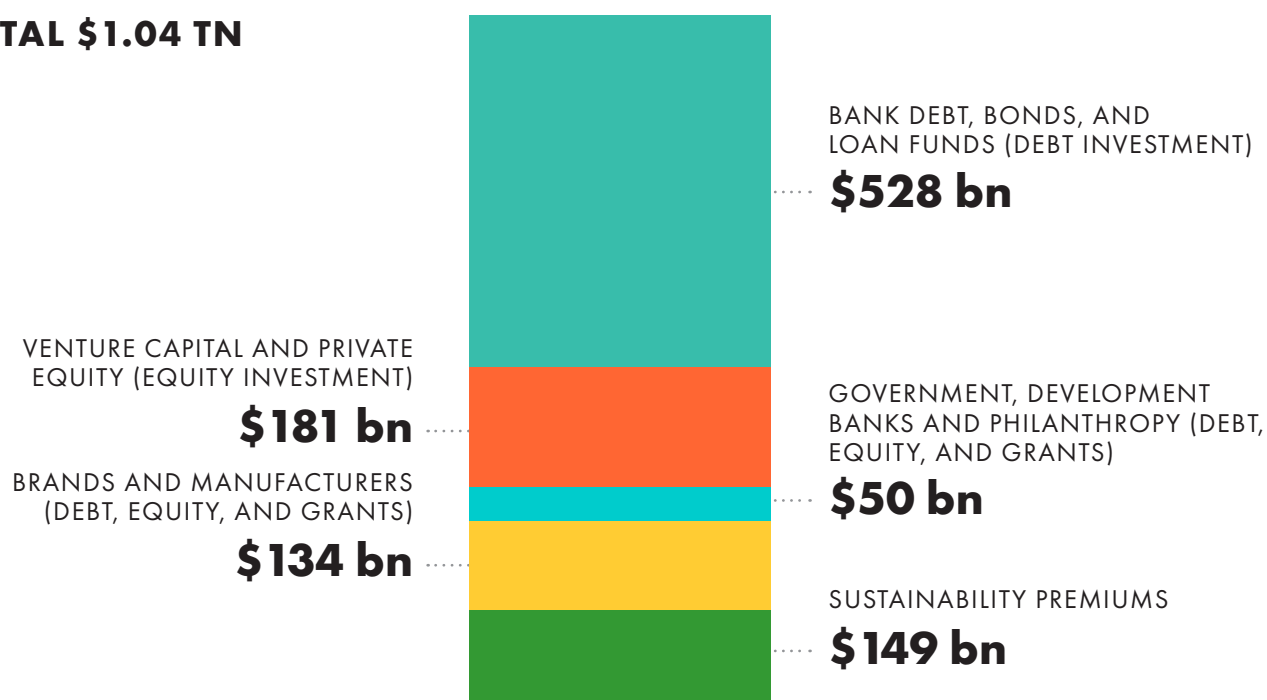
**“When it comes to a complete change in energy use or a new way of manufacturing, the manufacturer cannot take on the entire cost burden and project risk. There needs to be additional stakeholders to co-invest alongside the manufacturer to implement disruptive and sustainable technologies.”**

PUNIT LALBHAI, EXECUTIVE DIRECTOR, ARVIND LIMITED

## TYPES OF FUNDERS

This report has identified five different funder types that will each play a role in financing the \$1 trillion decarbonisation opportunity:

**TOTAL \$1.04 TN**

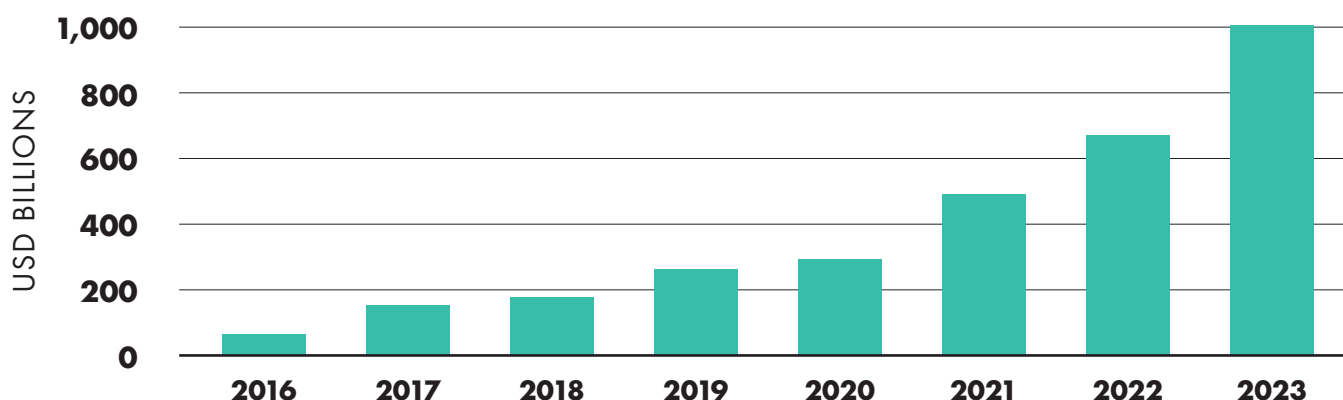


**Figure 16.** Types of Funders. Source: Aii and FFG analysis (2021).

## BANK DEBT, BONDS, AND LOAN FUNDS (DEBT INVESTMENT)

Bank debt includes loans from local, regional, and international banks. Bonds are primarily publicly traded instruments issued by banks, brands, or manufacturers. Loan funds are private investment funds that make loans directly to companies and projects. Debt capital typically invests in lower risk projects with a high degree of certainty. Embedding sustainability aspects in debt financing has become quite widespread as seen in Figure 17 below.

### GLOBAL GREEN BOND ISSUANCE FORECAST TO EXCEED \$1 TRILLION BY 2023 (ACROSS ALL INDUSTRIES)<sup>49</sup>



**Figure 17.** Global Green Bond Issuance. Source: Climate Bonds Initiative (2021).

### H&M GROUP'S SUSTAINABILITY-LINKED BOND TO SCALE RECYCLED MATERIALS<sup>50</sup>

Sustainability-linked bonds are something new on the bond market. In contrast to green bonds, where the funds are linked to specific projects, sustainability-linked bonds are coupled to the company meeting a number of defined sustainability targets.

H&M sustainability-linked bond raised EUR 500 million (\$583 million) with a maturity of 8.5 years. The annual coupon rate is 0.25%. The bond generated great interest and was 7.6 times oversubscribed.

#### The targets\* that H&M Group has committed to achieving by 2025 are:

- Increase the share of recycled materials used to 30%.
- Reduce emissions from the Group's own operations by 20%.
- Reduce absolute Scope 3 emissions from fabric production, garment manufacturing, raw materials and upstream transport by 10%.

\*For more detailed information see [H&M Group Sustainability-Linked Bond Framework](#).

**"For H&M Group, sustainability is an integral part of our operations. This type of bond creates a clear and transparent commitment and incentive for the company. It is an important step in our continued work to optimise the company's capital structure, while at the same time providing investors with an opportunity to contribute to the positive transformation of the fashion industry."**

ADAM KARLSSON, CFO, H&M GROUP

## THE GOOD FASHION FUND<sup>51</sup>

The Good Fashion Fund is a one-of-its kind initiative to create systemic change in the textile and apparel industry by making loans to finance the implementation of highly impactful and disruptive production technologies in Asia.

The capital structure of the Good Fashion Fund is a blended finance structure comprising 3 different risk/return layers: Junior Equity /first loss, Senior Equity, and Senior Debt tranche.

The fund has been active since the end of 2019, has a target size of \$60m and its typical investments are between \$1m and 5m. It finances apparel manufacturers in India, Bangladesh and Vietnam for adoption and implementation of impactful technologies. This kind of long-term USD financing is barely available for manufacturers that are keen to become more sustainable but do not have their own funds or bank loans available to finance this.

The first deal of the fund was a \$4.5m loan to support Pratibha Syntex's planned capital expenditures for the replacement of machinery and expansion of sustainable equipment in their spinning, processing and garmenting divisions. The company supplies textiles and garments to popular brands including C&A, H&M, Patagonia and Zara.

Although the fund itself is too small to enable systemic change, the fund hopes to demonstrate that investing in the sustainability investments of smaller manufacturers leads to healthy financial returns, and therefore can be done at scale by existing financial institutions.





## VENTURE CAPITAL AND PRIVATE EQUITY (EQUITY INVESTMENT)

Venture capital and private equity make equity investments directly into companies and low-carbon projects. This type of capital is seeking higher return investment opportunities and consequently accepting higher risk.

### CASE STUDY: JEANOLOGIA<sup>52</sup>

Jeanologia's laser technology is applied to 20% - 30% of the billions of jeans manufactured annually, allowing for an increase in productivity, reduction of water and energy consumption, while eliminating waste and harmful emissions. The innovator was founded in Spain in 1994, but has gone on to become a dominant equipment provider for modern denim production, selling its equipment to manufacturers in about 50 countries.

In 2019, private equity group Carlyle led a EUR 60 million (\$70m) equity financing transaction, and Jeanologia secured an Environmental, Social and Corporate Governance (ESG) linked term loan later that year, with costs tied to water-saving targets. Interest rates on the loan decrease if Jeanologia meets those goals, and go up if the company misses its targets by 15% or more.

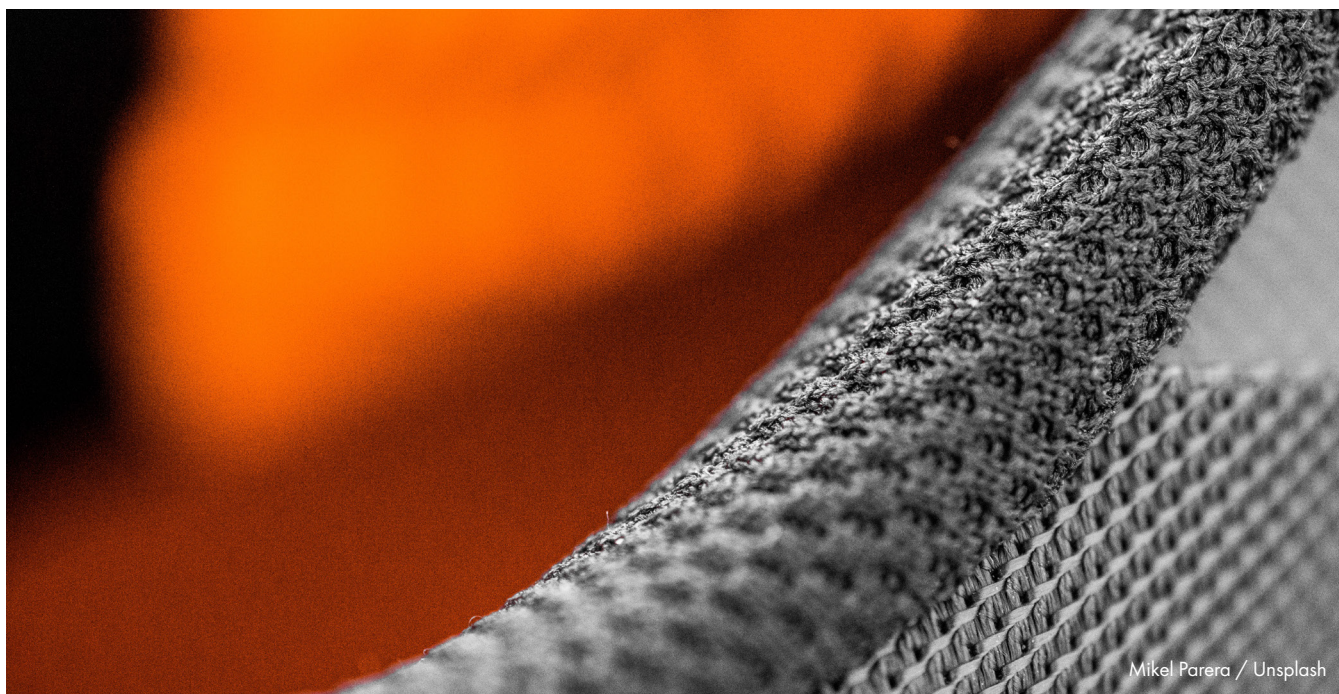


Photo courtesy of Jeanologia

## BRANDS AND MANUFACTURERS (DEBT, EQUITY, AND GRANTS)

Brand and manufacturer capital represent corporate treasury dollars or support that come from within a company's budget directly. Many of the projects in this report include brand and manufacturer dollars to assess feasibility or support low-carbon projects by co-investing alongside financial capital.

Given the fashion industry's specific supply chain interdependencies between brands and their Tier 1 suppliers, brands may act as a facilitator and multiplier for low-carbon finance granted to their suppliers. The following case studies show examples of brands facilitating low-carbon finance for their suppliers:



### PUMA AND ITS INSURER PROVIDE ESG-LINKED INSURANCE PREMIUMS FOR THEIR TIER 1 SUPPLIERS

The approach to offer preferential rates for Tier 1 suppliers with above average ESG rating also works for non-financing products like insurance. PUMA is arranging liability and recall insurance for their Tier 1 suppliers that either have no access to similar insurance coverages or suffer much higher premiums on a stand-alone policy. Through this programme, suppliers with better ESG ratings pay lower insurance premiums.

**“With this programme, we can leverage our economies of scale with the Insurer and let our suppliers directly participate from lower premiums. For the insurance company, better ESG ratings are connected with better production conditions for the workers in the supplier's factories, less product issues with the finished goods and consequently lower claim numbers. We consider this as a Win-Win-Win situation.”**

FRANK WAECHTER, GLOBAL DIRECTOR TREASURY & INSURANCE, PUMA SE





Presstigeux

## LEVI STRAUSS & CO. AND IFC PROVIDE LOWER COST SUPPLY CHAIN FINANCING FOR MANUFACTURERS THAT IMPLEMENT ENERGY EFFICIENCY MEASURES<sup>53</sup>

Under a new partnership between Levi Strauss & Co. and the International Finance Corporation (IFC), facilities that participate in the PaCT programme (for more detail, see 'Partnership for Cleaner Textiles (PaCT)' on pg. 19), have access to larger loans and lower cost financing through IFC's Global Trade Supplier Finance (GTSF) programme, which offers low-cost capital and early payments on completed orders to suppliers that meet environmental and social standards. This type of financing has been welcomed by suppliers and the programme has already increased the amount of financing available to meet the growing need.

**"The fundamental driver is that these investments make economic sense. We identify cost-effective water and energy savings and renewable energy solutions to these suppliers. These are climate-friendly investments that make economic and environmental sense and, on a life-cycle cost basis, these are highly attractive investments that are paid off in one to six years with increased savings."**

JEREMY LEVIN, SENIOR ENERGY SPECIALIST,  
INTERNATIONAL FINANCE CORPORATION

## GOVERNMENT, DEVELOPMENT BANKS AND PHILANTHROPY (DEBT, EQUITY, AND GRANTS)

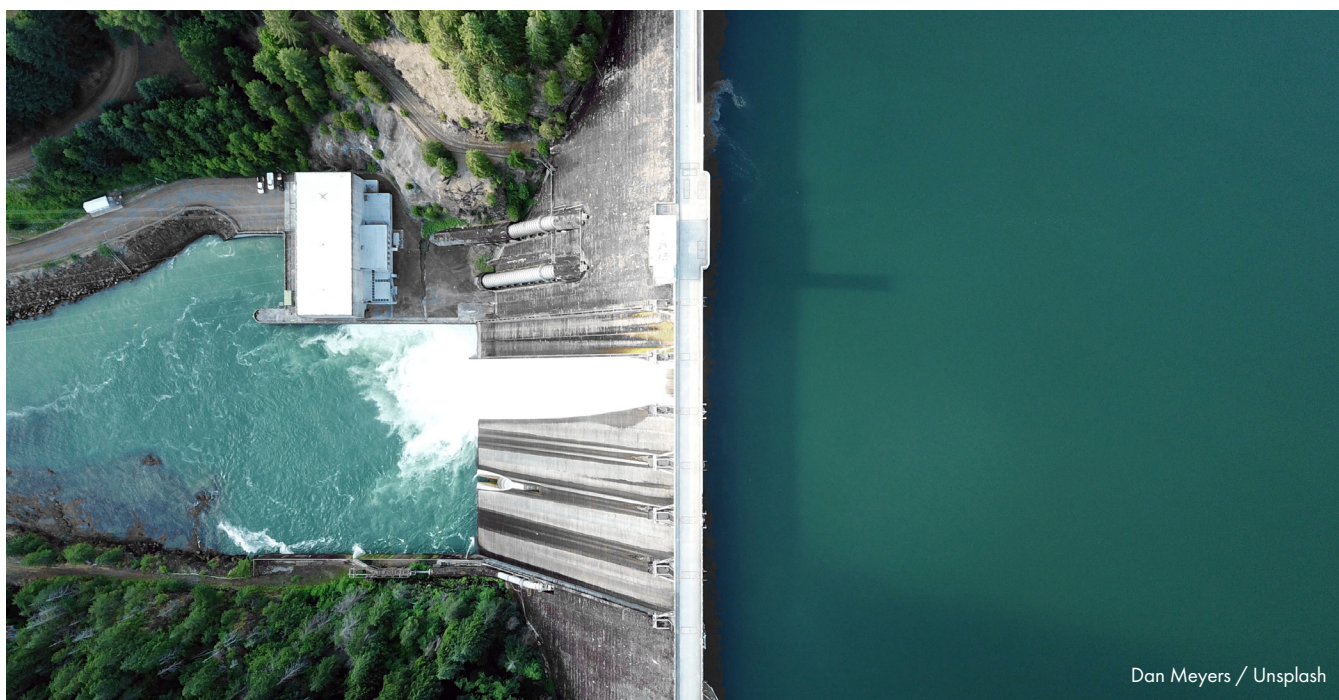
Government, Development Bank and Philanthropy investments seek to promote a sustainability goal for society. Investments may consist of direct equity investments, grants, interest free / subsidised loans, loan guarantees, or other economic incentives (e.g., feed-in tariffs). This type of capital is important for de-risking early-stage technologies and helping them reach scale.

### WHAT ROLE DO DEVELOPMENT BANKS PLAY?

Development banks are often formed by governments to fill a gap in the market (e.g., support small business, developing countries, etc.). While development banks, such as the International Finance Corporation (IFC) have programmes for climate loans, green banks are a type of development bank that is specifically formed to make climate-related loans.

Development banks and green banks are a powerful tool for spurring investment and allow governments to mobilise more capital than through traditional grants. By making loans that are set up to take the first loss in case a project fails, development banks de-risk projects for other investors that may have otherwise declined to invest. In addition, they can recycle capital they receive from loan repayments into new loans. For example, IFC, a member of the World Bank Group, has leveraged US \$2.6 billion of capital to deliver over US \$265 billion in financing for businesses in developing nations.<sup>54</sup>

A large portion of development bank lending goes to local banks in production countries. These local banks then make loans directly to local companies and projects. Local banks play a critical role as they possess relationships with suppliers and local market knowledge.







Andreas Guckhorn / Unsplash

## WHAT IS A SOLAR FEED-IN TARIFF?

A solar feed-in tariff (FIT) is a government-sponsored programme to encourage development of clean energy generation. In regions with a FIT, the owner of the solar project has the option of selling any excess electricity generation back to the national grid at the FIT price (fixed and guaranteed for 20 years).

### **Benefits of a FIT**

- Provides a guarantee for the price at which the project owner can sell the project's electricity to the grid (rather than selling at market rates which can be volatile). This guarantee de-risks investment in solar energy and encourages more investors to participate
- FITs can be combined with power purchase agreements (PPAs). Under this model, most of the electricity is sold to the PPA offtaker (i.e., the manufacturing facility), and any excess electricity can be sold to the grid at the FIT price

Source: Clean Energy Investment Accelerator (CEIA)



# SUSTAINABILITY PREMIUMS

A sustainability premium is an increase in cost resulting from the implementation of sustainable materials or services, that may be either temporary (e.g. because new materials or processes are not yet at scale) or structural (e.g. paying higher wages in the supply chain). This additional cost must be funded by a stakeholder in the value chain (customer, brand, government etc.), otherwise the project will not move forward. Figure 18 shows that consumers, especially of younger generations, are willing to pay more for a sustainable product. While this could fund part of the sustainability premium costs, it should be noted that there is also a discrepancy between how people say they'll spend their money versus how they do in practice.

## CONSUMER WILLINGNESS TO PAY THE SUSTAINABILITY PREMIUM BY GENERATION<sup>55</sup>



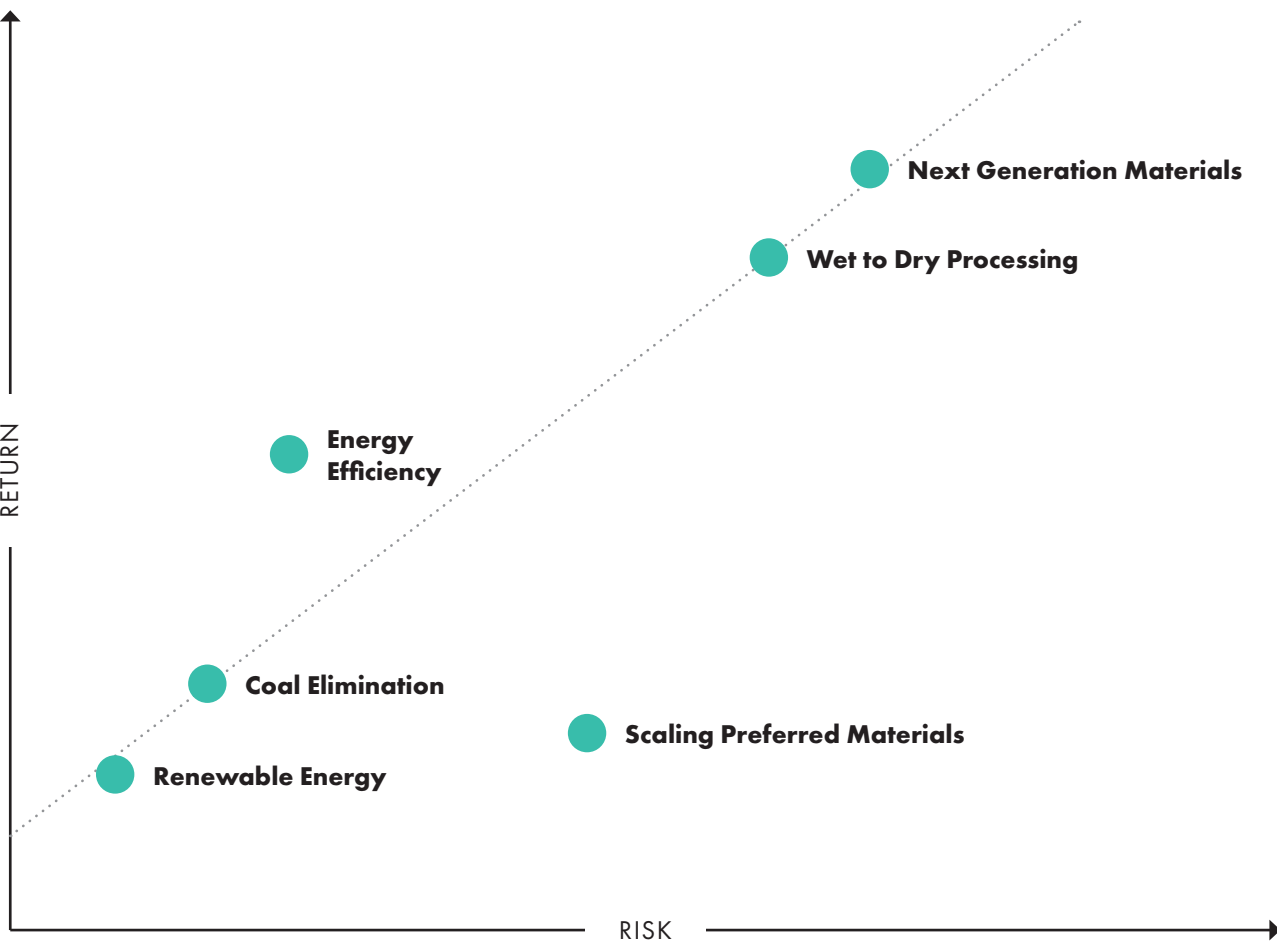
**Figure 18.** Consumer Willingness to Pay the Sustainability Premium by Generation. Source: Vogue Fashion (2020).



# Breaking Down the Size of the Prize by Type of Funder

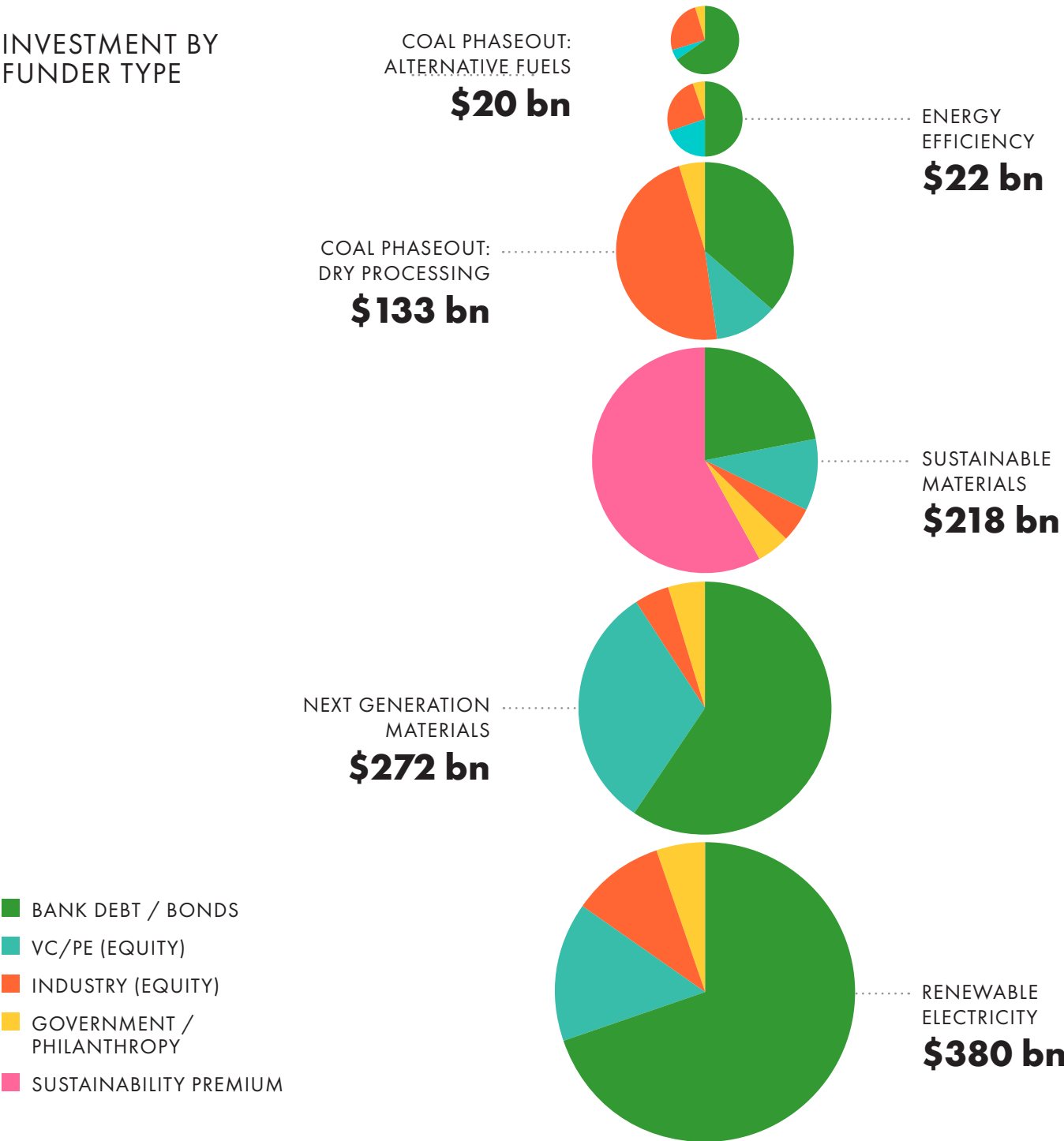
Each of the solutions offered in this report will attract a different range of investor categories, driven by differences in (perceived) risk levels, as shown on the risk versus return graph in Figure 19:

## RISK/RETURN RELATIONSHIP



**Figure 19.** Risk / Return relationship between investor categories. Source: Aii and FFG analysis (2021).

In most cases, multiple types of financing will be involved in a single project. Projects with higher risk will typically have a higher percentage of equity capital, whereas projects with lower risk will have a higher percentage of debt capital. However, nearly all projects will include a mix of both debt and equity capital. Figure 20 shows a breakdown of the types of funders for each solution:



**Figure 20.** Investment by Funder Type. Source: Aii and FFG analysis (2021).

The following section deep-dives into each of the solutions to break down the funding required by funder, and provides examples of existing initiatives to demonstrate the opportunity within.

# The Role of Finance in Existing Solutions

**“We have found many smaller manufacturers struggling to attract debt financing for interesting and impactful projects despite sufficiently strong financial performance”**

BOB ASSENBERG, GOOD FASHION FUND

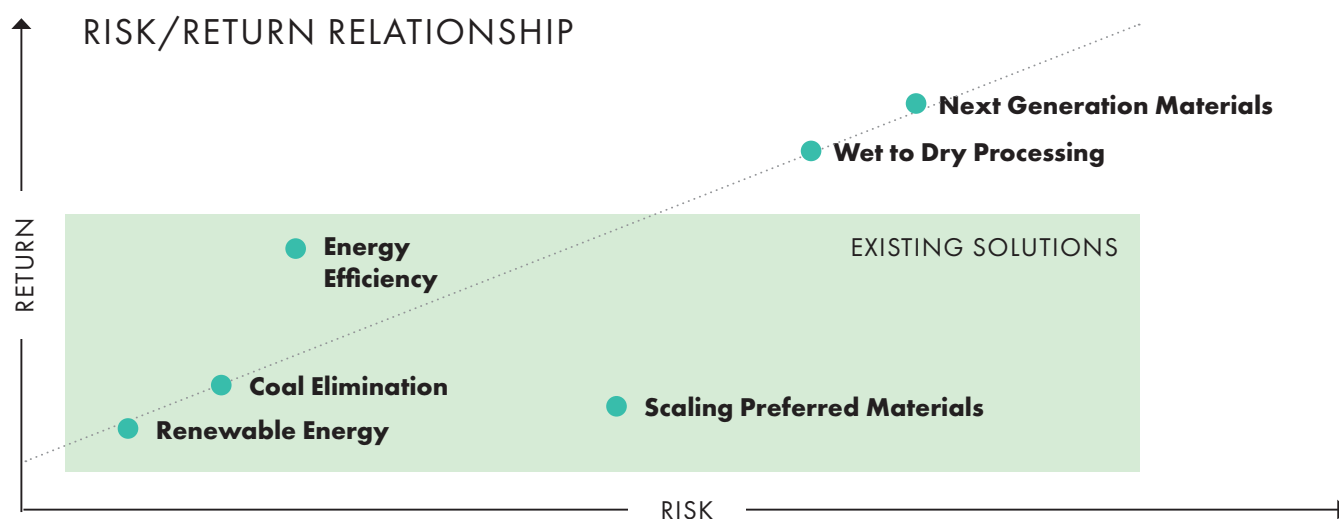
Existing solutions have a lower risk profile and therefore attract a different type of financing mix than innovative solutions.

## Qualities of projects with a lower perceived risk profile can include:

- Financing of a proven investment that has been done many times before, e.g. installation of solar panels on the roof of a factory — the technology itself has been proven to be feasible thus no technology risk
- Contractual agreements that give a higher certainty of project cash flows, e.g. long-term contracts
- Financing of hard assets that have a relatively high value for alternative uses, e.g. leasing equipment that can be readily deployed in other facilities

## Why is Financing Needed?

Although implementation of low-carbon equipment in factories often has a compelling investment case, (local) debt financing is not always widely available. Manufacturers often operate at thin margins and may lack the financial strength to attract debt financiers for sustainable projects. Even the most financially strong manufacturers are not able to fully fund projects themselves.



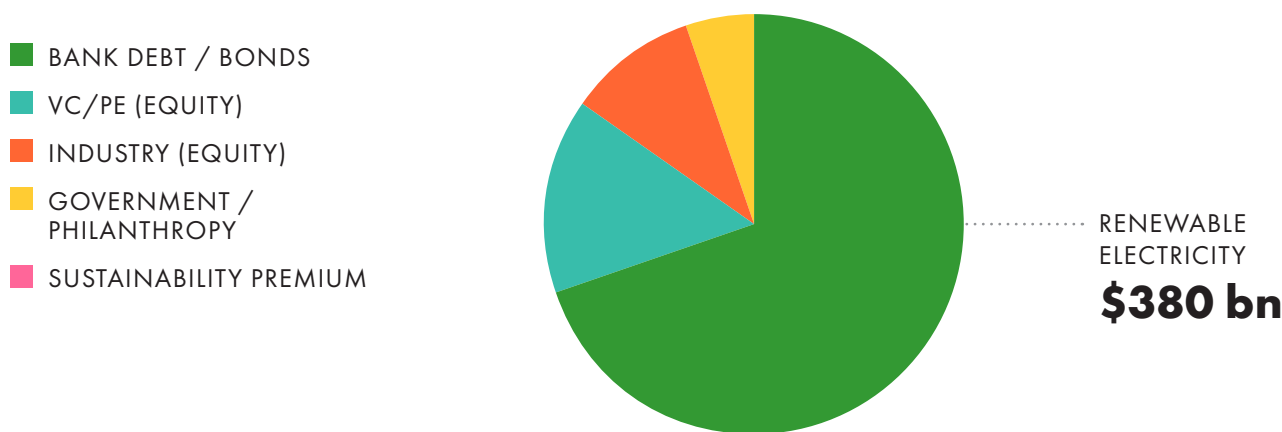
**Figure 21.** Risk/Return relationship between investor categories for Existing Solutions. Source: Aii and FFG analysis (2021).



### Funding the shift to 100% renewable electricity

Of all the solutions discussed in this report, renewable electricity is the most proven solution with the lowest overall risk profile, and can therefore be funded with a high percentage of debt financing in most markets. Renewable electricity is typically low risk because generation technologies, such as solar and wind have been proven to work around the world. Furthermore, electricity prices are relatively stable, so most projects have a known payback period. Government incentives, such as feed-in tariffs, can help de-risk projects even further, and make certain projects fundable that may have otherwise not been viable (e.g., a project in a region with only a moderate amount of sunlight).

### ESTIMATED BREAKDOWN OF FUNDING THE SHIFT TO 100% RENEWABLE ELECTRICITY:



**Figure 22.** Breakdown of Funder Type for Renewable Electricity. Source: Aii and FFG analysis (2021).

## SOLAR POWER PURCHASE AGREEMENTS<sup>56</sup>

### What is a solar power purchase agreement?

A solar power purchase agreement (PPA) is a financial agreement where a developer arranges for the design, permitting, financing and installation of a solar energy system that sells the generated power to the host customer at a fixed rate that is oftentimes lower than the local utility's retail rate. This lower electricity price serves to offset the customer's purchase of electricity from the grid while the developer receives the income from these sales of electricity as well as any tax credits and other incentives generated from the system. PPAs typically have a lifespan of 10 to 25 years and the developer remains responsible for the operation and maintenance of the system for the duration of the agreement.

### Benefits of a PPA

- **No or low upfront capital costs:** The developer handles the upfront costs of sizing, procuring and installing the solar photovoltaic (PV) system. Without any upfront investment, the host customer is able to adopt solar and begin saving money as soon as the system becomes operational.
- **Reduced energy costs:** Solar PPAs provide a fixed, predictable cost of electricity for the duration of the agreement, which is often lower than the projected cost of electricity from the grid
- **Limited risk:** The developer is responsible for system performance and operating risk.
- **Better leverage of available tax credits:** Developers are typically better positioned to utilise available tax credits to reduce system costs.

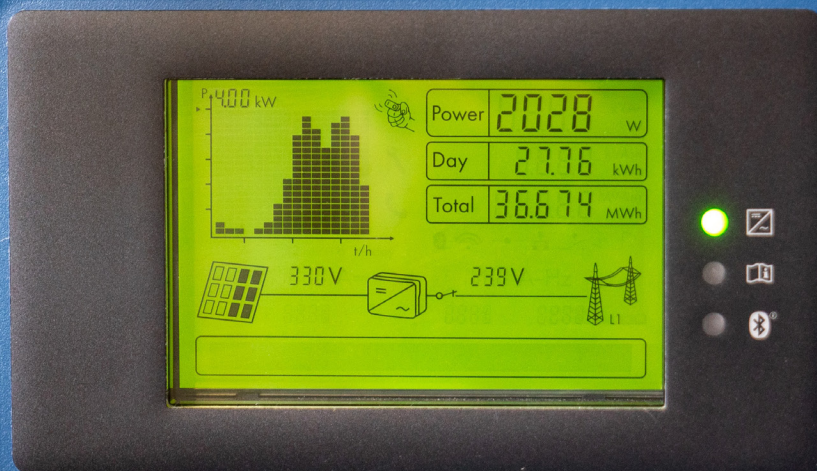
ON-SITE RENEWABLE ELECTRICITY FINANCING CASE STUDY<sup>57/58</sup>**Project Overview**

In 2021, Berkeley Energy Commercial Industrial Solutions (BECIS), a solar developer, installed 8 megawatts (MW) of rooftop solar at two textile facilities owned by Hansoll Textile in Vietnam. The total cost of the project was \$5.6mm (~\$700 per kW), which was funded entirely by the solar development company, an example of private equity financing. The two textile facilities signed 15-year power purchase agreements (PPA) at a discounted rate to their electricity cost from the local utility (~\$135,000 in savings for the manufacturers per year).

**Strategies Used to Increase Project Viability**

- The systems were designed to meet the electricity needs of the facilities, which reduced reliance on selling excess electricity back to the grid
- By combining the two facilities into one project, the total system size increased to 8 MW and created cost efficiencies
- The project took advantage of Vietnam's zero import duty on solar products

**CO<sub>2</sub>eq savings:** 10,000 tonnes per year



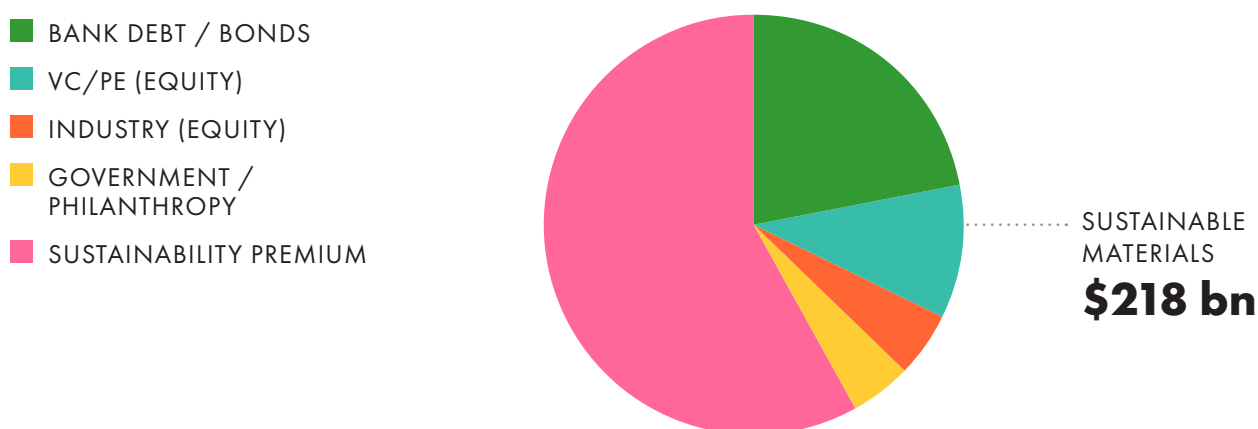
### Scale Sustainable Materials and Processes

There are two main categories of financing for scaling sustainable materials and processes —

- (i) infrastructure investment for collecting input materials and converting them into fibres
- (ii) the sustainability premium (i.e., the cost difference between sustainable materials and conventional materials).

The infrastructure investment is asset heavy and positive ROI, and can therefore be funded with debt and equity. The sustainability premium is primarily a cost, with limited financial ROI. However, some brands have been able to achieve some financial benefit by effectively marketing their use of sustainable materials. Ideally, customers would be motivated to bear most of the sustainability premium in the form of higher retail prices, but in the absence of regulation that requires sustainable materials, some portion of the sustainability premium will likely need to be funded by brands, philanthropic dollars, government funds, and potentially concessionary financing.<sup>59</sup>

### FUNDING BREAKDOWN FOR SCALING PREFERRED MATERIALS:



**Figure 23.** Breakdown of Funder Type for Sustainable Materials and Processes. Source: Aii and FFG analysis (2021).

### ORGANIC COTTON ACCELERATOR (OCA) FARM PROGRAMME HIGHLIGHT<sup>60</sup>

OCA's Farm Programme is changing how brands, retailers and the supply chain source organic cotton. The goal of the Farm Programme is to improve the farmer business case for switching to organic cotton. OCA is creating a secure market for farmers, advocating for better prices for organic cotton and creating visibility into the source of organic cotton.

SOME SUCCESSES OF THE FARM PROGRAMME, INCLUDE:

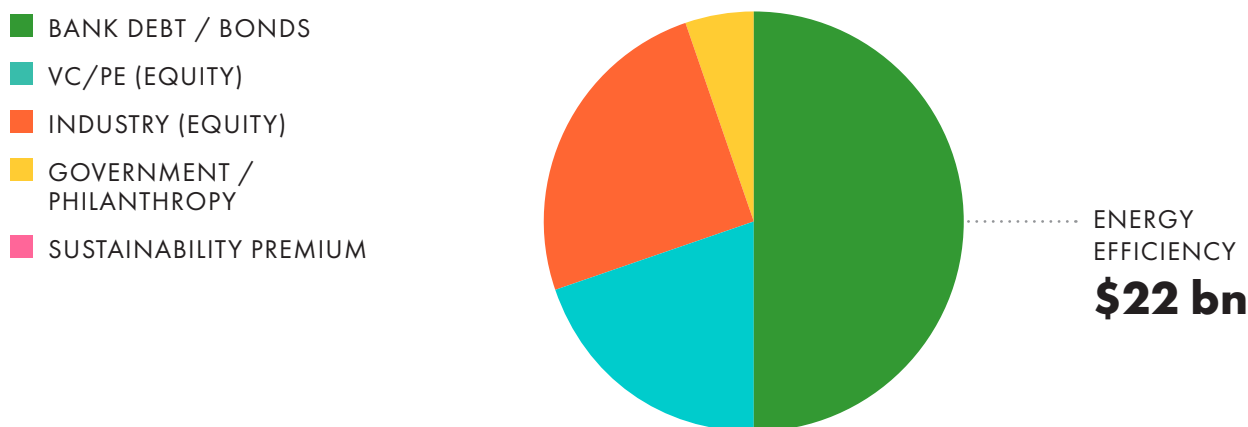
- Direct-to-farmer sourcing model that gives clear transparency at farm-level
- Cost sharing and economies of scale through the global Platform
- Third-party validated data that demonstrates the positive impact of paying a premium

Programmes like this are critical in helping justify the cost of the sustainability premium.

### Maximise energy efficiency

Given the high return on investment and relatively short payback period, many energy efficiency investments are funded by the manufacturers themselves, which is reflected in the higher percentage of manufacturer funding in the investment breakdown by funder type. Nevertheless, it can be difficult for manufacturers, even those that are large and well-established, to find enough capital to make these investments themselves, so banks and equity investors have an important role in filling the gap. Given the small size of these investments, there is a need for aggregation of projects in order to attract deeper pools of capital. In addition, manufacturers are hesitant to take on additional debt for projects like these due to the risk that cost savings may not materialise and/or brand order volumes may decline. Equity investment is a potential solution as the downside risk is shared between investors and manufacturers. Finally, brand guarantees and volume commitments would further reduce risk for manufacturers and investors.

### FUNDING BREAKDOWN FOR ENERGY EFFICIENCY:



**Figure 24.** Breakdown of Funder Type for Energy Efficiency. Source: Aii and FFG analysis (2021).

### CLEAN BY DESIGN DEMONSTRATES AN ATTRACTIVE ROI FROM ENERGY EFFICIENCY INVESTMENTS<sup>61</sup>

The Clean by Design programme helps manufacturers identify manufacturing efficiency improvements to reduce energy, water and chemicals use (See 'Clean by Design Highlight' on pg. 20). The programme has proven to be effective at achieving sustainability goals as well as generating a strong ROI for manufacturers.

#### SOME HIGHLIGHTS OF THE PROGRAMME INCLUDE:

- Average GHG reduction: 10.8%
- Average annual energy cost saving: USD \$369.5k (12.6% reduction)
- Average payback period: 13.8 months (60%+ ROI)

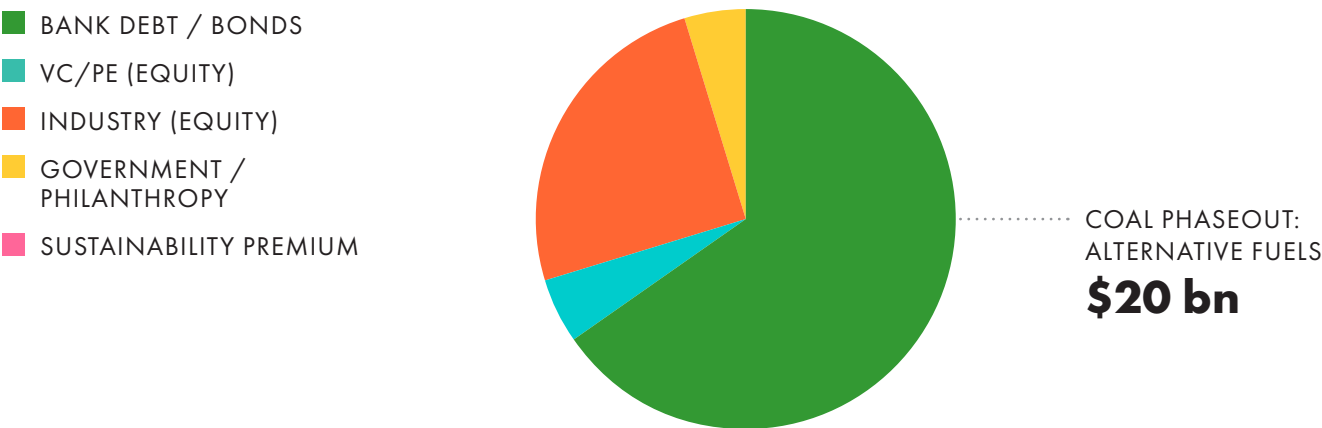
To date, the majority of energy efficiency investments in the apparel industry have been funded by a mix of manufacturer equity and bank loans. However, given the high ROI of the program, the authors see an opportunity for private equity investment to increase adoption.



### Phase Out Coal with Alternative Fuel Sources

Coal boilers typically have a long life (10+ years). The ROI for a coal replacement project varies significantly depending on whether the project is replacing a coal boiler during its useful life or at the end of its useful life. Therefore, it is key that all planned new boiler installations switch to an alternative fuel source. Given that these projects typically have a positive ROI, consistent cash flow profile, and are backed by the boiler as an asset, debt financing is the primary source of funding. However, as showcased in the below case studies, there are innovative methods for funding the transition from coal that go beyond traditional bank loans.

### FUNDING BREAKDOWN FOR COAL PHASE OUT THROUGH ALTERNATIVE FUEL SOURCES:



**Figure 25.** Breakdown of Funder Type for Coal Phase Out: Alternative Fuels. Source: Aii and FFG analysis (2021).

### SKYVEN TECHNOLOGIES' ENERGY-AS-A-SERVICE FOR PROCESS HEAT<sup>62</sup>

Outside of the apparel sector, Skyven Technologies has pioneered an innovative approach to reduce greenhouse gas emissions in industrial manufacturing. Many thermal energy related capital projects (e.g. boilers, industrial heat pumps, recuperators, etc.) have payback periods longer than two years, making them difficult to get through a typical capital-approval process. Skyven offers to cover upfront all capital costs and maintenance costs related to implementing such projects.

Using a state-of-the-art, proprietary Internet of Things (IoT) technology to measure and verify the energy savings generated by such projects, Skyven can bill for the saved energy at a discount from what the facility would have otherwise paid for that energy. This unique model allows manufacturers to reduce emissions with zero CapEx, reduced risk, and savings from day one. While this structure is not currently being used in the fashion industry, this type of financing could be replicated to mobilise finance in the fashion industry.

# The Role of Finance in Innovative Solutions

**Characteristics of the Financing Innovations**

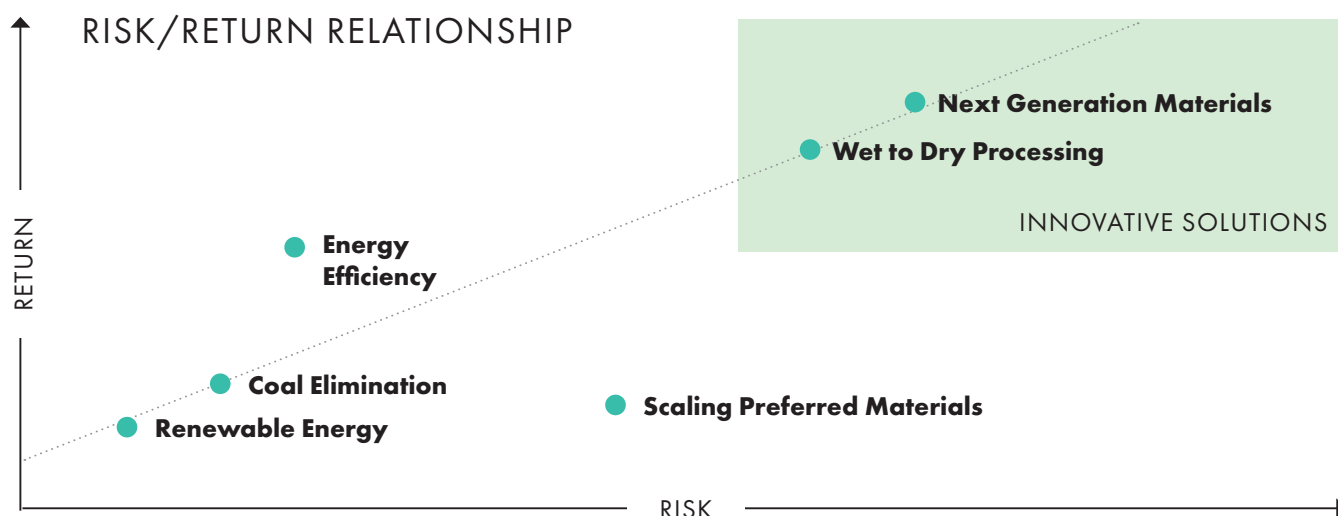
Whereas existing solutions can be implemented immediately, innovative solutions require further development before they can be implemented at scale. Therefore, the first three phases below are relevant when discussing the funding paths innovative solutions must follow:

PHASE	NAME	DESCRIPTION	TYPE OF FINANCING
PHASE 1	Research and Development (R&D)	Characterised by high technological and execution risks — often a lack of evidence of product-market fit. Suitable financiers include: venture capitalists, philanthropy, government, universities, informal investors.	Equity, grants
PHASE 2	Piloting and small-scale production	Concrete applications identified, however still bringing high risk and typically requiring significant capital. Smaller scale production with pre-commercial facilities. Suitable financiers include: (corporate) venture capital, informal investors.	Equity
PHASE 3	Commercial production	Proven technology and product-market fit, first production at industrial / commercial scale. Operating and market risks may still exist. Suitable financiers include: (corporate) venture capital, supply chain investors.	Equity
PHASE 4	Adoption phase	The winning solutions are brought to scale. This involves the replication of proven projects, which may cover building a sufficient number of material production plants or installing processing equipment at manufacturing sites, and presents a much lower risk profile. Suitable financiers include: institutional lenders, (corporate) venture capital, supply chain investors.	Debt, equity

**Figure 26.** Financing pathway from idea to adoption for innovative solutions. Source: Aii and FFG analysis (2021).

Phases 1 through 3 are financed by equity only as a result of the significantly higher risk profiles compared with Phase 4 and the existing solutions described previously. The higher risk profiles are the result of one or a combination of the following factors:

1. the presence of technology risk; often up to and including Phase 3,
2. the lack of attractive unit economics; which will only be reached at industrial scale,
3. low revenue
4. negative cash flows



**Figure 27.** Risk/Return relationship between investor categories for Innovative Solutions. Source: Aii and FFG analysis (2021).

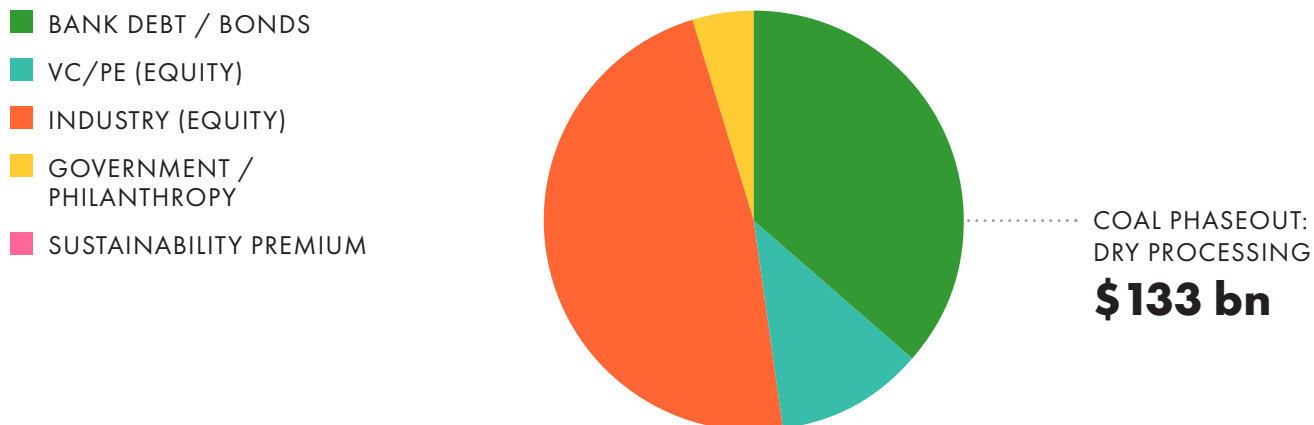
Importantly, before Phase 4, there is no significant role for debt funding. Once Phase 4 is achieved and growth is merely about replication of a proven, commercially successful, set-up, debt financing becomes available and a further roll-out can be implemented at an accelerated pace.

### INNOVATION PHASES 1 THROUGH 3: A SIGNIFICANT EQUITY FINANCING GAP EXISTS

The report “Financing the Transformation in the Fashion Industry” (2020) by Fashion for Good and BCG, estimates a \$20-30bn shortfall in investment per year to develop and scale disruptive innovations in textile technology. A significant portion of that sum lies at the beginning and end of the value chain, the most important areas from an environmental impact perspective.

The report found that innovators especially struggle to bridge the “missing middle” of finance between early venture capital and late-stage funding. The key barriers identified are the misaligned incentives in the industry, investors’ limited awareness of the opportunity, an absence of a structured innovation process, the lack of experience and technical expertise, inadequately structured exclusivity, and incorrect perceptions regarding pricing and externalities.

The report highlighted that not only more equity financing is needed from investors, but that all actors involved should build towards conditions that promote attractive returns and impact. Although governments are currently playing a limited role, they can have a powerful direct and indirect influence on the pace of innovation, and could financially contribute to capital intensive, high risk projects, e.g. building demonstration plants for recyclers and new material producers.

**Coal Phase Out: Dry Processing****FINANCING BREAKDOWN FOR THIS CATEGORY:**

**Figure 28.** Breakdown of Funder Type for Coal Phase Out: Dry Processing. Source: Aii and FFG analysis (2021).

About 10% of the financing requirements in this category relate to Phases 1 through 3 capital, with the remainder needed for implementation and further adoption of the developed solutions.

Taking into account geographic dynamics and the often limited debt capacity of manufacturers, a degree of asset-based lending is possible for manufacturers in Phase 4; this analysis assumes 40% of debt coming from lenders in this phase. On an aggregated basis, that means 59% is coming from equity sources, either from the industry (manufacturers) or new equity funders including private equity and venture capital.

### CASE STUDY: SCALING ALCHEMIE TECHNOLOGIES

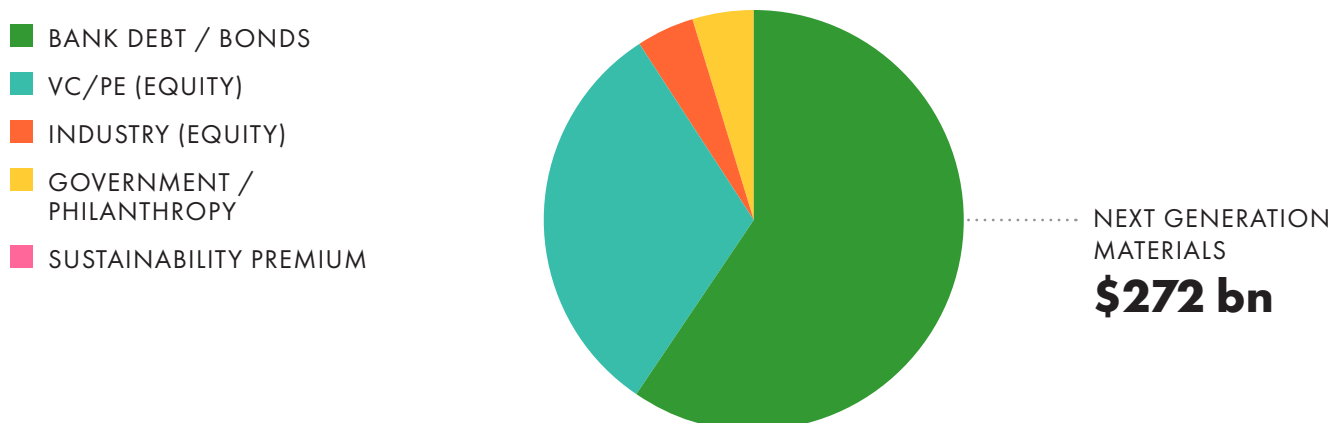
Alchemie Technology has developed clean-tech dyeing and finishing processes which are enabled by its unique digital fluid jetting technology. Alchemie's digital manufacturing solutions for dyeing and finishing deliver significant reductions in environmental impact: reducing wastewater, chemistry and energy consumption.

Earlier this year, Alchemie's first large funding round attracted investments from H&M CO:LAB and At One Ventures<sup>63</sup> to accelerate development and implementation of its disruptive equipment and technology.



Photo courtesy of Alchemie Technologies



**Next Generation Materials****FINANCING BREAKDOWN FOR THIS CATEGORY:**

**Figure 29.** Breakdown of Funder Type for Next Generation Materials. Source: Aii and FFG analysis (2021).

In contrast to Wet to Dry Processing, Next Generation Materials requires production plants to be built to produce materials at scale. Therefore only 8% of the financing requirements in this category relate to Phase 1 through 3 capital, with the remainder being Phase 4. Given that Phase 4 has been defined as the replication of projects that have already been completed in the past, it can safely be assumed these projects carry significantly less risk. For some innovators, the potential existence of long-term offtake agreements and/or a predictable and transparent product market will support a case for debt financing. In Phase 4, innovators can be optimistic of their leverage in rolling out new materials plants, as evidenced by the financing structures of current comparable facilities of listed commodity producers (e.g. PET, viscose, specialty chemicals). As a result, it is assumed debt financing of these projects may average 65% in Phase 4. On an aggregated basis, this results in 60% of the financing requirements being debt capital.



Photo courtesy of Renewcell

### CASE STUDY: RENEWCELL AND EUROPEAN INVESTMENT BANK<sup>64</sup>

In June 2021, the European Investment Bank (EIB) signed a loan agreement of EUR 30 million (\$35m) with the circular materials innovator Renewcell in Sweden, under the InnovFin “EU Finance for Innovators” programme that launched in 2014 within the EU Horizon 2020 programme — the EU’s programme for research and innovation.

The Sweden-based innovator has devised a way to turn discarded textiles into “Circulose”, their brand name for the pulp from which new fabric can be made, thus boosting the circular economy as a concept in the fashion industry. Renewcell will use the EIB loan to build their first full commercial-scale textile recycling plant in Sweden, able to produce 60,000 tonnes of fibre annually.

**Scaling Next Generation Materials: a Note on Sustainability Premiums**

Given the current low-output volumes and therefore absence of process optimisation and economies of scale, it is currently unknown whether new materials will be able to reach competitive price points. In the absence of significant regulation, sustainability premiums may hinder next generation materials in penetrating the market in a globally significant way. However, given that the prices of some materials (e.g. polyhydroxyalkanoates (PHA) and Polylactic acid (PLA)) have been decreasing in recent years, paired with the increasing availability of low-cost feedstock for many innovators, there are reasons to believe competitive pricing will be achieved.

Additionally, for many new and recycled materials, a transitory period exists in which prices are not competitive with conventional materials until reaching production at an industrial scale. In the absence of governments or philanthropies stepping in to finance these temporary premiums, brands and/or manufacturers would have to pay premiums for new fibres that, in many cases, are priced significantly higher compared to current alternatives. While brands have been able to achieve some financial benefit by effectively marketing their use of sustainable materials and charging higher prices, this presents a challenge to scaling and achieving the potential impact of these innovative materials.



Photo courtesy of Renewcell

# Barriers to Financing the Low-Carbon Transition of the Fashion Supply Chain

Based on interviews with manufacturers, investors, and key industry stakeholders, nine key factors that contribute to a lack of financing availability have been identified (see Figure 30).

OVERARCHING	SPECIFIC TO EXISTING SOLUTIONS	SPECIFIC TO INNOVATIVE SOLUTIONS
<p><b>1</b></p> <p>High degree of industry fragmentation.</p>	<p><b>4</b></p> <p>Credit worthiness of production facilities.</p>	<p><b>7</b></p> <p>Innovation lacks a successful track record.</p>
<p><b>2</b></p> <p>Externalities are currently not priced in, although regulatory pressure is likely to mount.</p>	<p><b>5</b></p> <p>Difficulty of deploying capital into emerging markets.</p>	<p><b>8</b></p> <p>Innovation cycles are very long and capital intensive.</p>
<p><b>3</b></p> <p>Limited awareness of the financial opportunity.</p>	<p><b>6</b></p> <p>Individual projects are often too small for most investors.</p>	<p><b>9</b></p> <p>Misaligned incentives and unequal power relations.</p>

**Figure 30.** Nine Factors Contributing to the Financing Gap. Source: Aii and FFG analysis (2021).

The following pages provide additional details on these nine barriers.

## **OVERARCHING**

### **High Degree of Industry Fragmentation**

The fashion industry generally prioritises price and has a very low level of vertical integration (i.e., brands rarely do their own manufacturing). As a result, a supply chain project is generally approved or denied funding based on the financial impact to the manufacturer that is undertaking the project. Often, increased costs in one step of the supply chain cannot be passed on to parties downstream (and ultimately to the consumer). Additionally, the fragmented and disconnected nature of the supply chain results in a lack of visibility on the operations of others, which makes it difficult for brands, as well as investors, to identify and act on opportunities within their own supply chains. This is a particularly challenging barrier for the fashion industry, where 96% of the total emissions are within the supply chain (see Figure 4).

### **Externalities Are Currently Not Priced in, Although Regulatory Pressure is Likely to Mount**

Given the low prices of most commodities used in this industry (e.g., polyester - PET) and the industry's focus on economics, many sustainable alternatives struggle to present attractive business cases due to their higher costs. Tighter regulation could enable the industry to take into account the significant environmental externalities of current production processes.

### **Limited Awareness of the Financial Opportunity**

The demand for innovation and sustainability in the fashion industry has only recently accelerated, so private, public, and philanthropic investors have had limited exposure to the size and scale of the untapped opportunity in the coming industry transformation. Many of the investors and philanthropic funders questioned were not aware of how attractive the financial returns are for many of the solutions profiled in this report. Furthermore, sustainability professionals within the industry are often unaware of the potential financing mechanisms that are available.





## **SPECIFIC TO EXISTING SOLUTIONS**

### **Credit Worthiness of Production Facilities**

Long-term purchase agreements are rare in the fashion industry. As such, most manufacturers have limited visibility into order volumes beyond 12 months. Since the bank loans needed to support the projects in this report are for multi-year periods, banks often seek assurances that volumes will be maintained during the life of the loan. This dynamic makes manufacturers appear less attractive for bank financing, preventing banks from investing in projects with a positive ROI and short payback period.

### **Difficulty of Deploying Capital Into Emerging Markets**

There are many risks and obstacles to deploying capital into emerging markets. For one, many of the countries where apparel manufacturing facilities are located require government and local bank approval, making for a lengthy and complicated process. Furthermore, investors are hesitant to invest in markets that don't have policies to support clean energy and where regulations can quickly change. Finally, investments into emerging markets present currency exchange rate risks, which can be offset by hedging, but causes financing costs to increase.

### **Individual Projects Are Often Too Small for Most Investors**

Because investors have to spend time and resources underwriting each project, many individual projects, such as adding solar panels to a single manufacturing facility, are too small for large investors to consider on a one-off basis. There are currently not enough vehicles to aggregate opportunities together in order to make them more attractive to larger pools of capital.

## **SPECIFIC TO INNOVATIVE SOLUTIONS<sup>65</sup>**

### **Innovation Lacks a Successful Track Record**

The demand for industry innovation has emerged only recently, so investors have had limited exposure to the opportunity and successful exits are rare. Furthermore investors' herd mentality results in some areas receiving significant funding, while other areas languish.

### **Innovation Cycles Are Very Long and Capital Intensive**

Innovation cycles are very long and capital intensive, especially in new materials and recycling, where companies often take 10+ years to get to commercial revenue, which conflicts with the timelines of many venture capital investors.

### **Misaligned Incentives and Unequal Power Relations**

Although brands have the greatest incentive and the most pressure to drive towards sustainability, efforts are limited, and the industry expects the upstream supply chain to account for the costs and risks, resulting in a misalignment of incentives for major innovation along the supply chain.

# Key Industry Actions and Recommendations

---

## GOVERNMENT/PHILANTHROPIC:

### Government—Strengthening Policy Framework and Mechanisms to Catalyse Private Investment

Although regulatory action has begun to influence the industry's move toward sustainability, more regulatory pressure is needed to support the business rationales and provide incentives that will drive systemic change. Specifically, the public sector should:

- Offer government-backed loan guarantee funds and/or green banks to de-risk loans to facilities (i.e., green bank takes first loss on loans to facilities), including making direct loans to local market banks in local currency
- Require brands to meet specific sustainability targets, such as reducing Scope 3 emissions and meeting minimum thresholds for recycled content of fibres
- Align upcoming regulatory taxonomy with existing methods used to measure, report and reduce GHG emission (i.e., Corporate Sustainability Reporting Directive and Substantiating Green Claims)
- Link regulations to preferential trade agreements with key importing countries
- Ramp up its direct investments and technical support, especially for SMEs
- Provide additional economic incentives for low-carbon production and energy use, such as tax credits, eco-modulated fees, and feed-in tariffs

### Philanthropy—Encourage Coordination, Promote Early-Stage Catalytic Work, and Explore Blended Capital Approaches

Philanthropy has a critical role to play in de-risking projects in order to unlock other forms of capital, specifically:

- In the absence of stricter regulation, some of the required investments don't meet traditional investor expectations — therefore, philanthropic funders can play an important role in partnering with financial capital to make edge-case projects viable
- Fund early-stage catalytic work in order to de-risk solutions prior to industry and traditional financial capital taking them to scale
- Funding and encouraging coordination between existing industry organisations

## STRATEGIC / INDUSTRY:

### Manufacturers—Adopt a Strategic Capital Improvement Plan

Many of the investments that are needed to reach net-zero have positive financial and strategic benefits to manufacturers. These benefits are stronger for manufacturers that:

- Proactively adopt a strategic plan for funding sustainability initiatives and adopting new innovations
- Discuss and align environmental priorities with key brand partners
- Join programmes that aggregate multiple manufacturers for better financing options
- Evaluate projects based on both GHG reduction potential and financial ROI

**Brands—Stronger Engagement and Commitment to Innovation and Suppliers**

Brands sit at the nexus of all stakeholders and therefore have a critical role to play in accelerating investment in the sector. Some steps that brands can take, include:

- Offer more support to their suppliers through volume guarantees, pilot projects, and direct investments
- Create cross-functional working groups with finance, sourcing, and sustainability teams to identify innovative financing opportunities
- Endorse innovators and work directly with investors to help identify and prioritize projects to fund
- Given that brands have an easier time accessing capital markets (i.e. green bonds, bank loans, equity issuance, etc.) compared to manufacturers, brands can serve as an important intermediary for moving capital from investors to manufacturers.
- Work towards a transparent and traceable, connected, supply chain
- Work with other brands to adopt an aligned roadmap of environmental initiatives so that manufacturer and investors have a clear understanding of collective brand demand
- Source materials based on GHG emissions, not just price and performance

**FINANCIAL CAPITAL:****Banks and Lenders—Prioritise key production regions and innovative financing opportunities**

As the largest source of funding, banks and lending institutions can accelerate their impact if they:

- Prioritise key production regions, which are attractive for investment yet underserved by international financiers
- Support innovative transitional financing opportunities (e.g. coal phase out programme), which are large in size and low in risk
- Work with brands and manufacturers to align priorities and quickly find solutions to key roadblocks
- Fund local banks directly in local currency loans in order to reach small- and medium-sized enterprises

**Equity Investors and Funding Aggregators—Become Familiar With The Increasingly Large Array of Investment Opportunities**

In order to achieve GHG emission targets, equity investors and funding aggregators must:

- Advance their industry expertise and join forces with brands, supply chain partners and innovators to develop investment propositions that match their risk-return profiles.
- Aggregate projects together to achieve larger transaction sizes, potentially through the use of technology platforms
- Evaluate projects based on both GHG reduction potential and financial ROI.

To mobilise \$1 trillion through overcoming the aforementioned barriers, a concerted and collaborative effort is needed by key stakeholder groups inside and outside of the industry. The most relevant stakeholders are: financiers (equity and debt), manufacturers, brands, philanthropy and governments. The recommendations centre around creating the conditions required to enable a larger flow of financing towards a net-zero industry. It is critical that stakeholders work together to create an environment where investors are presented with projects and opportunities that are:

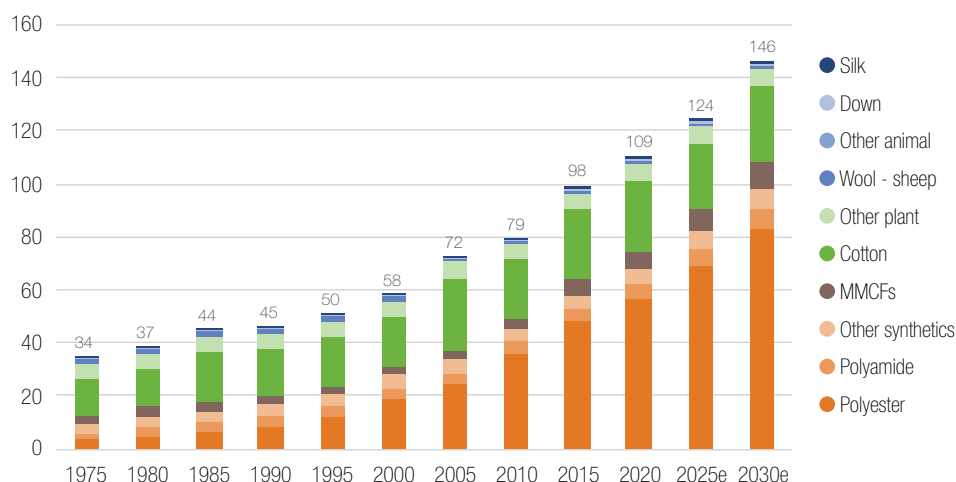
- (1) attractive from a risk-return perspective
- (2) impactful from an environmental (and social) perspective
- (3) understandable for funders not intimately familiar with the industry

**Reaching net-zero by 2050 will require all of these stakeholder groups to work together and implement these necessary changes in order to transform the apparel industry.**

# Methodology and Calculations

## GLOBAL TEXTILES VOLUME CALCULATION

- In 2020, the total global textiles production volume was 109 million tonnes. (Source: [Textile Exchange, 2021](#))
- Textile Exchange projects a 3% annual growth rate in fibre volume through 2030. Under the “business as usual” case, it is assumed the 3% growth rate continues through 2050, resulting in a total textiles production volume of 264 million tonnes in 2050. (Source: [Textile Exchange, 2021](#))
- According to Ellen MacArthur Foundation, 54% of the global textiles volume is used by the apparel and footwear sectors (Source: [Ellen MacArthur Foundation, 2017](#)). The 3% growth rate is assumed to be constant for all sectors and that 54% of 2050 textiles volume is used by the apparel and footwear sectors (143 million tonnes).



**Figure 31.** Global fibre production in million tonnes. Source: Textile Exchange (2021)

## PROJECTED GLOBAL FACILITY COUNT

- The Open Apparel Registry database identifies 55,795 global Tier 1 and Tier 2 facilities as of 2020, including country locations.
- Using Higg FEM, the authors calculate that approximately 70% of those facilities are Tier 1 facilities and 30% are Tier 2 facilities.
- The authors assume there are an additional 16,553 Tier 3 facilities (approximately equal to the number of Tier 2 facilities), for a total of 72,348 global facilities in 2020.
- Using the projection for global textiles volume growth (Figure 31), it is assumed that 25% of the capacity growth will be absorbed by existing facilities, and that another 77,444 facilities will need to be added in order to absorb the remaining 75% of volume increase, resulting in 149,792 global facilities by 2050 (note that in reality the new facilities may not be identical in size to existing facilities, but for the purposes of this report, the amount of investment required is generally proportional to production volume, not facility count).



## EMISSIONS REDUCTION CALCULATIONS

EXISTING SOLUTIONS (TONNES OF CO<sub>2</sub>EQ IN MILLIONS)

Solution Name	WRI and Aii 2030 Reduction Potential *	WRI and Aii Assumed Implementation Level	Emissions Savings at Full Implementation *	2050 Emissions Reduction Equivalent *
<b>Shift to 100% Renewable Electricity</b>	424	100%	366	657
<b>Scaling Sustainable Materials and Processes</b>	29	13%	223	400
<b>Maximise Energy Efficiency</b>	62	30%	134	240
<b>Coal Phase Out: Alternative Fuel Source</b>	105	50%	181	326
<b>EXISTING SOLUTIONS TOTAL</b>	<b>620</b>		<b>904</b>	<b>1,623</b>

\*2050 Emissions Equivalent calculated using a 3% annual growth rate, assumed to be the same as the textiles production volume growth rate (see Figure 31). 2030 Emissions Savings at Full Implementation is adjusted down from the WRI & Aii report to account for a 3% growth assumption, rather than the 4.5% assumed by WRI and Aii.

For more details on the emissions methodology, see the [Roadmap to Net Zero](#) report.

**Figure 32.** Reduction of emissions with existing solutions. Source: WRI & Aii (2021).

INNOVATIVE SOLUTIONS (TONNES OF CO<sub>2</sub>EQ IN MILLIONS)

Solution Name	2030 Emissions Reduction Potential *	2050 Emissions Reduction Equivalent *
<b>Wet to Dry Processing</b>	498 <sup>1</sup>	895
<b>Next Gen Materials</b>	241 <sup>2</sup>	433
<b>INNOVATIVE SOLUTIONS TOTAL</b>	<b>739</b>	<b>1,328</b>

<sup>1</sup> Represents a 100% reduction of emissions from the preparation, colouration and finishing stages and a 20% reduction in emissions from the textile formation stage. Figures for emissions within Tier 2 taken from WRI & Aii (2021).

<sup>2</sup> Represents a 75% displacement of Tier 4 GHG emissions - acknowledging that there will be some 'hard-to-abate' materials that will contribute to Tier 4 emissions.

\*2050 Emissions Equivalent calculated using a 3% annual growth rate, assumed to be the same as the textiles production volume growth rate (see Figure 31). 2030 Emissions Savings at Full Implementation is adjusted down from the WRI report to account for a 3% growth assumption, rather than the 4.5% assumed by WRI and Aii.

**Figure 33.** Reduction of emissions with innovative solutions. Source: WRI & Aii (2021).

## MATERIALS EFFICIENCY, EXTENDED USE, WASTE, AND OTHER

### MATERIALS EFFICIENCY (TONNES OF CO<sub>2</sub>EQ IN MILLIONS)

Solution Name	WRI and Aii 2030 Reduction Potential *	WRI and Aii Assumed Implementation Level	Emissions Savings at Full Implementation *	2050 Emissions Reduction Equivalent *
<b>Materials Efficiency</b>	24	29%	72	130

\* 2050 Emissions Equivalent calculated using a 3% annual growth rate, assumed to be the same as the textiles production volume growth rate (see Figure 31). 2030 Emissions Savings at Full Implementation is adjusted down from the SBTi report to account for a 3% growth assumption, rather than the 4.5% assumed by WRI and Aii.

For more details on the emissions methodology, see the [Roadmap to Net Zero](#) report.

**Figure 34.** Emissions reduction through materials efficiency. Source: WRI & Aii (2021).

### EXTENDED USE AND OVERPRODUCTION (TONNES OF CO<sub>2</sub>EQ IN MILLIONS)

Solution Name	Reduction assumed in McKinsey (2021) * / **	Implementation potential assumed in McKinsey * / **	Emissions Savings at Full Potential *	2050 Emissions Reduction Equivalent *
<b>Overproduction</b>	75	Reduction from 20% to 10% waste	150	269
<b>Extended Use</b>	44	100% (full potential)	44	79
<b>TOTAL</b>	<b>119</b>		<b>194</b>	<b>348</b>

\* 2050 Emissions Equivalent calculated using a 3% annual growth rate, assumed to be the same as the textiles production volume growth rate (see Figure 31).

\*\* Based on [Fashion on Climate](#) report (2021, p. 18).

**Figure 35.** Emissions reduction through reducing overproduction and extending use. Source: McKinsey (2021).

## SIZE OF THE PRIZE CALCULATIONS

Note: All figures are reported in 2021 U.S. Dollars. The contemplated investments will take place over the next several decades. The authors have not applied an inflation factor or a discount rate. The cost of each investment is based on today's cost, except where otherwise noted (e.g., renewable electricity).

### Renewable Electricity

- Using Higg FEM the average electricity use per facility was calculated for each tier and region. The global weighted average electricity use per facility is 8,251,954 kWh/year
- The global average capacity factor for solar energy in 2019 was 18%. The authors made the simplifying assumption that improvements in the capacity factor from technological advancement will be offset by installing renewable projects in regions with less ideal conditions (e.g., less sun exposure). (Source: [International Renewable Energy Agency \(IREA\), 2020](#))
- Therefore, the average facility would require a solar system with a capacity of 5,233 kW to offset 100% of their electricity use
- The global average system cost is projected to be \$587 per kW by 2030 (Source: [IREA, 2021](#)). The 2030 figure is used since the projects are assumed to be installed over the next two decades. It is further assumed that this cost applies for both on-site or off-site projects.
- Therefore, the average investment per facility is \$3,071,979
- Using the projected 2050 global facility count of 149,792, it is assumed that 75% of facilities will install a renewable electricity source (and the remaining 25% either already have a renewable electricity source or will receive renewable electricity from the grid)
- For all projects, it is assumed an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders

## SCALING SUSTAINABLE MATERIALS AND PROCESSES

### Mechanically-recycled Synthetic fibres

- It is assumed 53% of synthetic fibres are mechanically-recycled by 2050. Using the growth rates above, that results in 37 million additional metric tons per year of mechanically-recycled synthetic fibre.
- In order to source enough input materials (plastics), additional collection infrastructure will be required. This report uses a cost of \$136 per ton (Source: [Schneider, 2021](#)), resulting in a collection infrastructure investment of \$5.1 billion.
- The cost of new infrastructure to convert input materials (plastics) to new fibres is assumed to be \$728 per ton (Source: [Plastics in Packaging, 2020](#)), resulting in a conversion infrastructure investment of \$27.2 billion
- For both collection and conversion infrastructure, it is assumed an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders (\$3.2 billion)
- The total mechanically-recycled synthetic fibre volume produced between 2020 and 2050 is assumed to be 728 million metric tons based on an extrapolation of WRI and Aii Estimates. As of 2019, the cost premium of recycled fibre compared to conventional fibre was \$72 per ton (Source: [Ambrose, 2019](#)), resulting in \$52.4 billion required for the 'Sustainability Premium'.



**Preferred/Organic Cotton**

- In this report, it is assumed 70% of cotton volume is preferred/organic cotton by 2050. Using the growth rates above, that results in 16 million additional metric tons per year of preferred/organic cotton
- The certification and training cost to incentivise farmers to switch to preferred/organic cotton is assumed to be \$135 per ton (Source: Textile Exchange, 2019, pg. 49, assumes 1 year of expenditure with no production), resulting in a conversion investment of \$2.1 billion
- For the conversion investment, it is assumed an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders (\$210 million)
- The total preferred/organic cotton volume produced between 2020 and 2050 is assumed to be 365 million metric tons based on an extrapolation of WRI and Aii estimates. As of 2019, the cost premium of recycled fibre compared to conventional fibre was \$308 per ton (Source: Textile Exchange, 2019), resulting in \$38.5 billion required for the 'Sustainability Premium'.

**Mechanically-recycled Cotton**

- It is assumed 9% of cotton production volume is mechanically-recycled by 2050. Using the growth rates above, that results in 2.5 million additional metric tons per year of mechanically-recycled cotton
- In order to source enough input materials (post-consumer cotton), additional collection infrastructure will be required. This report uses a cost of \$136 per ton (Source: Schneider, 2021), resulting in a collection infrastructure investment of \$333 million
- The cost of new infrastructure to convert input materials (post-consumer cotton) to new cotton fibres is assumed to be \$728 per ton (Source: Plastics in Packaging, 2020), resulting in a conversion infrastructure investment of \$1.8 billion
- For both collection and conversion infrastructure, this report assumes an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders (\$212 million)
- The total mechanically-recycled cotton volume produced between 2020 and 2050 is assumed to be 41 million metric tons (using the growth rates and assumptions in the Global Textiles Volume Calculations in Figure 31). The cost premium for recycled cotton is assumed to be the same as preferred/organic cotton (\$308 per ton), resulting in \$12.6 billion required for the 'Sustainability Premium'.

**Maximise Energy Efficiency**

- Using Clean by Design data for the average cost of energy efficiency improvements by region and tier (from \$20,350 per facility up to \$1,010,000), the global weighted average energy efficiency investment was calculated to be \$178,924 per facility
- Using this reports projected 2050 global facility count of 149,792, it is assumed that 75% of facilities will implement an energy efficiency programme (and the remaining 25% have either already implemented a programme or are using state of the art production equipment)
- For all projects this report assumes an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders

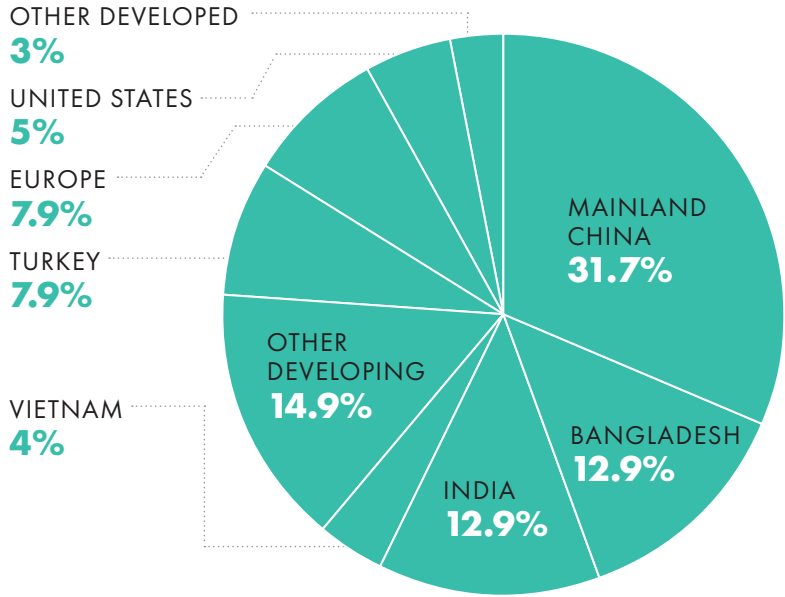
**Coal Phase Out: Alternative Fuel Source**

- Of all global facilities, this report assumes 100% of new facilities and 50% of existing facilities install a non-coal fired boiler / replace an existing coal-fired boiler, resulting in 113 million incremental metric tons of textile volume being processed at facilities that make an investment in a non-coal fired boiler
- The average natural gas mmBTU needed per metric ton of textile fabric is 27.7 (Source: American Council for an Energy Efficient Economy, 2005), so 3.15 billion mmBTU of new natural gas capacity will be needed
- The capital investment in a natural gas boiler per mmBTU is assumed to be \$5.77 (Source: U.S. Environmental Protection Agency, 2013)
- Therefore, the total investment required to replace coal fired boilers with natural gas or equivalent boilers is \$18.1 billion
- For all projects, this report assumes an additional 10% cost of feasibility assessments, programming, and coordination amongst stakeholders

**Methodology for facilities location by region**

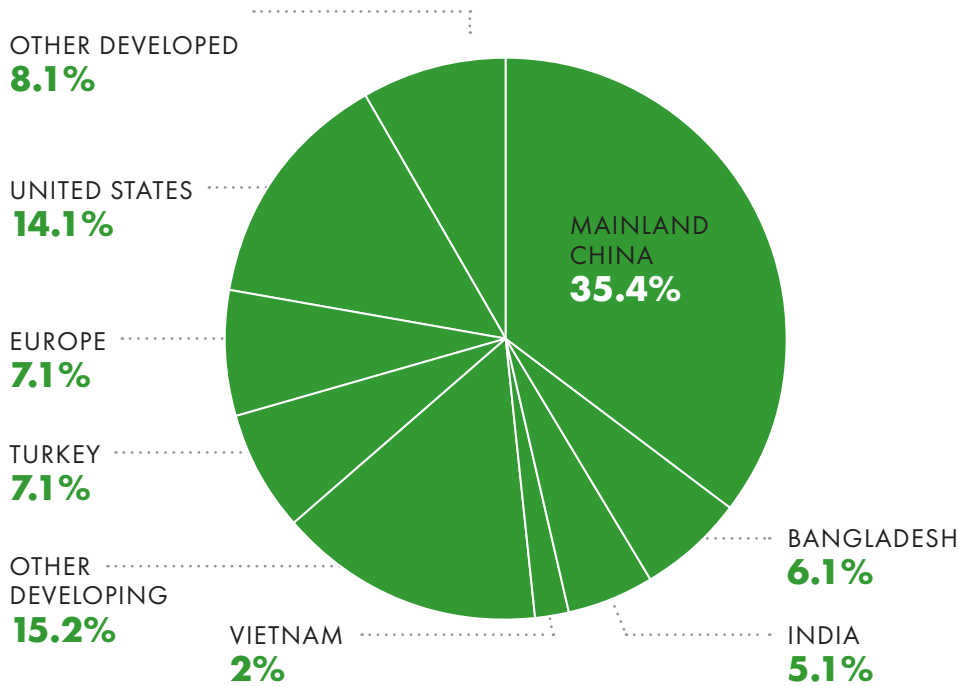
- The Open Apparel Registry database identifies 55,795 global Tier 1 and Tier 2 facilities as of 2020, including facility locations
- Using Higg FEM, the authors of this report calculated the ratio of Tier 1 to Tier 2 facilities in each region

GLOBAL APPAREL FACILITIES - TIER 1



**Figure 36.** Distribution of global apparel facilities of all tiers. Source: Open Apparel Registry (n.d.), Higg (n.d.)

GLOBAL APPAREL FACILITIES - TIER 2



**Figure 37.** Distribution of existing solutions and allocation of investments. Source: Open Apparel Registry (n.d.), Higg (n.d.)

**Innovative solutions**

- The total financing requirement for innovative solutions is driven by a bottom-up methodology based on the maturity and financing profiles of carbon-focused innovators. The total figure is a function of the following components:
  - The total number of innovators in Fashion for Good's database in each innovation category with significant relevance to carbon abatement, multiplied by:
  - The extent (%) to which those innovators are relevant, further corrected to account for the extent to which those innovators are covering the total requirement for innovation, resulting in c.2,500 companies to be financed, multiplied by:
  - The capex required to scale each of those innovations for the first three phases (respectively: R&D, piloting, production at scale), further corrected for the fact that many innovations may not make it to the next stage (the innovation funnel). Used assumptions result in a 11% success rate from phase 1 to 2 and 23% success rate from phase 2 to 3. Assumed financing requirements are:
    - Processing innovators: \$5m, \$25m, and \$50m for phase 1-3 respectively;
    - Materials: \$10m, \$50m, and \$100m for phase 1-3 respectively.
- Added to the above is the amount of financing necessary to adopt the resultant winning solutions at scale (Phase 4), which may cover building sufficient number of material production plants or installing new processing equipment at manufacturing sites. These amounts are based on confidential insights from multiple innovators in Fashion for Good's portfolio.
- Each of the resulting amounts for the four Phases and different innovation categories are subsequently allocated over the various financing categories, including high risk / high return venture capital vs. later stage debt.

# Endnotes

---

1. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. Available at: [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
2. Excluding footwear
3. Fashion for Good. 2019. Investing in Textile Innovation. Available at: [https://fashionforgood.com/wp-content/uploads/2019/10/FashionForGood\\_Investing-in-Textile-Innovation\\_October.pdf](https://fashionforgood.com/wp-content/uploads/2019/10/FashionForGood_Investing-in-Textile-Innovation_October.pdf)
4. Intergovernmental Panel on Climate Change (IPCC). 2021. AR6 Climate Change 2021:
5. McKinsey & Company and GFA. 2020. Fashion on Climate, How the Fashion Industry can Urgently Act to Reduce its Greenhouse Gas Emissions. Available at: [https://www.mckinsey.com/~/\\_media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf](https://www.mckinsey.com/~/_media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf).
6. Quantis. 2018. Measuring Fashion: Insights from the Environmental Impact of the Global Apparel and Footwear Industries. Available at: <https://quantis-intl.com/report/measuring-fashion-report/>.
7. World Resources Institute. 2019. Apparel and Footwear Sector Science-Based Targets Guidance. Available at: <https://www.wri.org/research/apparel-and-footwear-sector-science-based-targets-guidance>.
8. World Economic Forum (WEF) and Boston Consulting Group (BCG). 2021. Net-Zero Challenge: The supply chain opportunity. Available at: <https://www.weforum.org/reports/net-zero-challenge-the-supply-chain-opportunity>.
9. This analysis excludes footwear, leather and luxury goods and home textiles
10. Greenhouse Gas Protocol (GHG Protocol). 2015. GHG Protocol Corporate Accounting and Reporting Standard. Available at: <https://ghgprotocol.org/corporate-standard>.
11. The Carbon Disclosure Project, an industry standard for carbon reporting, weights scope 3 emissions, called “Value Chain Emissions” at only 5% of a company’s overall score. Carbon Disclosure Project. 2020. Climate Change 2020: General Scoring Methodology Category Weightings. Available at: [https://6fefcbb86e61af1b2fc4-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/guidance\\_docs/pdfs/000/002/290/original/2020\\_CC\\_General\\_and\\_Sectors\\_weightings\\_V2\\_FINAL.pdf?1588864063](https://6fefcbb86e61af1b2fc4-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/guidance_docs/pdfs/000/002/290/original/2020_CC_General_and_Sectors_weightings_V2_FINAL.pdf?1588864063)
12. The Fashion Pact. 2019. The Fashion Pact. Available at: <https://thefashionpact.org/>.
13. The Fashion Pact. 2020. First Steps to Transform Our Industry. Available at: <https://thefashionpact.org/wp-content/uploads/2020/10/038906e111abca13dce4c77d419e4f21.pdf>.
14. United Nations Framework Convention on Climate Change (UNFCCC). 2020. Fashion Industry Charter for Climate Action - Climate Action Playbook. Available at: <https://unfccc.int/documents/250059>.
15. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)



16. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
17. McKinsey & Company and Global Fashion Agenda (GFA). 2020. Fashion on Climate, How the Fashion Industry can Urgently Act to Reduce its Greenhouse Gas Emissions. Available at: <https://www.mckinsey.com/~media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf>.
18. Quantis. 2018. Measuring Fashion: Insights from the Environmental Impact of the Global Apparel and Footwear Industries. Available at: <https://quantis-intl.com/report/measuring-fashion-report/>.
19. World Resources Institute (WRI). 2019. Apparel and Footwear Sector Science-Based Targets Guidance. Available at: <https://www.wri.org/research/apparel-and-footwear-sector-science-based-targets-guidance>.
20. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
21. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
22. The final solution category includes various initiatives as calculated by McKinsey & Company and Global Fashion Agenda (GFA), Fashion on Climate Report (2020), including reductions in overproduction, an increased market share of re-commerce and other circular business models, extensions of average product life, and improvements in consumer washing behaviour. Financing requirements were not calculated for this category.
23. National Renewable Energy Laboratory. 2021. Documenting a Decade of Cost Declines for PV Systems. Available at: <https://www.nrel.gov/news/program/2021/documenting-a-decade-of-cost-declines-for-pv-systems.html>.
24. Mathis, W. 2021. Building New Renewables Is Cheaper Than Burning Fossil Fuels. Bloomberg Green. Available at: <https://www.bloomberg.com/news/articles/2021-06-23/building-new-renewables-cheaper-than-running-fossil-fuel-plants>.
25. Science Facts. 2020. Types of Renewable Energy Sources. Available at: <https://www.sciencefacts.net/types-of-renewable-energy.html>.
26. WEF and BCG. 2021. Net-Zero Challenge: The supply chain opportunity. Available at: <https://www.weforum.org/reports/net-zero-challenge-the-supply-chain-opportunity>.
27. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf).
28. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
29. Adidas. 2019. Environmental Good Practice Guide & Toolkit. Available at: [https://www.adidas-group.com/media/filer\\_public/1b/28/1b28e1cc-c702-4dd4-8f1d-4779ca61f083/envgoodpracticetoolkit\\_en\\_2019.pdf](https://www.adidas-group.com/media/filer_public/1b/28/1b28e1cc-c702-4dd4-8f1d-4779ca61f083/envgoodpracticetoolkit_en_2019.pdf).
30. UNFCCC. 2020. Fashion Industry Charter for Climate Action - Climate Action Playbook. Available at: <https://unfccc.int/documents/250059>.

31. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
32. Textile Exchange's Preferred Fiber & Materials Market Report 2021
33. UNFCCC. 2020. Fashion Industry Charter for Climate Action - Climate Action Playbook. Available at: <https://unfccc.int/documents/250059>.
34. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
35. Textile Exchange. 2021. Preferred Fiber & Materials Market Report 2021. Available at: [https://textileexchange.org/wp-content/uploads/2021/08/Textile-Exchange\\_PREFERRED-Fiber-and-Materials-Market-Report\\_2021.pdf](https://textileexchange.org/wp-content/uploads/2021/08/Textile-Exchange_PREFERRED-Fiber-and-Materials-Market-Report_2021.pdf).
36. Partnership for Cleaner Textile. n.d. Partnership for Cleaner Textile. Available at: <https://www.textilepact.net/>.
37. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
38. There is also evidence that further energy efficiency savings can be achieved (as high as a 50% reduction in total energy use) by making more extensive capital improvements such as upgrading machines to the latest, state of the art models, as well as implementing more sustainable dyeing practices such as low water dyeing and and high affinity dyes. While these solutions are viable and important, the potential emissions savings and financial investment required have not been included within the scope of this report.
39. Natural Resources Defense Council (NRDC). 2018. Clean by Design 2018 Mill Overview. Available at: [https://www.nrdc.org/sites/default/files/brochure-for-cbd\\_2018-02-27.pdf](https://www.nrdc.org/sites/default/files/brochure-for-cbd_2018-02-27.pdf).
40. UNFCCC. 2020. Fashion Industry Charter for Climate Action - Climate Action Playbook. Available at: <https://unfccc.int/documents/250059>.
41. Adidas. 2019. Environmental Good Practice Guide & Toolkit. Available at: [https://www.adidas-group.com/media/filer\\_public/1b/28/1b28e1cc-c702-4dd4-8f1d-4779ca61f083/envgoodpracticetoolkit\\_en\\_2019.pdf](https://www.adidas-group.com/media/filer_public/1b/28/1b28e1cc-c702-4dd4-8f1d-4779ca61f083/envgoodpracticetoolkit_en_2019.pdf).
42. Forest Research. 2021. Carbon emissions of different fuels. Available at: <https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/carbon-emissions-of-different-fuels/>.
43. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
44. Except for printing
45. Textile Exchange. 2021. Preferred Fiber & Materials Market Report 2021. Available at: [https://textileexchange.org/wp-content/uploads/2021/08/Textile-Exchange\\_PREFERRED-Fiber-and-Materials-Market-Report\\_2021.pdf](https://textileexchange.org/wp-content/uploads/2021/08/Textile-Exchange_PREFERRED-Fiber-and-Materials-Market-Report_2021.pdf).
46. Nova Institute. n.d. Renewable Carbon. Available at: <https://renewable-carbon.eu/>.
47. Biofabricate and Fashion for Good. 2020. UNDERSTANDING 'BIO' MATERIAL INNOVATION: a primer for the fashion industry. Available at: <https://reports.fashionforgood.com/wp-content/uploads/2020/12/Understanding-Bio-Material-Innovations-Report.pdf>

48. WRI and Aii (2021). Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector. [https://apparelimpact.org/wp-content/uploads/2021/11/21\\_WorkingPaper\\_RoadmapNetZero\\_.pdf](https://apparelimpact.org/wp-content/uploads/2021/11/21_WorkingPaper_RoadmapNetZero_.pdf)
49. Climate Bonds Initiative. 2021. 2021 Green Forecast Updated to Half a Trillion – Latest H1 Figures Signal New Surge in Global Green, Social & Sustainability Investment. Available at: <https://www.climatebonds.net/2021/08/climate-bonds-updates-2021-green-forecast-half-trillion-latest-h1-figures-signal-new-surge>
50. H&M Group. 2021. Sustainability-Linked Bond Framework. Available at: [https://hmgroupp.com/wp-content/uploads/2021/02/HM\\_Sustainability-Linked-Bond-Framework.pdf](https://hmgroupp.com/wp-content/uploads/2021/02/HM_Sustainability-Linked-Bond-Framework.pdf).
51. Good Fashion Fund. n.d. Available at: <https://goodfashionfund.com/>.
52. Jeanologia. n.d. Available at: <https://www.jeanologia.com/>.
53. International Finance Corporation. 2020. Levi Strauss & Co. Manufacturing Case Study. Available at: [https://www.ifc.org/wps/wcm/connect/industry\\_ext\\_content/ifc\\_external\\_corporate\\_site/manufacturing/resources/manufacturing\\_casestudy\\_levis](https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/manufacturing/resources/manufacturing_casestudy_levis).
54. Apparel Resources. 2019. IFC's unparalleled vision to bolster the garment and textile industry of Vietnam. Available at: <https://apparelresources.com/business-news/sustainability/ifcs-unparalleled-vision-bolster-garment-textile-industry-vietnam/>.
55. Vogue Fashion. 2020. How much more would you pay for a sustainable T-shirt? Available at: <https://www.voguebusiness.com/sustainability/how-much-more-would-you-pay-for-a-sustainable-t-shirt>
56. Solar Energy Industries Association. 2012. Solar Power Purchase Agreements. Available at: <https://www.seia.org/research-resources/solar-power-purchase-agreements>.
57. Berkeley Energy Commercial Industrial Solutions. n.d. Available at: <https://www.berkeley-energy.com/>.
58. Clean Energy Investment Accelerator. n.d. Available at: <https://www.berkeley-energy.com/>.
59. Concessionary finance is a financial investment in which investors accept a lower return on investment in return for additional environmental, social and/or economic development benefits of the project.
60. Organic Cotton Accelerator. n.d. OCA Programmes. Available at: <https://www.organiccottonaccelerator.org/oqa-programmes>.
61. NRDC. 2018. Clean by Design 2018 Mill Overview. Available at: [https://www.nrdc.org/sites/default/files/brochure-for-cbd\\_2018-02-27.pdf](https://www.nrdc.org/sites/default/files/brochure-for-cbd_2018-02-27.pdf).
62. Skyven Technologies. n.d. How we Work. Available at: <https://skyven.co/how-we-work/>.
63. <https://www.ecotextile.com/2021022627458/dyes-chemicals-news/h-m-backs-dyeing-and-finishing-innovator.html>
64. European Investment Bank. 2021. EU backs Renewcell to boost circularity in the fashion industry. Available at: <https://www.eib.org/en/press/all/2021-239-eu-backs-renewcell-to-boost-circularity-in-the-fashion-industry>.
65. See [Financing the Transformation in Fashion](#) report for more information on these barriers.