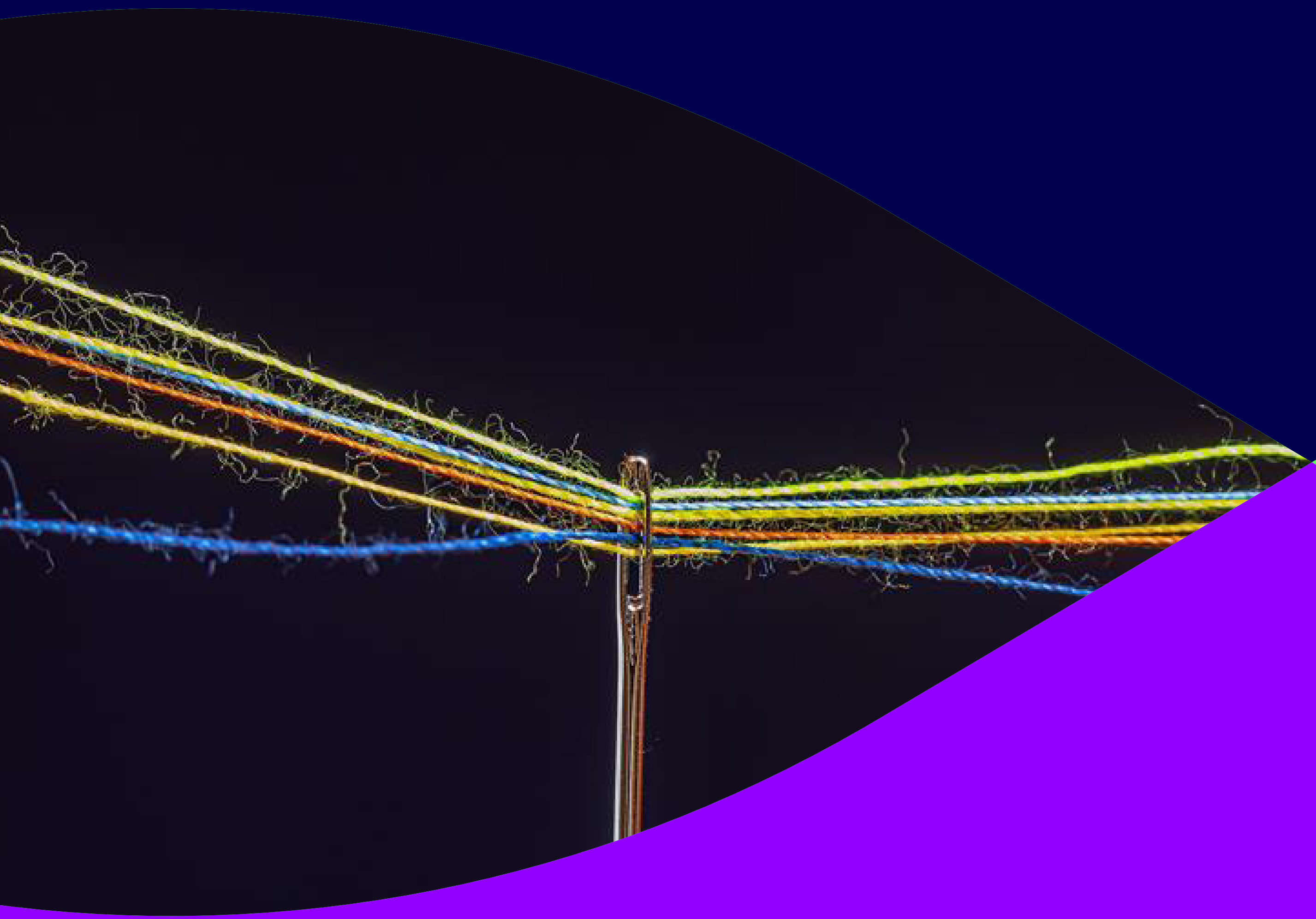
Fashion's Supply Chain Challenge

Strengthening Collaboration for Decarbonizing Apparel and Textile Manufacturing



Fashion for Climate

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FASHION'S SUPPLY CHAIN CHALLENGE: STRENGTHENING COLLABORATION FOR DECARBONIZING APPAREL AND TEXTILE MANUFACTURING

Fashion for Climate

CONTENTS

ABBREVIATIONS

Aii	Apparel Impact Institute
CapEx	Capital Expenditure
DPPA	Direct Power Purchase Agreement
EAC	Energy Attribute Certificate
EPZ	Export Processing Zone
ESCO	Energy Service Company
FOB	Freight on Board
GEC	Green Electricity Certificate
GHG	Greenhouse Gas
GO	Guarantee of Origin
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
I-REC	International Renewable Energy Certificate
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
OpEx	Operating Expenditure
PPA	Power Purchase Agreement
PV	Photovoltaic
REC	Renewable Energy Certificate
RE	Renewable Energy
ROI	Return on Investment
SBT	Science-Based Target
SBTi	Science Based Targets initiative
SME	Small and Medium-sized Enterprise
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

INTRODUCTION FROM THE MANUFACTURERS PEER ACTION GROUP OF THE FASHION INDUSTRY CHARTER

It is well documented that the fashion industry is responsible for somewhere between 2 and 8%[1] of global greenhouse gas (GHG) emissions and a large proportion of these emissions occur in the manufacturing sector of the fashion industry's value chain (from fiber to garment making). These facts are a driving force behind the Fashion Charter's ambitious commitments and calls to action, and we recognize that action is not currently happening as fast as desired. As mentioned, a significant proportion of the industry's GHG emissions occur during manufacturing. The fashion industry's manufacturing base is highly fragmented and complex, and this creates challenges to scaling solutions which may work in some contexts but not in others.

As manufacturers of the Fashion Industry Charter, we commissioned this report to highlight the structural and systemic challenges which create barriers to quicker action. We have experienced a misalignment between expectations and the reality of the industry in which we operate. To resolve this, we call on the fashion industry to address climate change as a business problem with the same investment and incentives given to commercial relationships. Manufacturers across the value chain (from fiber to fabric to garment production) face direct and indirect costs in addressing climate action and adapting to its impacts. The purpose of this report is to highlight where tensions exist, how they hinder scaling current solutions, and to provide recommendations for the transformation needed to address these issues.

1 The wide range is due to differences in scope, methodology and included emissions sources applied in various reports, with 2% being on the conservative side.

EXECUTIVE SUMMARY

The fashion industry is responsible for between 2 and 8%[2, 3] of the global total of GHG emissions, and approximately 80% of the industry's emissions occur within the supply chain.[4] This report examines the economic and cost challenges of decarbonizing fashion's supply chain, given the difficulty and importance of decarbonization to sustainable development and a Just Transition, as well as outlining transformative solutions.

In many countries apparel and textile manufacturing is critical to livelihoods and economic development, with the sector providing millions of jobs globally, especially to young women.[5] Major apparel and textile production hubs are highly vulnerable to climate change, and face significant risks from flooding, extreme heat, and intensifying storms, which can lead to business disruptions.[6] Apparel manufacturing is heavily concentrated in countries requiring high levels of social and economic adjustments in order to transition to a low-carbon society.

As a result, the fashion industry has a heightened responsibility to ensure that its shift to low-carbon practices is both inclusive and equitable, leaving no one behind.[7]

This report, commissioned by the Fashion Industry Charter for Climate Action's Manufacturers Peer Action Group, provides a road map to overcome these challenges. Based on insights from leading apparel and textile manufacturers operating nearly 200 production units across 50 countries, the report identifies the following internal and external cost roadblocks to decarbonization that hinders accelerated climate action:

- **Contextual differences:** value chain actors are often based in developing countries, each facing unique environmental, economic and social conditions. These challenges amplify the difficulty of decarbonizing manufacturing due to factors such as national policies, technological availability, access to finance, and technical expertise and know-how.

- **High cost of industrial transition at scale:** decarbonization options that deliver significant GHG reductions often come with higher capital expenditures (CapEx) and may also increase operational expenses (OpEx). However, scaling these transitions is essential for meeting the industry's climate goals.

2 Sadowski, Perkins, and McGarvey, (2021) 'Roadmap to Net Zero: Delivering Science-Based Targets in the Apparel Sector, Working Paper (World Resources Institute (WRI) and Apparel Impact Institute (Aii), https://files.wri.org/d8/s3fs-public/2021-11/roadmap-net-zero-delivering-science-based-targets-apparel-sector.pdf

3 McKinsey, (2020) "Fashion on climate: How the fashion industry can urgently act to reduce its greenhouse gas emissions", https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf

4 Sadowski, Perkins, and McGarvey (2021), 'Roadmap to Net Zero'. This report notes that Tiers 1 through 4 of the supply chain (as defined in the report) represent over 80% of sector emissions.

5 International Labour Organization (ILO), "Textiles, clothing, leather and footwear sector," Accessed January 29, 2025, https://www.ilo.org/industries-and-sectors/textiles-clothing-leather-and-footwear-sector

6 Judd et al., (2023) "Higher Ground?," Executive Summary (ILR Global Labour Institute and Schroders), https://www.ilr.cornell.edu/sites/default/files-d8/2023-09/Higher%20Ground%20Executive%20Summary%20REV%20%28v1%29%20%281%29.pdf

7 International Labour Organization (ILO), (2015) "Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies for All" https://www.ilo.org/publications/guidelines-just-transition-towards-environmentally-sustainable-economies

- **Systemic risks:** prevailing costing models are often not fit for purpose in accurately valuing manufacturers' decarbonization investments. These costing models, which can include short-term contracts combined with fluctuating business relationships, may account for the cost of key product inputs but often fail to cover the necessary investment for decarbonization.

Overcoming these barriers requires a multi-pronged approach that helps support apparel-producing countries to achieve their national climate targets while developing new models of private sector support and engagement. For the private sector, partnerships and incentives are the twin pillars of progress, which can work in tandem to help alleviate the core barriers that the industry is facing. This report identifies three transformative steps which should occur concurrently to help build effective and stronger partnerships that unlock the necessary speed and scale of action needed to meet the ambitions to reduce GHG emissions.

1. Approach decarbonization through more strategic commercial partnerships.

Just as commercial partnerships drive product innovation, fostering long-term collaboration between value chain companies is essential for effective decarbonization. Stronger partnerships would lead to outcomes such as:

a. **Building decarbonization strategies into product design and innovation:** this approach will help build the net cost of decarbonization strategies into product costing models and encourage value chain actors to favor and prioritize partnerships built on investment in actions that reduce GHG emissions from energy use, as well as identifying impact reductions through thoughtful, more sustainable design.

b. **Sharing resources, information and challenges:** strong partnerships share knowledge and resources, and support each other through challenges. It is important that there is open communication and listening between value chain actors so that they can support each other.

c. **A 'whole of company' approach towards the partnership:** a partnership approach would embed responsibility for achieving climate action goals company-wide, rather than having it siloed in sustainability departments. Each department should have clear roles and responsibilities to meet in order to bring low-carbon products to market.

d. **Guidelines for low-carbon products:** an industry aligned definition of a low-carbon product from both a manufacturing and consumer use perspective should be developed utilizing a science-based methodology. Once the definitions are agreed upon then effort should be made to embed them into regulations.

e. **Commitment to fairness:** the roles and responsibilities for decarbonization should be embedded within value chain partners based on fairness of specialization to the problem. Each partner holds a key to part of the solution and can provide specialized knowledge or resources.

2. Develop country and regional forums for knowledge and best practice sharing.

Decarbonization costs and challenges are highly context-specific yet can also rapidly change. Therefore, companies need access to up-to-date country or region-specific knowledge, guidance and training programs that

cover the current available strategies, technologies, case studies and funding opportunities and these should also include the different contexts in which manufacturers operate. Investment is needed in order to organize and maintain these forums.
Multi-stakeholder initiatives, including the Fashion Charter, can and should take the lead in organizing these forums, and should collaborate with partners to fund these forums, guidance documents and case studies. The following factors should be considered when organizing these forums:

a. **Holding more multi-stakeholder forums on a more frequent basis:** the industry needs more frequent events that cover all regions as well as some that have an individual country focus. Multi-stakeholder initiatives should coordinate their efforts to organize these forums for sharing pre-competitive knowledge.

b. **Varying the size of these forums from conference settings to workshops:** both types are useful, and each one can focus on specific audiences from business leaders to technical managers involved in implementation.

c. **Having platforms for up-to-date country and region-specific guidance and case studies:** the industry needs access to country or region-specific guidance that provides information on the available strategies, cost challenges and funding opportunities.

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3. Create robust industry-wide policies and incentives.

Consistent and clear policies and incentives should be developed for brands and manufacturers in order to reduce emissions. The two other transformative steps previously mentioned highlight the need for the fashion industry to establish leading commercial partnerships and benchmarks for best practices for decarbonization. Governments can support these practices and partnerships through appropriate policies and regulations. However, governments also need to know which effective policy and economic incentives are most helpful for companies to reduce their emissions. Some activities that the private sector can undertake to encourage effective policy and economic incentives include:

a. **Organizing public-private forums:** these forums will deepen engagement between governments and the private sector through regional and global knowledge sharing of best practices, effective policies and incentives that encourage climate action. These forums should include the participation of producing country governments and manufacturers.

b. **Advocating supportive policies:** these policies should align cross-industry efforts to incentivize renewable energy, expand power purchase agreements (PPAs) and phase out coal across priority countries. The recent approval of the direct power purchase agreement (DPPA) regulations in Viet Nam is an example of a successful cross-sector alignment that could provide a road map for more coordinated policy engagement.

c. **Research the development of an industry specific carbon market:** a global carbon price could help unify fragmented efforts, create a consistent cost for emissions across markets, and ensure fair competition. Research should be conducted into how carbon markets can be implemented in the industry and how their use can help to finance decarbonization efforts. Momentum is building to explore this solution, and coordinated support from the fashion industry would be an important contributor to its success.

d. **Partnering with governments on creative new financial models and markets:** when returns on investment (ROIs) become challenging, governments, the financial sector and the fashion industry should work together to develop innovative financing models to scale newer technology and solutions that may result in higher OpEx. These new financing models would involve linking the financing of decarbonization solutions to the sales generated from bringing new products to market. In addition, a new carbon market that includes concepts such as insetting should be evaluated and piloted. Such models can help finance a manufacturer's decarbonization efforts by providing a revenue stream from the GHG reductions generated by the decarbonization efforts.

RESEARCH DESIGN

This report draws on qualitative research methods, using surveys and in-depth interviews with key informants,[8] a literature review and desk research. The key informants consulted were sustainability professionals from 15 apparel and textile manufacturing companies (referred to as 'manufacturers' throughout this report) that operate 192 production units in 50 countries, representing all major apparel and textile production hubs and providing a range of contexts regarding barriers to decarbonization. This is an illustrative sample of the industry. According to the most recent data from the World Trade Organization, in 2022, the top five global exporters of clothing were China, the European Union, Bangladesh, Viet Nam and Türkiye.[9] However, the findings of this report primarily highlight challenges in Asia, both because Bangladesh, China, Indonesia and Viet Nam had the largest representation in this sample and also because several Asian economies are production hotspots with communities that rely heavily on textile and apparel exports, raising Just Transition concerns.[10]

Key informants were selected based on their company's commitment and active engagement to reduce GHG emissions. All but two companies have set science-based targets (SBTs) or an equivalent to reduce emissions. Six interviewees represented Tier 1 of the supply chain [see figure 1] as cut-and-sew facilities; three represented Tier 2, including fabric mills and fastener producers; one represented Tier 3, a chemical processor; and one represented Tier 4, a raw material extractor. Two interviewees were vertically integrated (Tier 1 through 3), encompassing spinning, weaving and final assembly. Two represented Tiers 1 and 2, including cut-and-sew facilities and fabric weaving. A mix of product types was represented, from high-tech outerwear to apparel basics and footwear, but most produce apparel. Given the sensitive nature of sharing financial information and details of relationships with buyers, the findings and quotes were anonymized to encourage candor.

Brands and retailers who are Fashion Charter Signatories were invited to participate in a 90-minute focus group to identify similarities and differences in the perspectives previously shared by the manufacturers in the interviews. Sustainability professionals from five brands and retailers participated. Though the focus group was not representative of the whole fashion industry, it produced valuable insights that further informed this report.

The report was reviewed by the Fashion Charter Manufacturers Peer Action Group and Fashion Charter Steering Committee.

8 Faifua, Denise (2024) 'The Key Informant Technique in Qualitative Research.' In Sage Research Methods Cases Part 1. London: Sage Publications Ltd., https://doi.org/10.4135/9781446273050145402254

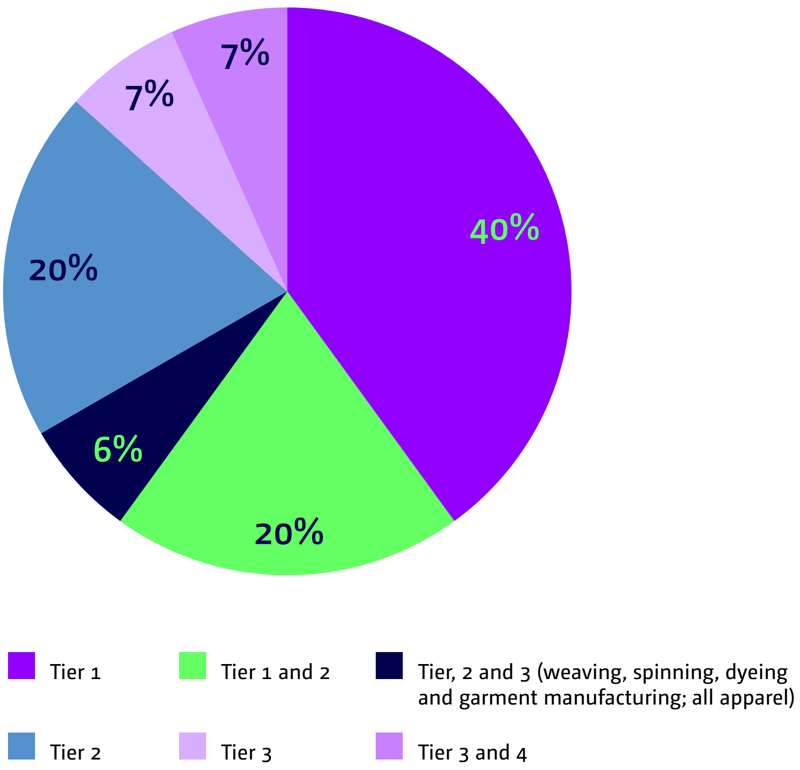
9 World Trade Organization, (2023) 'World Trade Statistical Review' https://www.wto.org/english/res_e/booksp_e/wtsr_2023_e.pdf

10 International Labour Organization, (2021) 'Opportunities for a Just Transition to Environmental Sustainability and COVID-19 Recovery in the Textile and Garment Sector in Asia', ILO Asia-Pacific Report, https://www.ilo.org/publications/opportunities-just-transition-environmental-sustainability-and-covid-19. In Bangladesh, more than 80% of exports come from the textile and garment sector; in Pakistan, more than 50% of exports come from the textile and garment sector; in India, it is 55%.

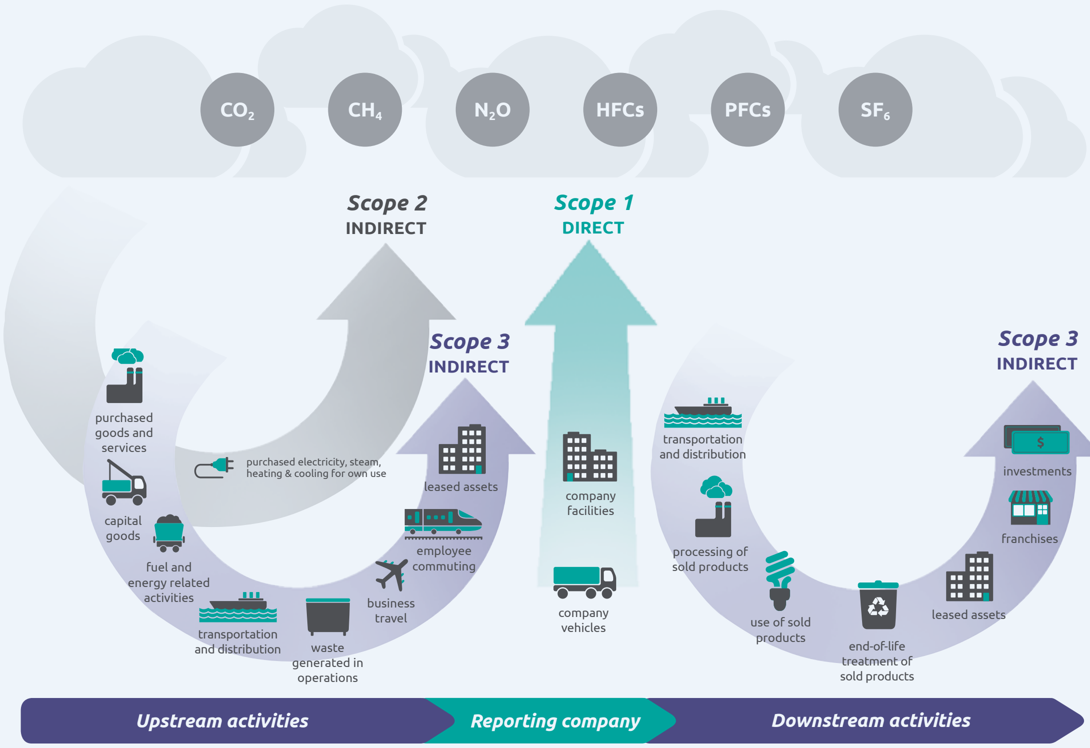
The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) was consulted for subject matter expertise on thermal energy transition.

The results of the report show the reality of costs for manufacturers with established and well-developed decarbonization plans. We assume this group mostly represents companies that are highly motivated at the leadership or sustainability team levels to meet climate goals. Most companies are relatively large, with a median annual turnover of €655 million, among those that shared data. Barriers to decarbonization are likely magnified for smaller manufacturers and many small and medium-sized enterprises (SMEs). Moreover, as challenges to decarbonization are highly context-specific, the concentration of interviewees in Asia reflects challenges in this specific regional context. We encourage others to continue to produce research and guidance focused on other contexts and regions.

FIGURE 1: Supplier Interviewees – Tiers distribution



TEXTBOX 1: GHG Emissions Scopes



The Greenhouse Gas Protocol[11] developed Scopes 1, 2 and 3 carbon emission categories to help organizations measure and manage their GHG emissions. They are defined as follows:

- Scope 1 emissions are **direct emissions** from sources that are owned or controlled by the reporting company, such as from fuel combustion in company-owned vehicles or coal-fired or natural gas boilers, which is particularly relevant for some manufacturers.

- Scope 2 emissions are **indirect emissions** from the generation of purchased electricity, steam, heating or cooling, e.g. for lighting, air conditioning or electricity to power machinery in production sites.

- Scope 3 emissions are **all other indirect emissions** (not included in Scope 2) that occur in the value chain of the reporting company, including the production and transportation of purchased goods, e.g. emissions embedded in garments and footwear purchased by a brand and retailer or in textiles purchased by a garment factory for final assembly.

11 Greenhouse Gas Protocol, (2024) "Corporate standard frequently asked questions: 1. How does the GHG Protocol define and categorize emissions?", https://ghgprotocol.org/corporate-standard-frequently-asked-questions#question%20one

CHAPTER 1

SUPPLY CHAIN COST CHALLENGE: AN OVERVIEW

The fashion industry has an obligation and opportunity to take the lead in addressing the climate crisis. To do so, it must solve the supply chain challenge which is where the bulk of emissions are concentrated, and progress so far has proven difficult. Supply chains are where products are made, and raw materials are sourced. Moreover, industrial processes are inherently energy-intensive and historically dependent on fossil fuels.

Many brands and retailers have set ambitious climate targets, and many manufacturers have, in turn, set their own extensive emissions reduction goals.[12] However, the industry is struggling to make real progress, with the supply chain emissions proving to be a major hurdle. Overall, sector emissions have shown little decline.[13] Brands and retailers report that their Scope 3 emissions (indirect emissions in their supply chain) are the most significant barrier to net-zero targets.[14]

Drawing on interviews with leading manufacturers working to decarbonize across 50 countries and nearly 200 production facilities, the report illuminates the direct and indirect barriers manufacturers face regarding decarbonization.

The majority of companies interviewed have set science-based targets (SBTs) (or the equivalent) in line with the Paris Agreement, which commits nations to limit the global temperature rise to well below 2°C and to pursue efforts to limit it to 1.5°C above pre-industrial levels.[15] Critical to this ambition is the private sector setting and meeting science-based targets (or equivalent reductions), committing companies to roughly halve emissions by 2030 and meet net zero goals by 2050 against a 2019 baseline.[16]

Collectively, these manufacturers have achieved an average reduction of 22.4% in their Scope 1 and 2 emissions. Despite significant investments in energy efficiency, rooftop solar installations and coal phase-out, most manufacturers are struggling to make further progress and do not have a clear path to meet net zero goals. Two companies' emissions have increased since setting targets, with express concern that the cost barriers detailed in this report may impede their ability to make progress and maintain low-carbon initiatives. Most of the manufacturers interviewed have reported no progress on Scope 3 emissions (indirect emissions in their

12 Science Based Targets, 'Companies Taking Action', accessed January 30, 2025, https://sciencebasedtargets.org/companies-taking-action ; UN Fashion Charter for Climate Action, "Fashion Charter - Participants," accessed February 2, 2025, https://unfccc.int/climate-action/sectoral-engagement-for-climate-action/fashion-charter/participants.

13 Apparel Impact Institute, (2024) 'Taking Stock of Progress Against the Roadmap to Net Zero 2024', https://files.wri.org/d8/s3fs-public/2021-11/roadmap-net-zero-delivering-science-based-targets-apparel-sector.pdf?VersionId=LxrwUSv9dHytM7zybuQgoJ8LUHBZVgM1

14 Cernansky, (2024) 'Fashion's Carbon Footprint Is Outpacing Its Climate Progress,'Vogue Business, https://www.voguebusiness.com/story/sustainability/fashions-carbon-footprint-is-outpacing-its-climate-progress.

15 "Paris Agreement," conclusion date: December 12, 2015, United Nations Treaty Series Online, registration no. I-54113, https://treaties.un.org/pages/AdvanceSearch.aspx?tab=UNTS&clang=_en.

16 Science Based Targets & World Resources Institute, (2019) 'Apparel and Footwear Sector Science Based Targets Guidance', https://sciencebasedtargets.org/resources/legacy/2019/06/SBT_App_Guide_final_0718.pdf United Nations Climate Change Global Climate Action & CDP, (2023) 'Fashion Industry Charter for Climate Action Progress Report 2023," United Nations Framework Convention on Climate Change, https://unfccc.int/sites/default/files/resource/230329%20BLS23055%20UCC%20Climate%20Action%202023%20v06.pdf.

own value chain), which, like for apparel brands, is often the largest source of emissions. The roadblocks are likely magnified for smaller or less-resourced manufacturers. The sheer size and complexity of global production make supply chain decarbonization difficult. This report focuses on the economic dimensions of these challenges, as this was the barrier that most concerned manufacturers, and it is also important to equity and a Just Transition.[17]

TEXTBOX 2: Just Transition in detail

The International Labour Organization defines a Just Transition as the process of achieving sustainability transitions in a way that is 'just' to the enterprises, workers and communities involved, ensuring that no one, or no community, is left behind.[18]

Achieving environmental sustainability in textile and garment sector includes meeting global targets for carbon emission reductions per the Paris Agreement, but it also includes many other aspects, including addressing the resource intensiveness of the sector (water, land and chemicals) and boosting sustainable production and consumption systems, all while addressing textile waste and microplastics.[19]

Implementing strategies for decarbonization alone will not necessarily bring about more work or work that is decent.[20] As such, a Just Transition requires intentional planning and collaborative strategies. At a minimum, achieving a Just Transition in the apparel and textile sector requires:

- Creating frameworks and policies to ensure that green growth comes with an increase in decent jobs that are equitably distributed.
- Identifying jobs and communities negatively impacted in the transition, and instituting plans for new opportunities for these workers and communities.
- A commitment to sharing the burdens and opportunities of a Just Transition.
- Prioritizing 'hotspot' areas where economies and communities are more heavily dependent on garment and textile production, such as those in Asia, for investments.[21]

17 International Labour Organization (ILO), (2015) 'Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies for All', https://www.ilo.org/publications/guidelines-just-transition-towards-environmentally-sustainable-economies. See also: International Labour Organization, (2021) 'A "Just Transition Toolkit" for Textile and Garment Supply Chain in Asia', https://www.ilo.org/resource/news/just-transition-toolkit-textile-and-garment-supply-chain-asia.

18 Ibid.

19 International Labour Organization (ILO), (2023) 'Introducing the 'Just Transition Toolkit' for the Textile and Garment Supply Chain in Asia' www.youtube.com/watch?v=U1kF31pTwLo&t=24s

20 International Labour Organization (ILO), (2021) 'Opportunities for a Just Transition to Environmental Sustainability and COVID-19 Recovery in the Textile and Garment Sector in Asia', ILO Asia-Pacific Report, https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/documents/publication/wcms_823229.pdf. In Bangladesh, more than 80% of exports come from the textile and garment sector; in Pakistan, more than 50% of exports come from the textile and garment sector; in India, it is 55%.

21 Ibid.

Apparel and textile manufacturing is critical to economic and social development, with the sector providing millions of jobs globally, especially to young women.[22] Moreover, key apparel and textile production hubs are profoundly vulnerable to climate change, and are at significant risk of flooding, extreme heat and increasing business disruptions.[23] The fashion industry has a heightened responsibility to meet the three dimensions of sustainable development – social inclusion, environmental protection and economic growth – and ensure that its low-carbon transition adheres to the principles of a Just Transition, leaving no one behind.[24]

The findings of this report show that the economic barriers to supply chain decarbonization are multi-faceted and include:

1. The capital crunch.

Manufacturing is capital-intensive, and decarbonizing both the industry and production is costly. Across the fashion industry, an estimated trillion-dollar investment is needed.[25]

In factories, capital is needed to phase out coal-dependent thermal energy infrastructure, upgrade machinery and transition heating and cooling systems to using energy-efficient models, and install solar panels, to name a few examples.

Manufacturers drew attention to the sheer scale of investments required. One interviewee mentioned total investments of €25 million needed to meet the 2030 climate goals of the Paris Agreement. Another spent €15 million to phase out coal in a single facility. Many others mentioned projects and equipment that required upwards of €1 million in investment, including high-capacity biomass and natural gas boilers, large-volume biomass storage silos, state-of-the-art energy efficient spinning and fabric finishing machines, energy efficient chilling equipment, and structural modifications for rooftop solar panels.

Financing these investments may be manageable for larger manufacturing companies, "but is a significant challenge for standalone

A **payback period** refers to the time that an investment takes to generate enough returns to cover the project's costs and generate a profit.

22 International Labour Organization (ILO), "Textiles, clothing, leather and footwear sector," Accessed January 29, 2025, https://www.ilo.org/industries-and-sectors/textiles-clothing-leather-and-footwear-sector

23 Judd et al., (2023) "Higher Ground?," Executive Summary (ILR Global Labour Institute and Schroders, September 13, 2023), https://www.ilr.cornell.edu/sites/default/files-d8/2024-09/Higher%20Ground%20Executive%20Summary%20Rev%209-19-24%20.pdf.

24 International Labour Organization (ILO), (2015) "Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies for All" https://www.ilo.org/publications/guidelines-just-transition-towards-environmentally-sustainable-economies.

25 Ley et al., (2021) 'Unlocking the Trillion-Dollar Fashion Decarbonization Opportunity: Existing and Innovative Solutions' (Fashion for Good (FFG) and Apparel Impact Institute (Aii), https://apparelimpact.org/wp-content/uploads/2024/02/Aii_UnlockingTheTrillion-DollarFashionDecarbonisationOpportunity_Report_v11.pdf

manufacturers," one interviewee noted. A manufacturer's ability to raise capital connected to decarbonization is highly dependent on its size, financial health and the payback period.[26] Manufacturers may struggle to access affordable or adequate financing, with access further constrained in some developing countries.[27]

Manufacturers said that their firms are structured to look for a **payback period of six years or less**, with the majority noting that three years or under is the optimal return.[28] Some projects offer returns under six years, such as low-hanging fruit energy efficiency measures [discussed on p. 17] and on-site solar in many contexts, but other projects that are critically important to reaching climate goals take much longer. For example, one manufacturer in Pakistan noted that some state-of-the-art machinery that could dramatically reduce electricity consumption has a payback period of 15 years. Such projects require a more convincing business case, which the industry can help develop.

2. Projects with no payback.

Not every decarbonization project saves money or offers a return, yet they are still just as critical for achieving climate targets. Projects with no financial payback that increase costs on an ongoing basis are still undertaken and often require hiring new employees or skilled consultants or need increased maintenance. This can raise costs overall to be a significant part of the decarbonization effort in supply chains and require targeted strategies to overcome. Key areas driving increased operating costs include:

- **Thermal energy and fuel transition away from coal:** More than half of apparel's supply chain emissions come from Tier 2,[29] where it is estimated that thermal energy is responsible for between 75 and 90% of energy consumption.[30] In evaluating three leading strategies to decarbonize thermal energy – electrification, sustainable biomass and natural gas – all three strategies were found to have the potential to increase operating and production costs in some contexts. In Viet Nam, a Tier 1 and Tier 2 manufacturer reported a cost increase of € 10 cents per product after replacing coal with sustainable biomass.

- **Renewable electricity supplementation:** On-site solar is a critical energy cost saver but it does not meet the total electricity demand for large, high-demand manufacturers due to limited space, regulatory barriers and the lack of affordable battery storage. However, alternatives to on-site generation often include a price premium in the cost, such as with energy attribute certificates (EACs), or are not typically available in production markets such as corporate PPAs. One company that purchased EACs across Asia, the European Union and the United States roughly estimated that purchasing EACs added approximately € 5 cents Euros per production stage per kg of material.

26 Wickramasuriya, (2024) 'From Catwalk to Carbon Neutral: Mobilising Funding for a Net Zero Fashion Industry', white paper (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Fabric Asia Project, Transformers Foundation), https://asiagarmenthub.net/resources/2024/240229_fabric_whitepaper_a4-executive-summary-a.pdf. The findings of this project align with those in this report, which draws from a similar sample.

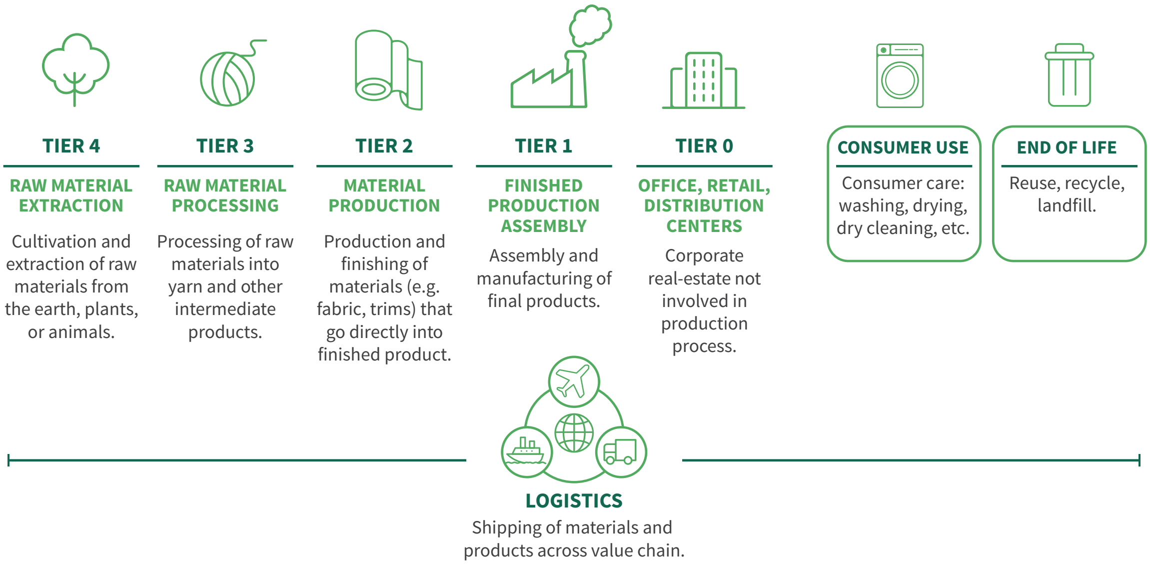
27 Ibid.

28 Ibid. Paybacks are shaped by the way bank loans are structured, the cost of the project, local energy prices and incentives, as well as order visibility and business cycle risks unique to fashion, among other factors.

29 Katrin Ley et al., 'Unlocking the Trillion-Dollar Fashion Decarbonization Opportunity.'

30 Sadowski, Perkins, and McGarvey, (2021) 'Roadmap to Net Zero'.

FIGURE 2: Supply chain Tiers



Source: Sadowski, M., C. Yan, and N. Aden. 2019. Apparel and Footwear Sector Science-Based Targets Guidance. Washington, DC: World Resources Institute.

3. The struggle for high-impact solutions.

The findings show that leading manufacturers have exhausted low-hanging fruit solutions that are less capital and resource intensive. They are now focusing on high-impact solutions that will bring them closer to achieving their climate goals. However, the cost and complexity of these solutions pull manufacturers back towards lower impact solutions. This is because manufacturers are often working with limited internal resources and many projects lack a strong business case.

The Science Based Targets Initiative (SBTi) is considering new guidance[31] that encourages companies to prioritize the most climate-relevant activities, such as those responsible for high volumes of emissions. Likewise, the OECD *Guidelines for Multinational Enterprises on Responsible Business Conduct*[32] advocates for businesses to continually seek to improve environmental performance. These high-impact strategies may come with more costs, as the guidelines highlight, underscoring the need for collaborative solutions. Greater cost-sharing and investment is required in order for manufacturers to take on a wider range of projects.

4. Business model constraints and cost pressures.

Business model risks systemic to fashion amplify costs and financial risks. Apparel and textile manufacturers occupy a low margin part of the value chain.[33] Interviewees noted making

31 Science Based Targets initiative (SBTi), (2024) 'Scope 3 Discussion Paper: Aligning Corporate Value Chains to Global Climate Goals', https://sciencebasedtargets.org/resources/files/Aligning-corporate-value-chains-to-global-climate-goals-SBTi-Research-Scope-3-Discussion-Paper.pdf.

32 OECD, (2023) 'OECD Guidelines for Multinational Enterprises on Responsible Business Conduct', https://www.oecd.org/en/publications/oecd-guidelines-for-multinational-enterprises-on-responsible-business-conduct_81f92357-en.html.

33 Anner, (2018) 'The Sourcing Squeeze, Workers' Rights, and Building Safety in Bangladesh Since Rana Plaza', (University Park, PA: Penn State Center for Global Workers' Rights, March 22, 2018). Mark Anner, https://www.wiwiss.fu-berlin.de/forschung/Garments/Medien/2018-Anner-Research-Report-Binding-Power.pdf.

significant investments in other sustainability initiatives, from water and chemical reductions to worker well-being, and most feared that they lacked the leverage to ask for price increases to cover decarbonization in a hyper-competitive industry. Interviewees noted that even a few cents of added cost per garment or kilogram of fabric could erode profitability and may put early adopters at a competitive disadvantage.

Furthermore, the fashion industry's purchasing practices, such as freight-on-board (FOB) prices and payment terms, must be improved to catalyze change. Interviewees noted that, in general, buyers continue to ask for lower prices, and this finding is supported by additional research.[34] According to Better Buying, a non-profit organization tracking apparel companies' purchasing practices, sourcing and purchasing practices do not fully account for the expense and risk of sustainability investments such as emissions reductions.[35] Interviewees face pre-existing cost pressures and decarbonization can amplify their financial difficulties.

Traditionally, companies along the fashion value chain have operated independently of one another, focusing on efficiency, speed and reduced cost. This must shift, with business relationships striving to build trust, reduce risks and generate rewards for all parties.

Lastly, the short time horizon of the fashion industry and the lack of formal commitments make the big investments needed for the low-carbon transition risky. Buyer commitments rarely extend beyond a season and internal planning horizons are typically five years or less. According to Better Buying,[36] more than two thirds of reporting companies have formal commitments lasting less than a year.[37] There is also a fear that buyer commitments to decarbonization could disappear completely during economic downturns or geopolitical shifts, adding further uncertainty.

5. Equity in regional transitions.

Woven through the findings are the difficulties faced in many apparel-producing countries, resulting from regulatory burdens and the slow transition to renewables.[38, 39] Coal remains heavily used in many apparel-producing countries.[40] Apparel manufacturing is heavily concentrated in countries like

34 Anner, (2018) 'The Sourcing Squeeze, Workers' Rights, and Building Safety in Bangladesh Since Rana Plaza', (University Park, PA: Penn State Center for Global Workers' Rights, March 22, 2018). Mark Anner, https://www.wiwiss.fu-berlin.de/forschung/Garments/Medien/2018-Anner-Research-Report-Binding-Power.pdf. $10 FOB (converted to Euro) is from Anner's research and was corroborated by interviewees. FOB prices for mass-market garments are often below €10 per item, with prices historically trending downward, not up.

35 Better Buying Initiative, (2023) 'Better Buying™ Index Report 2023', https://betterbuying.org/download/better-buyingtm-purchasing-practices-index-report-2023/?wpdmdl=2539&refresh=678e9273208b81737396851. In fact, less than half (44.3%) of manufacturers participating in the Better Buying Initiative surveys report that buyers covered all basic costs required to produce the order.

36 Better Buying Initiative, (2023) 'Better Buying™ Index Report 2023'.

37 Ibid. 72.6% reported formal commitments of less than a year.

38 Ritchie, (2020), 'What Are the Safest and Cleanest Sources of Energy?" Our World in Data', https://ourworldindata.org/safest-sources-of-energy.

39 Southeast Asia, a major fashion production hub, remains particularly dependent on fossil fuels. Ember, (2024) 'ASEAN's Clean Power Pathways: 2024 Insights' https://ember-energy.org/latest-insights/asean-insights-2024/#:~:text=ASEAN%20electricity%20demand%20grew%20by,entirely%20met%20by%20fossil%20fuels.

40 Hasanbeigi, Springer, and Wei, (2024) 'Low-Carbon Thermal Energy Technologies for the Textile Industry' Apparel Impact Institute (Global Efficiency Intelligence, LLC, August 2024), https://apparelimpact.org/wp-content/uploads/2024/08/Low-Carbon-Thermal-Energy-8.27.24.pdf.

Bangladesh, China, India, Pakistan and Viet Nam, making them highly exposed to the challenges of a net zero transition. This shift requires significant social and economic adjustments, as these economies are largely dependent on emissions-intensive manufacturing and production. Policy engagement and international cooperation are key, emphasizing equitable solutions that alleviate regional disparities, support producing nations in their transitions, and align with the principles of a just transition. This ensures that workers, communities and industries affected by the shift to a low-carbon economy receive adequate support, social protection and opportunities for sustainable development.

SOLUTIONS: COLLABORATIVE PATHWAYS FOR DECARBONIZATION

The next section highlights the direct and indirect cost challenges for three common decarbonization strategies. The report's conclusion further defines the transformation needed to unlock their full potential. This will require developing stronger partnerships, coordinated knowledge sharing, and robust government policies and incentives.

CHAPTER 2

UNLOCKING PROGRESS: ACCELERATING CORE STRATEGIES TO SUPPLY CHAIN DECARBONIZATION

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As highlighted in the previous section, the fashion industry faces multi-faceted economic barriers to supply chain decarbonization. This section delves deeper, analyzing the roadblocks within three high-impact climate strategies in the supply chain: advanced energy efficiency, 100% renewable electricity and the phase-out of coal for thermal energy demands.

This section does not cover all available approaches to supply chain decarbonization, for instance, it does not address heat pumps, low-carbon fibers and materials, or emerging solutions like thermal heat storage. Instead, it focuses on the strategies that manufacturers are most commonly engaged in based on the interview cohort, providing deeper insight into decarbonization from the supply chain perspective. We can assume manufacturers face similar barriers to other solutions, and thus, the findings are more broadly applicable.

It is important to note that the potential impact of these three key strategies is significant. Achieving 100% renewable electricity, maximizing energy efficiency, and a complete coal phase-out could reduce over half of the industry's current emissions, according to some estimates.[41]

STRATEGY 1: ENERGY EFFICIENCY

Impact:	Medium to high
CapEx cost:	Low to High
OpEx cost:	Cost savings
Indirect costs:	Medium to high
Regulatory barriers:	Low

41 Sadowski, Perkins, and McGarvey, (2021) 'Roadmap to Net Zero'. This report by Aii and WRI notes that maximizing energy efficiency, achieving a 50% shift to zero carbon fuel for thermal processes, and 100% renewable electricity in manufacturing would mitigate nearly 600 million tonnes of CO_2, approximately 58% of the sector's total emissions (estimated at 1.025 million tonnes in 2019).

© PHOTO BY KRANICH17 FROM PIXABAY

First, we will examine roadblocks and opportunities for supply chain decarbonization in terms of energy efficiency. Most manufacturers begin their decarbonization journey with energy efficiency measures, as efficiency is an environmental priority and is fundamental to remaining competitive. The fashion industry has created numerous solutions and robust programs to improve energy efficiency to reduce GHG emissions, with a list of programs available in the Fashion Charter Climate Action Playbook.[42]

While energy efficiency is a common starting point, its full potential has yet to be realized. Manufacturers typically begin with 'low-hanging fruit' efficiency measures, such as heat recovery, leak detection and insulation improvements [see table 1], as these projects are relatively straightforward, offer clear benefits and have short payback periods. Interviewees who quantified their gains reported achieving emissions reductions of 5 to 18% from implementing these foundational measures.

Unlocking the deeper potential of energy efficiency requires a shift toward more complex, high-impact strategies that go beyond the essential basics and include projects like the replacement and upgrading of major machinery, as well as overhauling energy (heat) distribution systems. We refer to these projects as advanced energy efficiency, which have the potential to achieve up to a 50% reduction in the sector's overall energy use, according to some estimates.[43]

42 Fashion Industry Charter for Climate Action, (2020) "Climate Action Playbook" (United Nations Global Climate Action and Partnership for Sustainable Textiles), 64, https://unfccc.int/documents/250059.

43 Ley et al., (2021) 'Unlocking the Trillion-Dollar Fashion Decarbonization Opportunity: Existing and Innovative Solutions' (Fashion for Good (FFG) and Apparel Impact Institute (Aii), https://apparelimpact.org/wp-content/uploads/2024/02/Aii_UnlockingTheTrillion-DollarFashionDecarbonisationOpportunity_Report_v11.pdf.

To unlock advanced energy efficiency, many manufacturers need assistance on projects with **high upfront capital costs and long payback periods** (considering that any payback period beyond six years needs a strong business case). Interviewees cited interest in purchasing highly efficient state-of-the-art machinery and equipment. One interviewee in Pakistan was looking to purchase a €2 million fabric finishing machine that dramatically reduces emissions but has a payback period of well over 15 years. "This is where we need commitments to invest," they said. "Buyers can say they will give us business. In 15 years, when it pays off, everyone is in a win-win situation."

Some advanced efficiency projects entail **factory downtime or temporary slowdowns** for proper testing or adjusting to new processes, which can lead to lost productivity and revenue. A Tier 1 company was considering adopting an advanced waste heat recovery system to reduce its thermal energy needs, requiring new machinery, new piping and other system changes, which would involve shutting down production. "The ROI has to be clear because we would have to disrupt our production to install this new technology," they said.

Moreover, managing energy efficiency across multiple systems and production units is complex (one interviewee was pursuing 180 different energy efficiency measures) and requires **human resources and skilled labour support**. Some advanced projects require technical expertise, ongoing skilled maintenance and training on advanced equipment. Another interviewee faced skilled labour shortages when redesigning their ironing systems in Bangladesh and brought in foreign consultants at an added cost. Other manufacturers will need assistance to hire and afford such talent. Scaling brand, industry and national-level initiatives that take on some of the human resource burdens, such as energy audits and training, can help to overcome this issue.[44]

44 Apparel Impact Institute (Aii) Clean by Design and Climate Solutions Portfolio, GIZ's Renewable Energy and Energy Efficiency Programme (REEP), and Cascale's Decarbonization Program were all mentioned by interviewees as examples of initiatives that support with some human resource challenges related to energy efficiency. https://apparelimpact.org/climate-solutions-portfolio/; https://www.giz.de/en/worldwide/15127.html; https://cascale.org/tools-programs/impact-programs/decarbonization-program/

TABLE 1: Energy efficiency overview

Type of energy efficiency	Project examples	Payback period	Time and effort
Low-hanging fruit energy efficiency	• Metering and leak detection • Cooling water reuse • Recovering heat from hot water • Maintaining heat traps and systems • Recovering heat from exhaust gas and heating oil • Improving boiler efficiency • Improving insulation • Condensate collection and recovery • Compressed air optimization • Process and wastewater reuse	Short-term: less than 15 months[45] for most projects	Simple to complicated. Requires well-trained facility management and maintenance staff. Requires technical expertise and equipment to identify heat loss and suboptimal settings, as well as a partial system redesign for waste heat recovery options.
Advanced energy efficiency	• Heat system redesign • Boiler replacement/ upgrades • Wet process system redesign • Installation of new technology	Medium to long-term: 3–15 years or more	Complicated to highly complex. May require hiring consultants and expert project managers. Mechanical and industrial engineering skills are needed. Maintenance and repair costs may lengthen payback periods.

45 Clean by Design, Aii, CDP for For low-hanging fruit project examples and payback period: Apparel Impact Institute (Aii) and Climate Solutions Portfolio (CSP), “Clean by design.” Accessed October 21, 2024. https://csp.apparelimpact.org/solutions/clean-by-design.

STRATEGY 2: RENEWABLE ELECTRICITY

This next strategy will explore the roadblocks and opportunities for supply chain decarbonization within renewable electricity (RE). Electricity is essential to manufacturing and raw material production, powering machinery, lighting and cooling systems, and increasingly, systems like transportation and thermal energy that previously relied on fossil fuels.

While RE deployment is expanding rapidly around the world, a majority of the national grid electricity remains generated by fossil fuels globally, and coal is heavily used in many apparel and textile-producing countries.[46] However, strong industry demand for RE serves as a powerful signal to the public sector and market players, encouraging them to accelerate the grid's transition to renewable energy sources.

From a power buyer's perspective, various initiatives call for a transition to 100% RE consumption. For instance, the Fashion Charter calls on Signatories to source 100% of their electricity from renewable sources by 2030 for owned and operated Scope 2 emissions. Other industry initiatives advocate ambitious renewable electricity targets such as RE100,[47] a global corporate RE initiative bringing together hundreds of large and ambitious businesses committed to using 100% RE.

This section is organized into three subsections that explore roadblocks within manufacturers' primary pathways to adopting RE including **on-site renewables**, **corporate PPAs and EACs**. Green tariffs (also referred to as 'retail green electricity products) are not covered in this report as this solution was not referenced during the interviews with manufacturers.

2.1. ON-SITE SOLAR (SELF-FINANCED AND THIRD-PARTY FINANCED)

Impact:	Medium (typically this cannot cover 100% of power needs)
CapEx cost:	• Medium for self-financed • Low for third-party financed models
OpEx cost:	Cost savings
Indirect costs:	Medium to high
Regulatory barriers:	Low to medium

46 Ritchie, (2021) "Which Countries Get the Most Electricity From Low-Carbon Sources?," Our World In Data, https://ourworldindata.org/low-carbon-electricity-by-country. In Bangladesh – the second largest apparel exporter in the world – 98.5% of electricity is generated from fossil fuels, and across Southeast Asia, a major production hub, around 14.2% of energy generation was from renewables in 2022. There are notable exceptions, such as Costa Rica, Ethiopia and Portugal, where manufacturers benefit from nearly 100% renewable grids.

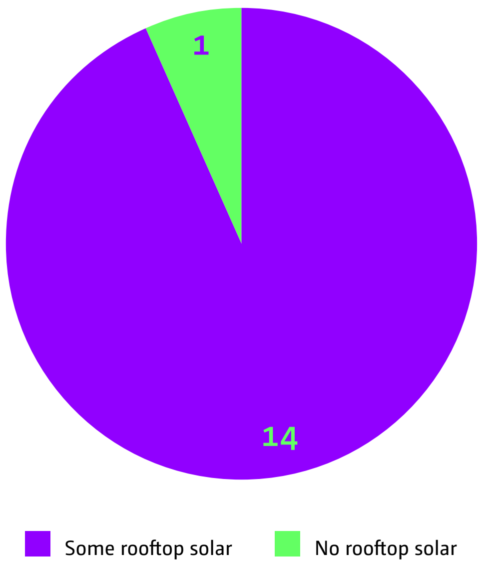
47 RE100, "About Us," accessed January 15, 2025, https://www.there100.org

On-site rooftop solar generation has relatively few barriers compared to the other approaches explored in this report and is widely adopted. All but one of the manufacturing companies interviewed have installed at least some on-site solar (see figure 3), using factories' untapped roof space and, in at least one instance, company grounds to build photovoltaic (PV) systems.

There are two main forms of financing models for on-site generation. **Self-financed** on-site solar means the company pays for the solar system upfront, owning and maintaining it themselves. This requires high initial investment but leads to long-term cost savings and enables full control over the system. **Third-party financed** on-site solar involves an external provider covering the installation costs in exchange for payments over time. This can be structured as a PPA or leasing model, where the company pays for the electricity generated rather than the system itself. While third-party financing reduces upfront costs, it may involve higher long-term expenses and also result in less control over the system compared to self-financing.

The cost of generating electricity via solar PV has dropped significantly and is competitive with local grid offerings in many contexts.[48] That said, CapEx is significant, as are the structural modifications needed to support the weight and the technical specifications of the panels on a factory roof. One interviewee's company paid around $1 million, to structurally prepare a factory for on-site solar. Given these high upfront costs, many manufacturers choose to partner with a third-party leasing company or enter into on-site PPAs, where available, rather than pursue self-financed solar generation.

FIGURE 3: **Adoption of rooftop solar by manufacturing companies.**
All but one company has installed some rooftop solar.



Source: Data from the sample.

48 Fashion Industry Charter for Climate Action, (2020) "Climate Action Playbook" (United Nations Global Climate Action and Partnership for Sustainable Textiles), 34.

Overcoming risks related to payback periods

There are various factors which influence the payback period of rooftop solar, including irradiance levels, roof space, local regulations (some of which limit roof space dedicated to solar) and physical aspects such as shadows from nearby buildings. As a result, the payback period of rooftop solar varies widely.[49] While payback is typically under six years, which is longer than desirable in textile manufacturing, manufacturers with longer payback periods may be reluctant to invest. One interviewee in Pakistan cited a payback period of eight years, and two others noted that the lack of **net metering policies** in Bangladesh's Export Processing Zones (EPZs),[50] which would allow factories to sell excess energy back to the grid and offset costs.

Feed-in tariffs: A feed-in tariff is an energy policy focused on supporting the development and dissemination of renewable power generation. In a feed-in tariff scheme, renewable energy providers receive a price for what they produce based on the generation costs. This purchase guarantee is generally offered on a long-term basis and is typically shared with electricity consumers.[51]

Power purchase agreements: PPAs are long-term contracts between third-party renewable energy providers and buyers that allow the purchase of renewable electricity in addition to the renewable electricity attributes (such as EACs), typically at a discounted rate or a fixed price depending on the terms of the agreement.[52]

Net metering: Net metering is a policy that allows electricity customers with their own generation capacity (e.g. rooftop solar) to be financially compensated for the energy they produce that goes back to their utility company. Net metering is widely regarded as having an important role in the deployment of distributed generation, especially solar energy.[53]

49 For more information on local photovoltaic power potential, see Global Solar Atlas: https://globalsolaratlas.info/

50 Chowdhury and Aziz, (2023), 'Barriers and Opportunities for Scaling Up Rooftop Solar PV Systems in Bangladesh' (Dhaka, Bangladesh: Centre for Energy Research United International University).

51 United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), 'Low Carbon Green Growth Roadmap for Asia and the Pacific: Fact Sheet, "Feed-in Tariff' accessed January 17, 2025, https://www.unescap.org/sites/default/files/26.%20FS-Feed-In-Tariff.pdf.

52 United States Environmental Protection Agency (EPA), "Understanding Third-Party Ownership Financing Structures for Renewable Energy," RE Toolbox, accessed October 23, 2024, https://www.epa.gov/greenpower/understanding-third-party-ownership-financing-structures-renewable-energy.

53 Congressional Research Service, (2019) 'Net Metering: In Brief', https://crsreports.congress.gov/product/pdf/R/R46010.

Industry case study: Home goods retailer

The retailer has a program to scale up renewable electricity usage, targeting markets where it's difficult to access, including access to affordable energy attribute certificates (EACs) and PPAs.

The retailer provides a financing package for on-site renewable electricity generation.

Filling the gaps in on-site solar

Rooftop solar can often supply some of the electricity needed for homes and very light manufacturing operations, but many manufacturers require additional sources of electricity due to their much higher energy demands.

- **Among the nine manufacturers that provided data, on-site rooftop solar generated a median of 25% of companies' total electricity demand**, leaving a significant gap to fill.

Currently, batteries to store and use excess solar power are in most cases still prohibitively expensive although battery storage costs are predicted to continue to decrease,[54] and the industry should continue to monitor this trend. However, as with on-site solar, the feasibility of battery storage is site-specific and may not be as impactful for factories in regions with low irradiance levels and high electricity demands (as in these cases, there is less excess energy to store).

To fill the gaps in RE needs, manufacturers can turn to other solutions such as contracting corporate PPAs with a private third party for the procurement of RE or claim the environmental attributes of renewables by procuring unbundled EACs.

2.2. OFF-SITE POWER PURCHASE AGREEMENTS

Impact:	100% of electricity-related emissions
CapEx cost:	None
OpEx cost:	Varies
Indirect costs:	High
Regulatory barriers:	High (e.g. contract negotiations, legal barriers)

54 Cole and Karmakar, (2023) 'Cost Projections for Utility-Scale Battery Storage: 2023 Update', (National Renewable Energy Laboratory, 2023), https://www.nrel.gov/docs/fy23osti/85332.pdf

PPAs are long-term contracts between third-party renewable energy providers and buyers that allow the purchase of RE in addition to the RE attributes (such as EACs) at a discounted rate or a fixed price.[55]

From a climate action standpoint, PPAs can be preferable and more impactful to purchasing unbundled EACs, which are discussed in the next section, because their long-term structure can help contribute to new renewable energy project development, or what is known as additionality. **Additionality** refers to a method of assessing the quality of emissions reduction projects by stipulating that the project "would not have happened anyway."[56] While not all PPA projects contribute to additionality, new-build projects funded by a PPA contract often fit this description. There are different types and structures of PPAs, such as **physical** and **financial PPAs**.

Additionality is a quality criterion for emissions reduction (offset) projects stipulating that the project would not have been implemented in a baseline or 'business as usual' scenario. Additionality is often applied to GHG project activities, stipulating that project-based emission reductions should only be quantified if the project activity "would not have happened anyway" i.e. the project activity would not have been implemented in its baseline scenario.[57]

EACs are market-based instruments representing the property rights or environmental attributes of RE generation, typically one MWh, and can be traded separately from the physical electricity (unbundled) to enable an RE sourcing claim.

A **physical PPA** contracts for the purchase of power and associated EACs from a specific renewable energy generator (i.e. the seller) to a purchaser of RE (i.e. the buyer).[58] The project may be located on-site or off-site, with the electricity being delivered via the grid to the manufacturing facility.

A **financial PPA** (also known as a virtual or synthetic PPA or 'contracts for differences) is a contract in which a generator and purchaser agree upon a predetermined reference electricity price (also called a 'strike price'), but the power is sold into the local wholesale electricity market near the generator rather than directly to the power purchaser.[59]

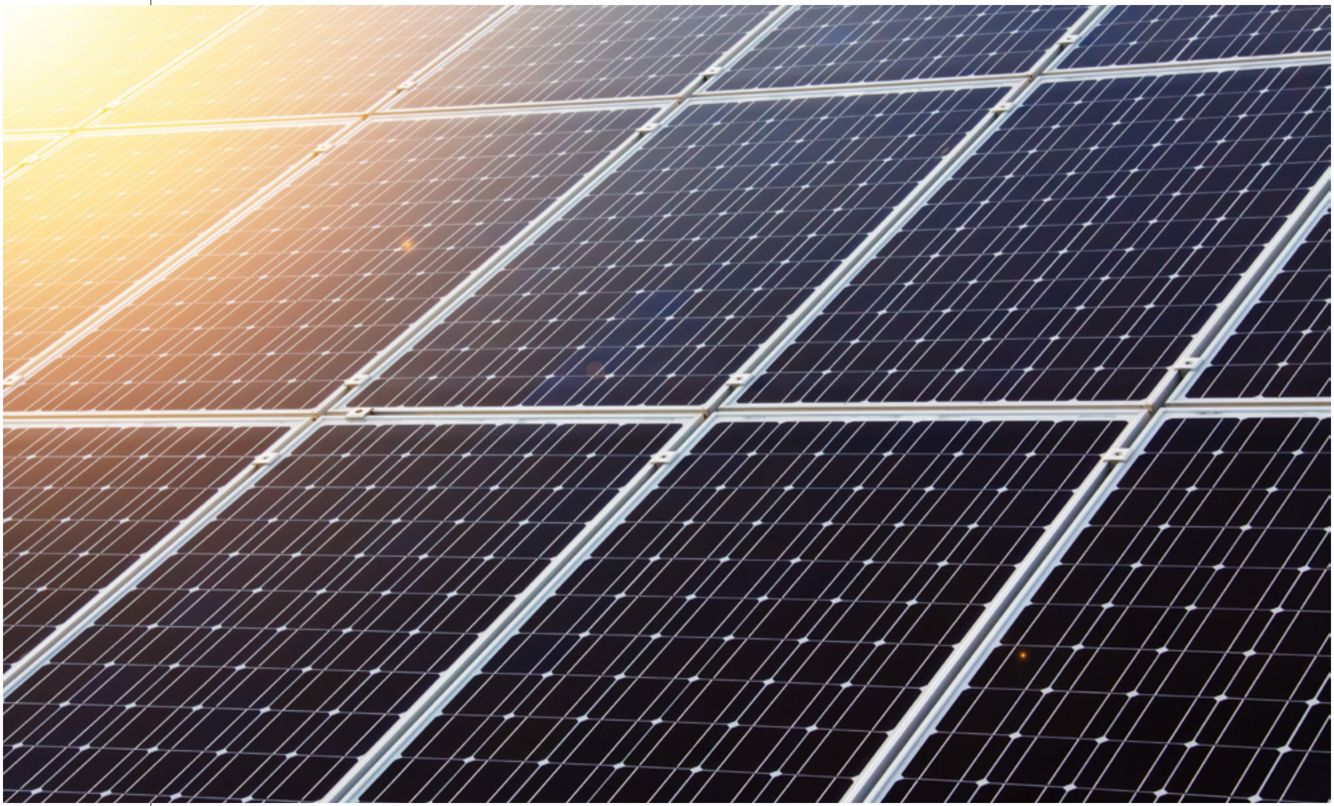
55 United States Environmental Protection Agency (EPA), "Understanding Third-Party Ownership Financing Structures for Renewable Energy," RE Toolbox, accessed October 23, 2024, https://www.epa.gov/greenpower/understanding-third-party-ownership-financing-structures-renewable-energy.

56 EPA, "Guide to Purchasing Green Energy," Additionality.

57 EPA, "Guide to Purchasing Green Power: Glossary," Physical PPA.

58 Ibid.

59 EPA, "Guide to Purchasing Green Power: Glossary," Financial PPA.



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Systemic barriers to PPAs

PPAs are not yet available in all production regions. The majority of countries with high market maturity for corporate PPAs are in the European Union and the Americas, with India and China being two notable exceptions in apparel production countries.[60] PPAs require significant changes in laws, as well as infrastructure to accommodate renewable energy.

Policies are shifting in some countries. A DPPA policy was recently approved in Viet Nam, enabling large energy consumers to buy RE directly from private energy manufacturers.[61] Interviewees were waiting on details regarding pricing mechanisms before entering into agreements, with some predicting that it could take a few years for the legal frameworks to be finalized. The DPPA in Viet Nam provides a noteworthy example of cross-sector coordinated efforts, as many companies in different sectors and governments have pushed for its approval.[62]

Moreover, manufacturers highlighted that they were dedicating significant time to policy engagement efforts to support the introduction and expansion of PPAs, recognizing them as a crucial mechanism for increasing access to renewable energy and driving decarbonization. By providing more incentives to manufacturers to decarbonize, companies can justify investing in more human resources to support and accelerate this work.

60 EY, (2024) 'Renewable Energy County Attractiveness Index: Corporate Power Purchase Agreements, "PPA Index,'63rd ed., https://www.ey.com/content/dam/ey-unified-site/ey-com/en-uk/insights/energy-resources/documents/ey-recai-63-ppa-index-06-2024.pdf.

61 U.S. Department of State, (2024) 'Vietnam Approves Direct Power Purchase Agreement – A Win for Clean Energy' media note, https://www.state.gov/vietnam-approves-direct-power-purchase-agreement-a-win-for-clean-energy/.

62 Ibid.

Industry case study: Multi-brick and mortar retailer

The retailer offers preferred status to manufacturers that participate in its programme to cut GHG emissions, promising participants continued or increased business from the company.

The retailer partners with banks to offer improved financed terms on approved projects that reduce emissions. The program caters to SMEs to fill in gaps faced by smaller companies.

The retailer offers early payments on invoices for financing linked to manufacturers' climate targets and progress.

The retailer assisted five of its brand and retail vendors to enter into a PPA in the United States for competitively priced renewable energy.

Case Study: Fashion Retailer

The retailer helps expand renewable energy access via PPAs in European markets.

The retailer provides manufacturers with a list of EAC schemes for renewable electricity claims.

The retailer engages in policy work to advocate renewable energy transition in garment-producing countries where roadblocks are high.

The retailers run a financing program with attractive terms for projects that reduce emissions in the supply chain.

PPAs offer capital savings in comparison to self-financing solar as they require no upfront investment from manufacturers. Another major advantage is the pricing: many are structured to offer pricing that is lower than local grid electricity[63] and some offer a locked-in price or discount on electricity.

However, it is important to note that cost savings are not guaranteed in every context or under every PPA arrangement. For example, one interviewee noted that entering a PPA in China would be four times more expensive than the EACs they previously purchased.

There was also concern among some interviewees that electricity acquired under the DPPA in Viet Nam may be more expensive than grid electricity.

A major roadblock is that PPAs are long-term legal contracts (as are leasing arrangements for rooftop solar), typically ranging from 10 to 25 years.[64] While the long-term nature of renewable contracts gives RE developers the stability they need to invest in green energy projects, the long timeframe is at odds with the fashion industry's traditional business horizon. Several interviewees noted that PPAs are currently a "hard sell" to their managers for this reason.

63 Ley et al., (2021) 'Unlocking the Trillion-Dollar Fashion Decarbonization Opportunity'

64 Retail Industry Leaders Association, Onsite Power Purchase Agreements, prepared by Schneider Electric, accessed January 15, 2025, https://rilastagemedia.blob.core.windows.net/rila-web/rila.web/media/media/pdfs/rcc/onsite-ppa.pdf?ext=.pdf.

2.3. UNBUNDLED ENERGY ATTRIBUTE CERTIFICATES

Impact:	Depends on additionality
CapEx cost:	None
OpEx cost:	Medium (increased costs)
Indirect costs:	Low
Regulatory barriers:	Medium

EACs are market-based instruments representing the property rights or environmental attributes of RE generation, typically one MWh, and can be traded separately from the physical electricity (unbundled) to enable an RE sourcing claim. There are a variety of EAC schemes: international renewable energy certificates (I-RECs) are available worldwide, Guarantee of Origin (GO) energy certificates are available in Europe, Renewable Energy Certificates (RECs) cover the United States and Canada, and Green Electricity Certificates (GEC) are available in China, to name a few. Interviewees mostly referred to RECs in their interviews, as the terms EACs and RECs are often used interchangeably. To avoid confusion, the terms EACs or 'certificates' are used in the remainder of this report.

Unbundled EACs are a widely used climate strategy for several reasons: they involve no upfront capital costs, require no changes to production processes, and do not demand high levels of specialized skills or expertise (however, managing certificate purchases for companies that operate in multiple countries is resource intensive). Additionally, since manufacturers often cannot meet all their electricity needs with on-site renewables and PPAs are unavailable in many situations, unbundled certificates provide a practical alternative by allowing companies to source RE.

EACs do not represent the physical purchase of RE and are separate from a company's electricity procurement for operations, which is why they are often referred to as 'unbundled EACs' when purchased independently from energy supply contracts.[65] Instead, certificates represent the purchase of electricity's environmental *attributes*. Thus, purchasing unbundled EACs does not de facto contribute[66] to **additionality**, and for instance some are issued from years-old projects. As a result, EACs are criticized as a form of greenwashing or offsets,[67, 68] as companies continue to use grid electricity, often sourced from fossil fuels, while claiming 100% renewable energy through certificate purchases.

65 RE100 Climate Group and CDP, (2022) 'RE100 Technical Criteria', https://www.there100.org/sites/re100/files/2025-01/RE100%20technical%20criteria%20%2B%20appendices.pdf.

66 Brander, Gillenwater, and Ascui, (2018) 'Creative Accounting: A Critical Perspective on the Market-Based Method for Reporting Purchased Electricity (Scope 2) Emissions', Energy Policy 112 (January 1, 2018): 29–33, https://doi.org/10.1016/j.enpol.2017.09.051.

67 Bjørn et al., (2022), 'Renewable Energy Certificates Threaten the Integrity of Corporate Science-Based Targets' Nature Climate Change 12, no. 6: 539–46, https://doi.org/10.1038/s41558-022-01379-5.

68 Osaka and Haymond, (2023) 'Buying Renewable Energy Doesn't Mean What You Think' Washington Post, https://www.washingtonpost.com/climate-environment/2023/06/21/renewable-energy-credits-certificates-greenwashing/.

However, there are rules of good sourcing practice to increase credibility of sourcing EACs. The GHG Protocol Scope 2 Guidance,[69] outlines key quality criteria for sourcing EACs, ensuring they credibly support RE claims. These include market boundary criteria (certificates must be issued and redeemed within the same geographic region as consumption), attribute specificity (certificates must contain clear information on generation technology, location and vintage), and exclusive ownership and claims (EACs must be uniquely retired for a specific entity to prevent double counting). Additionally, the guidance emphasizes sourcing from recently generated renewable energy (vintage requirements) and ensuring that EACs align with regulatory frameworks or recognized voluntary standards.

Cost barriers to EACs

EACs are a cost to manufacturers **on top of existing energy costs**. Costs vary widely based on national regulations, technology, and supply and demand but are generally well under €2 per megawatt-hour (MWh) in many of the production countries in the research. Based on interview responses, I-REC prices are around €0.30/MWh for solar in Brazil, €0.20/MWh for hydro in Türkiye, and €1/MWh for hydro in Malaysia as of April 2024.[70] One manufacturer shared their certificate costs for 2022 in three production countries as around €2/MWh in Thailand, around €1/MWh in Viet Nam, and €0.50/MWh in China.

There are **regions where certificates are much costlier**. Taiwan Province of China is one of the most challenging places to access affordable RE in the world, as high demand from the semiconductor industry has driven up prices.[71] A Tier 2 company noted that purchasing 100% RE via Taiwan Renewable Energy Certificates would cost them an additional €831,000 USD. The price of EACs can be somewhat volatile depending on the sourcing region and regulatory risk is also a factor. For example, China has phased out the use of I-RECS in favour of its national system, Green Electricity Certificates (GECs). As a result of this regulatory shift, one Tier 2 company noted that GECs would cost them four times more than I-RECs.

There is evidence that many manufacturers are willing to incur the costs of certificates in many contexts, in part because they require relatively few indirect or human resource costs compared to other decarbonization solutions. Many interviewees felt that certificates were an affordable and simple way to meet RE goals in comparison to other strategies, underscoring **how human resources and other indirect costs are factored into their decarbonization road maps alongside direct costs**. Incentivizing manufacturers to prioritize solutions like on-site generation or PPAs, where available and feasible, is key, as these options support additionality, mitigate price premiums and enable long-term commitments to renewable energy.

69 Greenhouse Gas Protocol,'GHG Protocol Scope 2 Guidance', World Resources Institute, accessed January 14, 2025, https://ghgprotocol.org/sites/default/files/2023-03/Scope%202%20Guidance.pdf.

70 Brunetti, (2024) 'Understanding Demand: Global Volumes and Prices - Where Are Markets Heading? (includes IREC, N. America, UK)', S&P Global Commodity Insights, April 2024, https://recmarket.eu/wp-content/uploads/2024/04/Session-7B_Brunetti.Bruno_.pdf.

71 Chung-Hua Institution for Economic Research (CIER) and European Chamber of Commerce Taiwan's Low Carbon Initiative (LCI), (2023) 'Taiwan Energy Market Briefing: Net-Zero Plan and Aggregated PPAs', RE100, https://www.there100.org/sites/re100/files/2022-12/Taiwan%20Market%20Briefing%2005.12.22.pdf

Case study in action: A garment manufacturer seeks to expand renewable electricity in Bangladesh

A Tier 1 manufacturer with facilities in Africa, Asia and the Middle East has made progress in emissions reduction, including installing 10 MW of rooftop solar. However, they have encountered significant barriers in Bangladesh, challenging the company's ability to scale renewable energy and efficiency measures. Their challenges and desired solutions are outlined below.

Challenges and progress:

- Solar projects in Jordan benefit from conducive policies, while efforts in Bangladesh are constrained by limited access to net metering in EPZs and high import duties on solar panels.
- Structural limitations in older facilities hinder the installation of additional solar capacity despite efforts to retrofit.
- Energy efficiency upgrades are slowed by a shortage of skilled labour.

Manufacturer's proposed solutions:

- Buyers could co-invest in retrofitting facilities to enable expanded solar installations and support the financing of further energy efficiency upgrades.
- Buyers and manufacturers could work together to foster local skill-building programmes for engineers and technicians to enable energy efficiency projects.
- Buyers and manufacturers could work together to support policy changes in Bangladesh, including net metering, PPAs and duty-free solar imports.

STRATEGY 3: COAL PHASE-OUT AND DECARBONIZING THERMAL ENERGY

Coal is the most emissions-intensive fossil fuel,[72] and phasing it out is one of the most vitally important climate goals for the fashion industry. However, phasing out coal is no small task. Coal is the traditional energy source used in apparel and textile mills for thermal energy – or heat energy[73] – for processes like the dyeing, bleaching and printing of fabrics, as well as de-sizing and adding water-repellent features or softeners and other finishes.[74]

Processes that use coal-fired thermal energy are responsible for a significant portion of the fashion supply chain's carbon footprint. Among interviewees:

- One Tier 1 and 2 manufacturer's six coal-fired boilers in its dye house accounted for 70% of the company's annual GHG emissions.
- 22% of annual emissions of another Tier 1 and 2 manufacturer stemmed from a single coal-fired boiler.

Eliminating coal is a vital goal for decarbonizing thermal energy. A 50% reduction in Tier 1 and 2 coal usage could reduce the industry's total emissions by nearly 10%, according to some estimates.[75] Highlighting the importance of the phase out of coal, Fashion Charter Signatories have committed to phasing out coal as soon as possible and, at the latest, by 2030 in owned and supplier sites (Tier 1 and Tier 2 for brands and immediate sub-suppliers for producers).[76] Encouragingly, most interviewees using coal in their facilities have made some progress towards reducing or, in some cases, eliminating the use of coal.

Emerging technological alternatives to coal, such as solar thermal and thermal storage systems, offer promising pathways to decarbonization.[77] For example, thermal heat storage utilizes cheaper off-peak electricity which is stored as heat and used as needed.[78]

72 Ritchie, (2020) "What Are the Safest and Cleanest Sources of Energy?" Our World in Data, https://ourworldindata.org/safest-sources-of-energy.

73 Merriam-Webster, "Thermal Energy," in Merriam-Webster.com dictionary, accessed October 18, 2024, from https://www.merriam-webster.com/dictionary/thermal%20energy.

74 Hasanbeigi, Springer, and Wei, (2024), 'Low-Carbon Thermal Energy Technologies for the Textile Industry' https://apparelimpact.org/wp-content/uploads/2024/08/Low-Carbon-Thermal-Energy-8.27.24.pdf.

75 Sadowski, Perkins, and McGarvey, Roadmap to Net Zero.

76 Ritchie, "What Are the Safest and Cleanest Sources of Energy?"

77 Hasanbeigi, Springer, and Wei, (2024) 'Low-Carbon Thermal Energy Technologies for the Textile Industry', https://apparelimpact.org/wp-content/uploads/2024/08/Low-Carbon-Thermal-Energy-8.27.24.pdf.

78 Ibid.

Furthermore, efficiency and reducing the overall demand for thermal energy (for example, by capturing and recycling thermal energy or eliminating processes that need high heat) are also critically important, as demonstrated in the preceding section on energy efficiency. Several interviewees mentioned the potential of **energy service companies (ESCOs)** to help finance electrification through energy and cost savings as an essential solution.[79]

This section focuses on the three alternatives to coal most commonly cited among interviewees: 1) electrification of thermal energy demand, 2) fuel switching from coal to biomass, and 3) fuel switching from coal to natural gas. All three solutions come with specific financial challenges, with high upfront costs and, in certain cases, increases in operating costs.

3.1. ELECTRIFYING INDUSTRIAL THERMAL PROCESSES

Impact:	Varies, low to high
CapEx cost:	Varies, medium to high
OpEx cost:	Varies, savings to high
Indirect costs:	High
Regulatory barriers:	High

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79 U.S. Department of Energy, "Energy Service Companies," accessed December 10, 2024, https://www.energy.gov/femp/energy-service-companies#:~:text=Energy%20service%20companies%20(ESCOs)%20develop,costs%20at%20their%20customers'%20facilities.

Electrifying thermal energy demand has the potential to significantly reduce GHG emissions, provided that manufacturers have reliable access to RE. Some electric technologies are more efficient and offer energy savings,[80] which can further lower emissions. The success of this transition depends on both access to RE and the level of decarbonization of the local grid.[81] Expanding grid capacity will be necessary in many countries, as industrial heat demand accounts for roughly half of global energy consumption.[82]

There are several technological pathways to electrifying thermal energy, including using industrial heat pumps, electric boilers and electric process equipment for steps like drying, dyeing and heat setting.[83, 84] Among these, electric boilers were the most commonly discussed by manufacturers, and the findings focus on the cost barriers associated with transitioning from coal boilers to electric alternatives. Some manufacturers also mentioned process redesigns to reduce hot water requirements in the dry-processing phase, as well as waste heat recovery efforts.

Electrification for low-heat demands

Electrification is feasible and attractive for lower energy demand systems or facilities, especially where on-site solar generation can replace thermal energy. For example, some interviewees have successfully electrified processes like laundering and ironing, which require less intensive thermal energy. One Tier 1 manufacturer in Viet Nam switched their power steam systems for ironing from coal-fired boilers to electric boilers.

However, those with large thermal energy demands face significant financial barriers to electrification. Electrification of thermal energy entails replacing machinery, equipment and systems that are run on fossil fuel combustion with electricity-powered alternatives.[85] **Electrification of major thermal energy processes can create a double cost bind for manufacturers, as the equipment is capital intensive, and switching to grid electricity can increase operating costs, as electricity is more expensive than fuel and coal in most geographies**.[86]

In the case study below, a manufacturer operating in Viet Nam explored transitioning their boilers from natural gas to electricity but could not justify the large capital expenses and doubling operating costs. Moreover, this case study only covered a tiny portion of their total thermal energy demand.

Electrification is a long-term investment in a net zero future. Buyers and manufacturers should continue working together to identify funding for projects that make financial sense while understanding that solutions lie elsewhere for many large thermal energy consumers.

80 Hasanbeigi and Zuberi, (2022) ‘Electrification of Heating in the Textile Industry: A Techno-Economic Analysis for China, Japan, and Taiwan’ (Global Efficiency Intelligence and Textile Sustainability Hub), https://www.globalefficiencyintel.com/electrification-of-heating-in-the-textile-industry.

81 Ibid.

82 International Energy Agency, (2023), ‘Heat – Renewables 2023 – Analysis’, accessed October 24, 2024, https://www.iea.org/reports/renewables-2023/heat.

83 Hasanbeigi and Zuberi, (2022), ‘Electrification of Heating’.

84 Hasanbeigi, Springer, and Wei, (2024) ‘Low-Carbon Thermal Energy Technologies for the Textile Industry'.

85 “Electrification: What Is Electrification?,” IEA, accessed October 24, 2024, https://www.iea.org/energy-system/electricity/electrification.

86 Hasanbeigi, Springer, and Wei, (2024) ‘Low-Carbon Thermal Energy Technologies for the Textile Industry'.

Case study: Electrifying natural gas boilers for a Tier 2 company in Viet Nam

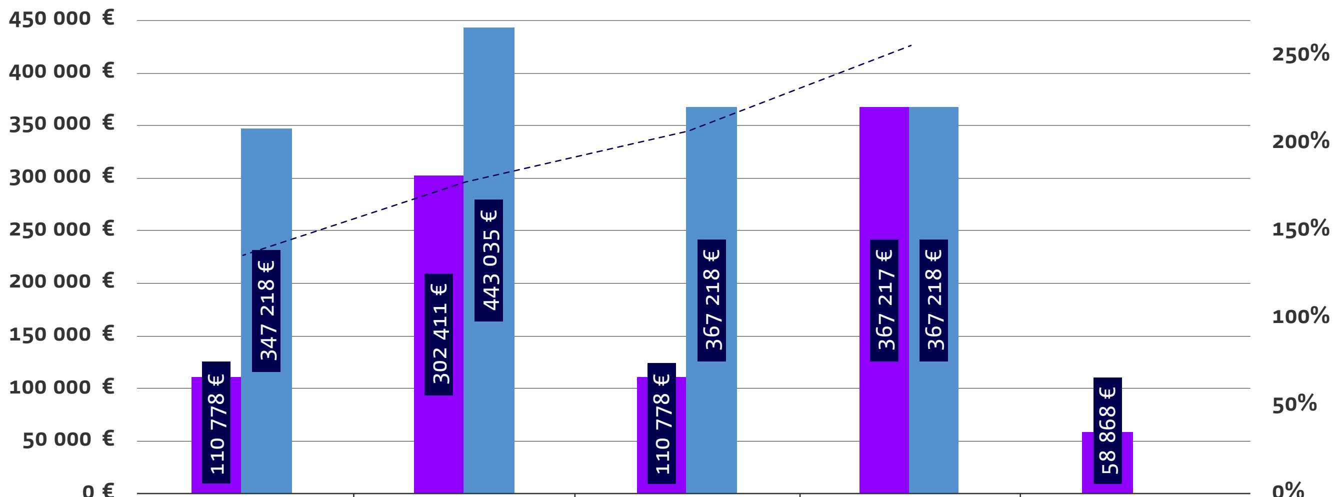
Challenge: A Tier 2 company with production in Viet Nam evaluated the costs of replacing its 1000 kg natural gas boiler with an electric boiler of similar capacity. Results showed CapEx to be twice as high on average and nearly six times higher when factoring in other auxiliary equipment (such as transformers to meet voltage specifications).

An electric boiler would almost double OpEx over a natural gas boiler, on average, using Viet Nam's grid electricity prices as the basis. Thus, the project has no payback.

Counterintuitively, if the manufacturer powered the electric boiler with the grid, the electric boiler would *increase* the company's greenhouse emissions by more than 270% compared to a natural gas boiler, as Viet Nam's grid is heavily dependent on coal.[87] The manufacturer is already using rooftop solar to meet some existing electricity demand and since DPPA rules are still being finalized, they cannot cover the added electricity load with renewable electricity.

Manufacturer's proposed solution: Buyers and the manufacturer could work together to identify funding for the capital investments in the electric boiler and waste heat recovery efficiency projects while offering price premiums. As Viet Nam's grid decarbonizes, these incentives could be scaled back and phased out.

FIGURE 5: Comparison of natural gas versus electric boiler (Viet Nam, Tier 2)



	Electric Boiler Brand #1	Electric Boiler Brand #2	Electric Boiler Brand #3	Electric Boiler Brand #4	Natural Gas Boiler Brand #1
Capacity	1000 kg	1200 kg	1200 kg	1200 kg	300 x 5
CO_2e emissions ton/year	720 t/yr	2,721 t/yr (+277.92%)*	2,721 t/yr (+277.92%)*	2,721 t/yr (+277.92%)*	2,721 t/yr (+277.92%)*

Boiler price   Boiler price plus transformer   Increased operating costs

**The increase in emissions is due to sourcing electricity from Vietnam's coal-dependent grid.*
Capacity: kg per hour of steam

87 "Viet Nam - Countries & Regions," IEA, accessed October 24, 2024, https://www.iea.org/countries/viet-nam. The country's energy mix includes 45.1% coal.

3.2. FUEL SWITCH: COAL TO SUSTAINABLE BIOMASS

Impact:	High (assuming carbon neutral or negative)
CapEx cost:	None to medium
OpEx cost:	Increased costs, medium
Indirect costs:	High
Regulatory barriers:	High

Another strategy to phase out coal is to switch fuels (also known as 'fuel switching') from coal to biomass or from coal to natural gas. Biomass offers manufacturers a relatively simple and cost-effective solution for phasing out coal, as many existing coal-fired boilers can be repurposed to burn biomass, thereby eliminating the need to invest in expensive new equipment.

Biomass is a biologically sourced fuel harvested from nature, such as in the form of agricultural waste like rice husks or straw, crops like eucalyptus grown explicitly for energy, and forestry products, meaning trees harvested for wood.[88]

Yet only some biomass sources can be considered carbon neutral, offering an impactful alternative to coal.[89] Biomass must be carefully sourced from carbon-neutral, sustainable sources that do not contribute to deforestation[90] or increase emissions. However, it is estimated that these carbon-neutral sources represent a minority of the global supply of biomass.

The World Resources Institute notes that sustainable biomass should be sourced using three principles: 1) prioritize wastes, residues, and by-products; 2) forestry wastes, residues, and by-products should come from ecologically managed forests; and 3) biomass crops should be limited to native perennial species on marginal lands.[91] Carbon Direct also outlines several core principles of sustainable biomass, including the commitment to strong governance and minimized harm to Indigenous Peoples.[92] Fashion Charter internal guidance advises Signatories to source biomass responsibly, requiring them to report on biomass emissions and justify any claims that biomass is carbon neutral.[93]

88 "Biomass Explained - U.S. Energy Information Administration (EIA)," accessed October 24, 2024, https://www.eia.gov/energyexplained/biomass/.

89 "Biomass and the Environment - U.S. Energy Information Administration (EIA)," accessed October 24, 2024, https://www.eia.gov/energyexplained/biomass/biomass-and-the-environment.php.

90 "Letter Regarding Use of Forests for Bioenergy," Environmental Paper Network (Letter to President Joe Biden, von der Leyen, Michel, Moon and Prime Minister Suga, February, 2021, https://environmentalpaper.org/biomass-library/letter-regarding-use-of-forests-for-bioenergy/.

91 Denvir and Leslie-Bole, (2024) 'Biomass Can Fight Climate Change, But Only If You Do It Right' World Resources Institute (WRI), https://www.wri.org/insights/sustainable-biomass-carbon-removal.

92 Carbon Direct, (2023) 'Sustainable Biomass Sourcing for Carbon Dioxide Removal', https://insights.carbon-direct.com/hubfs/Gated%20assets/Report_Sustainable-Biomass-Sourcing.pdf.

93 Fashion Charter for Climate Action, 'Setting 1.5 Degree Aligned Goals for the Fashion Charter Guidance to Interpret Charter Goals,' unpublished document, accessed October 24, 2024.

Sustainable biomass is not available everywhere and can require building a supply chain from scratch. Manufacturers noted they were able to access some certified, sustainable biomass in key production countries in Europe, as well as India, Sri Lanka, and the United States, but have struggled to access it in many other places, including Bangladesh, Indonesia, Mauritius and Taiwan Province of China.[94]

Industry case study: Multi-Brand Online Retailer

The retailer has made its sustainability and decarbonization guidance, along with case studies, available online as open-source resources for easy access.

The retailer has launched an incentive program to give more business to manufacturers that both provide their decarbonization plans and demonstrate progress towards targets.

Human resource barriers

Manufacturers are **committing substantial human resources to establish or further develop sustainable biomass supply chains**. A Tier 4 manufacturer transitioned much of their coal use to biomass in Thailand and Austria but has faced challenges in Indonesia, where a small biomass supplier struggled with funding and high transportation costs. A Tier 1 company in Bangladesh was vetting vendors to produce sustainable biomass briquettes. In contrast, another Tier 1 and 2 manufacturer in Viet Nam has focused on sourcing biomass with proper certifications for their dye house. Additionally, a vertically integrated manufacturer in Madagascar was supporting local foresters to obtain necessary biomass certifications.

Biomass is often used by households or other industries, making it challenging for manufacturers to secure sufficient supply, without endangering local markets. For example, one vertically integrated manufacturer in Mauritius aimed to replace a heavy fuel oil boiler used to produce steam for dyeing – a process accounting for 85% of their Scope 1 emissions. However, they estimated that it would take two to three years for a national biomass framework to unlock availability for industrial use.

Human resource and operational challenges also arise from burning biomass, which can generate dust and smoke, raising air quality and safety concerns for employees.[95] Addressing these issues might require specialized knowledge or new strategies to ensure a clean and healthy workplace.

94 Hasanbeigi, Springer, and Wei, (2024) 'Low-Carbon Thermal Energy Technologies for the Textile Industry', 22-23. Refer to this report for an overview of switching to sustainable biomass in major textile-producing countries.

95 Ibid, biomass can release local air pollutants such as volatile organic compounds, NOx, and particulate matter (PM)--and the ash can contain hazards and is difficult to dispose of responsibly in places with lower environmental standards.

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Cost barriers to sustainable biomass

The calorific value of biomass is generally lower than coal,[96] and modifications and shifts in operation modes are sometimes needed to burn biomass more effectively, which requires an upfront capital investment. **Capital costs vary widely, depending on the facility size, existing infrastructure and energy demands**.

For some manufacturers, modifying coal boilers can be relatively affordable, with one Tier 1 company estimating upgrades costing €58,000 in Viet Nam, for which they were able to access financing. For those requiring new equipment, costs are higher and vary significantly. A Tier 1 manufacturer noted that a medium-sized 5–10 tonne biomass boiler cost around €70,000, while another company estimated costs of €1.3 million per boiler for their larger operations, and they required six in total. Additionally, biomass storage can be capital intensive, as it must be kept dry and uncontaminated. A large Tier 4 manufacturer with high energy demands projected €5 million for biomass silos.

Sustainable biomass is **also increasing operating costs in some contexts, as it might entail administrative oversight, audits and certification fees**. In **Bangladesh**, a Tier 1 company switched from waste incineration as a thermal energy source to biomass, which increased operating costs. Forest Stewardship Council certified biomass in **Madagascar** has increased operating costs for one interviewee from 5 to 10%.

Prices can also be unpredictable. In **Viet Nam**, manufacturers face fluctuating prices linked to agricultural production, and the country exports much of its wood pellets, thereby reducing supply for domestic production.[97, 98] One Tier 1 and 2 company has struggled to fully transition from coal, citing “continuously rising and unsustainable costs” in Viet Nam. Another Tier 1 and 2 manufacturer estimated that using biomass to reduce coal usage by 50% would add 10 cents Euros per product to their operating expenses there. The company has not pursued the strategy as a result.

96 Suryaningsih, Nurhilal, Yuliah, and Mulyana, (2017), "Combustion Quality Analysis of Briquettes from Variety of Agricultural Waste as Source of Alternative Fuels," IOP Conference Series: Earth and Environmental Science 65: DOI:10.1088/1755-1315/65/1/012012

97 GIZ Energy Support Programme (ES), Vietnam’s Biomass Potential,” accessed January 15, 2025, https://www.esp.org.vn/news/vietnams-biomass-potential/.

98 Linh Bui-Duy et al., (2023) “Economic and Environmental Analysis of Biomass Pellet Supply Chain Using Simulation-Based Approach,” Asia Pacific Management Review 28, no. 4: 470–86, https://doi.org/10.1016/j.apmrv.2023.02.002.

Case study in action: A vertical manufacturer searches for sustainable biomass supplies in Pakistan

A vertically integrated manufacturer with facilities concentrated in Pakistan has achieved 20% renewable energy use and phased out most coal. However, challenges like limited biomass supplies, quality of biomass, cost of biomass, and high costs for machinery upgrades and the absence of PPAs hinder further progress.

Challenges and progress:

- The manufacturer has installed 12 MW of rooftop solar, covering 20% of its electricity demand. However, limited rooftop space and the lack of PPAs prevent further expansion.
- Upgrading older machinery to reduce energy use is costly, with long payback periods of 10–15 years. Inflation and currency fluctuations exacerbate these challenges.
- Thermal energy comprises 70% of this company's energy demand. The manufacturer has phased out coal and switched to natural gas but struggled to fully transition to biomass due to the cost and supply chain constraints.

Manufacturer's proposed solutions:

- Buyers could co-invest in structural upgrades to expand rooftop solar capacity.
- Providing financial commitments or price premiums for low-carbon products or production would help offset upfront costs for machinery upgrades and biomass boilers and support policy work to gain access to PPAs.
- Collaborating on pilot projects for sustainable biomass and incentivizing process innovations, such as low-heat dyeing, could further reduce emissions.

3.3. FUEL SWITCH: COAL TO NATURAL GAS

Impact:	Medium to high
CapEx cost:	Medium
OpEx cost:	Increased costs, medium
Indirect costs:	Medium
Regulatory barriers:	Medium

Natural gas is a fossil fuel that generally burns cleaner and emits roughly half the GHG emissions of coal (not counting methane).[99] In this context, the Intergovernmental Panel on Climate Change (IPCC) acknowledges that natural gas can serve as a transitional fuel for developing countries, offering a lower-carbon alternative to coal and oil. However, the climate impact benefits of natural gas can be overstated, as natural gas can leak significant methane during its production and transportation, releasing more powerful GHG emissions than coal.[100] The IPCC emphasizes that to achieve global climate goals, the use of natural gas must be accompanied by measures to mitigate its environmental impact, such as reducing methane emissions and implementing carbon capture and storage technologies. The IPCC also highlights the importance of aligning energy policies with sustainable development objectives, ensuring that the transition to cleaner energy sources does not compromise economic growth or social well-being in developing nations.

However, access to natural gas is not available in many garment-producing countries as its supply depends on national resources, regulations and infrastructure outside of manufacturers' control.[101] Moreover, in order to achieve net zero goals, the fashion industry must phase out natural gas by 2050. Manufacturers view natural gas as a coal alternative risk, locking in emissions for the lifespan of their combustion equipment, which typically lasts 15 years or more.

Nevertheless, for companies phasing out coal, natural gas may be a viable alternative, where available, depending on cost, regulatory constraints and accessibility. Further efforts to overcome barriers to alternative coal phase-out strategies are essential to reducing reliance on natural gas and redirecting investments towards other more sustainable solutions.

Cost barriers to natural gas

Switching from coal to natural gas requires purchasing new boilers and equipment or extensively modifying systems, as coal-fired boilers cannot be repurposed to burn liquid fuel. Costs vary based on the size and capacity of the boiler

99 Congressional Research Service, (2015) 'Life-Cycle Greenhouse Gas Assessment of Coal and Natural Gas in the Power Sector', CRS Report, https://crsreports.congress.gov/product/pdf/R/R44090.

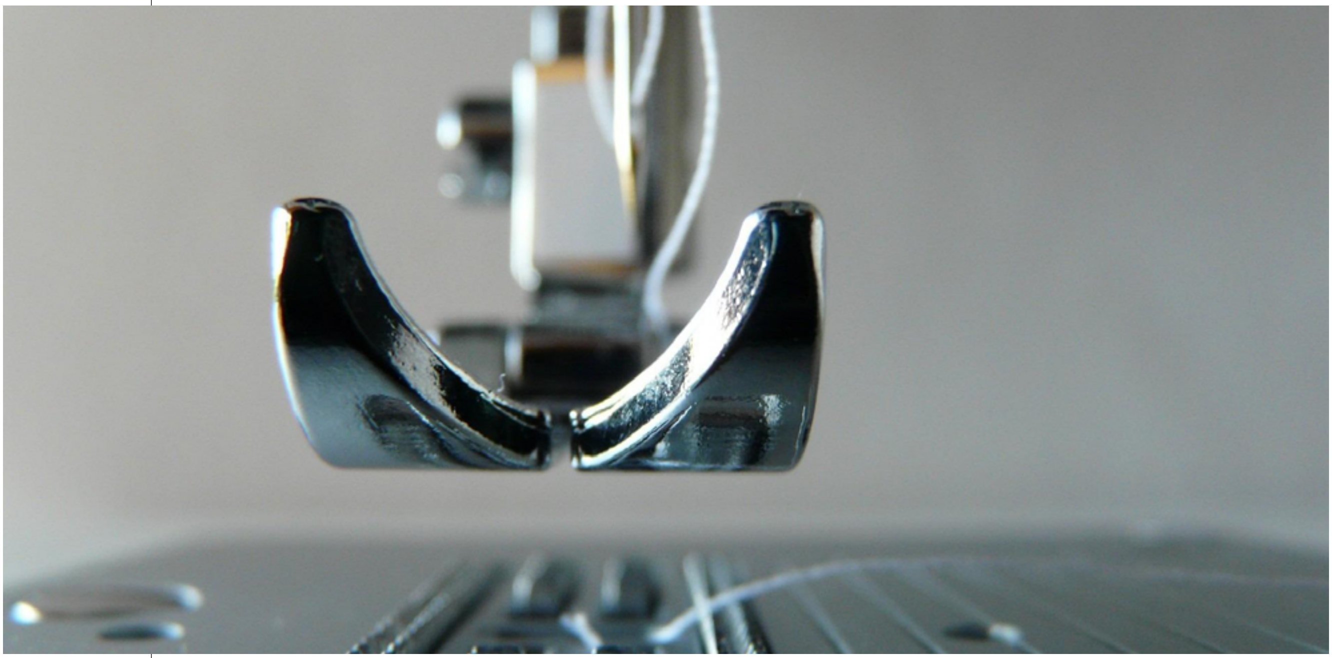
100 U.S. Energy Information Administration (EIA), (2021) "Electric power sector CO2 emissions drop as generation mix shifts from coal to natural gas," https://www.eia.gov/todayinenergy/detail.php?id=48296.

101 Apparel Impact Institute, (2024) 'Low-Carbon Thermal Energy Technologies for The Textile Industry', https://apparelimpact.org/wp-content/uploads/2024/08/Low-Carbon-Thermal-Energy-8.27.24.pdf.

(and energy demand), and a range of investments in natural gas boilers was given by interviewees. A Tier 2 manufacturer in Viet Nam noted that it cost €59,000 for a 15,000 kg natural gas boiler, but it would require about €690,000 to transition all of their coal-fired thermal energy to natural gas. Another company in the sample, a large Tier 4 manufacturer, cited a much larger figure, paying between €5 and 15 million each for their natural gas boilers, as they have significant thermal energy needs.

Natural gas increases operating costs in comparison to coal in most contexts.[102] One Tier 4 manufacturer that operates in eight countries (Austria, Brazil, China, Czech Republic, Indonesia, Thailand, the United Kingdom and the United States) said that OpEx on natural gas is twice that of coal in their operating contexts except in China, where costs are even higher. Another manufacturer made the switch from coal to natural gas in Pakistan, increasing their operating costs by approximately 20% or approximately 6 to 7 cents Euro per yard of fabric. Switching to natural gas can introduce pricing uncertainty and volatility. In Bangladesh, for example, acute natural gas shortages have pushed prices up.[103] In China, where energy markets are not liberalized, natural gas prices were nearly three times the average cost of coal supply in 2023.[104]

Transitioning from coal to natural gas can be a capital-intensive switch that raises operating costs, underscoring the financial difficulties of all the major strategies that manufacturers are using to pursue thermal energy decarbonization. Furthermore, costs associated with fossil fuels are expected to increase over the life of new combustion equipment as more countries look to implement carbon border taxes or put a price on carbon otherwise.



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102 Hasanbeigi, Springer, and Wei, (2024) Low-Carbon Thermal Energy Technologies, 58.

103 Zabbar Sakil and Ahmed, “Energy Price Fluctuations and Implications for Bangladesh,” The Financial Express, accessed October 25, 2024, https://thefinancialexpress.com.bd/views/energy-price-fluctuations-and-implications-for-bangladesh.

104 Reynolds, Doleman. Reynolds, Doleman. and Peh, (2024) ‘LNG Is Not Displacing Coal in China’s Power Mix’ (The Institute for Energy Economics and Financial Analysis (IEEFA)), https://ieefa.org/resources/lng-not-displacing-coal-chinas-power-mix.

TABLE 2: Manufacturers' key decarbonization strategies: roadblocks and impact

Strategy	Emissions reduction potential	CapEx cost	OpEx cost	Indirect costs	Regulatory roadblocks / constrained access
Energy efficiency: low-hanging fruit	Low to medium ~15%[105]	$	Cost savings	Low to medium • Skills needed include well-trained facility management and maintenance staff. • Technical expertise and equipment to identify heat loss, suboptimal settings and partial system redesign for waste heat recovery options.	Low
Energy efficiency: advanced	High ~35%[106]	$$-$$$	Cost savings	Medium to high • High skill levels are needed, including expert consultants and managers, and mechanical and industrial engineering skills are also needed. • Training on new equipment. • Human resources for planning and managing projects. • Opportunity cost of optimizing processes.	Low

105 Sadowski, Perkins, and McGarvey, (2021) 'Roadmap to Net Zero', Clean by Design estimates ~18% for its programs; assuming traditional techniques can achieve 15% energy and emissions savings in Tiers 1 through 3; based on Aii / WRI research.

106 The 50% figure is from Katrin Ley et al., 'Unlocking the Trillion-Dollar Fashion Decarbonization Opportunity'. We arrived at this number using the assumption that advanced energy efficiency can achieve as much as 50% energy savings. Noting that energy savings does not equate to emissions savings; this is a rough estimate. If traditional techniques achieve 15%, a balance of ~35% is left.

Strategy	Emissions reduction potential	CapEx cost	OpEx cost	Indirect costs	Regulatory roadblocks / constrained access
Renewable electricity: on-site solar PV (self-financed and PPAs)	Medium ~ 5–30%	$$* *covered by a third party under a PPA	Cost savings payback varies from medium to long	Medium to high For self-financed: • Skills needed (or hiring new employees) for solar PV system design. • Training of staff on operations and maintenance and handling system outage. For PPAs: • Skills are needed to ensure proper legal contracting and that both factory and developer interests are protected. • Legal contracts are long (10–25 years). • Proper training of staff once ownership of the rooftop system is passed to the factory.	Medium to high
Renewable electricity: off-site renewable PPAs (e.g. corporate PPA)	Depends on Tier • High for Tier 1 • Medium for Tier 2* *Approximately 75% of the energy demand in Tier 2 is for thermal energy; in Tier 1 it is approximately 20%. No data is available for Tiers 3 and 4. [107]	None	Varies* *Cost savings or higher costs, depending on the contract	High • Skills needed to assess the business case and ensure proper legal contracting and that both factory and developer interests are protected. • Skills and time are needed to research availability of PPAs and support governments in drafting and rolling out policies.	High* *Not yet available in many production regions
Renewable electricity: EACs	Low to medium Can address 100% of electricity-related emissions; this does not address thermal and might not address additionality.	None	Increased costs, low to medium	Low to medium • Generally easy to procure. • Mixed signals on whether these are acceptable GHG reduction mechanisms.	Medium

107 Sadowski, Perkins, and McGarvey, (2021) 'Roadmap to Net Zero'.

Strategy	Emissions reduction potential	CapEx cost	OpEx cost	Indirect costs	Regulatory roadblocks / constrained access
Coal phase-out: electrification of thermal energy	Depends on Tier • Medium for Tier 1* • Low to medium for Tier 2* Near-term increase in emissions if sourcing electricity from dirty grids or if there is limited access to PPAs. If grids transition to 100% carbon-free, then thermal heat can be decarbonized.	$$$	Increa-sed costs, medium to high	High • Newer technology can make hiring and maintenance challenging. • System modifications are needed. • Not all processes can be electrified.	High* *Grids infrastructure may not be able to take on large increases in electricity demand.
Coal phase-out: fuel switch: coal to sustainable biomass	30–130%[108] of thermal energy-related emissions Carbon neutral or negative source. This can raise GHG emissions if it is not sustainable.	$$	Increased costs	High • New boiler operations. • Different air emission pollution profiles and monitoring. • High risk of raising emissions. • Sustainable biomass certification/traceability. • New storage facilities.	High* *Sustainable supply chains are not available in many production regions.
Coal Phase-Out: Fuel Switch: Coal to Natural Gas	~50%* of thermal energy-related emissions Due to difference in emission factor.[109] Potentially zero savings in the long-term if methane leakage is not addressed.	$$	Increased costs	Medium • New boiler or boiler retrofits • New storage facilities • Mixed signals on phase-out because it is a fossil fuel	Medium* *Natural gas dependent on imports or local supply chains.

Note: The framework used to organize the data and interview responses was developed by the author. It is not a technical or peer-reviewed study but serves as an illustrative example of the challenges faced by the industry.

108 With carbon capture and storage after burning the biomass fuel.

109 Assuming natural gas is half as emissions-intensive as coal.

CONCLUSION: THE PARTNERSHIP APPROACH TO SUPPLY CHAIN DECARBONIZATION

Fashion supply chains are critical to ensuring a low-carbon future. As this report highlights, efforts by manufacturers to decarbonize their production face multi-faceted direct and indirect cost challenges, which are amplified by industry-wide issues and geographic disparities. Addressing these challenges requires a combination of industry-led solutions and supportive government policies.

It is important that each company commits to climate action and builds decarbonization into strategic partnerships. While many leading companies are actively working to reduce their impacts, sharing their knowledge with peers, and collaborating on solutions, progress is not being made fast enough. This report explores the barriers which are hampering quicker action, namely the need to address the direct and indirect cost barriers. However, rather than addressing the symptoms of the issue, this report advocates deeper, more meaningful changes.

There is a growing recognition of the need for partnerships to drive supply chain decarbonization. CDP and Boston Consulting Group (BCG) report that only four in ten companies engage with their manufacturers on climate-related issues, which include setting targets, sharing information and requesting data on progress. Yet these engagement strategies are outcomes from stronger partnerships and not the building blocks of partnerships.

In the research conducted for this report, manufacturers, brands and retailers mentioned several positive examples of a collaborative spirit in supply chain decarbonization, including:

- Providing training and guidance to help manufacturers access renewable energy in regions where it is difficult to source.
- Facilitating connections between manufacturers and energy efficiency programs, including subsidies for energy audits.
- Establishing industry initiatives that connect suppliers with low-interest financing options.
- Linking manufacturers with third-party renewable energy providers.
- Conducting and funding feasibility studies on sustainable biomass in collaboration with international organizations.

Additional Resources:

- **WBCSD & PWC**: “How to Create Beneficial Terms for Supplier Decarbonization”
- **CDP and BCG**: “Scope 3 Upstream: Big Challenges, Simple Remedies”
- **World Economic Forum Net-Zero Value Chain Support Hub**: “Engage and Support Your Suppliers”

110 WBCSD, ‘How to Create Beneficial Terms for Supplier Decarbonization’, in collaboration with PwC, accessed January 15, 2025, https://www.wbcsd.org/wp-content/uploads/2023/10/How-to-create-beneficial-terms-for-supplier-decarbonization.pdf.

111 Science Based Targets and Boston Consulting Group (BCG), (2024)’Scope 3 Upstream: Big Challenges, Simple Remedies’, https://cdn.cdp.net/cdp-production/cms/reports/documents/000/007/834/original/Scope-3-Upstream-Report.pdf?.

112 World Economic Forum, Net Zero Value Chain Support Hub: 3.4: Engage and Support Your Suppliers, accessed January 15, 2025, https://initiatives.weforum.org/net-zero-supply-chain-support-hub/3-4.

These actions show that the seed of partnerships has been planted. However, these actions do not fully address the systemic issues at hand to effectively deal with the direct and indirect costs associated with decarbonizing apparel and textile manufacturing. Important questions need to be addressed such as what are strong partnerships? What creates them and sustains them? How do companies effectively collaborate to build something which did not exist before? Partnerships are formed when there is a common purpose, and shared risk and rewards, and they are sustained through trust. We propose three action items which should occur concurrently to help build effective and stronger partnerships.

PROPOSED SOLUTIONS AND NEXT STEPS:

1. Approach partnerships for decarbonization in the same manner as commercial partnerships

Bringing a new, innovative product to market requires collaboration across value chain actors from brands to manufacturers, and across departments. To accomplish this there is a willingness for commercial partners to share resources and the costs of development. A similar approach towards decarbonization is required to unlock the business creativity and collaboration needed to bring entire supply chains to net zero. The fashion industry needs to create these new collaborative commercial models that unlock the creativity of business and explore different concepts of value chains. Establishing commercial relationships which embed decarbonization as part of the relationship will help ensure climate action is prioritized across departments. Some companies seeing the link between product innovation and sustainability, including brands and manufacturers interviewed, already link innovation and sustainability under the same department. Yet, the industry may not have fully realized the extent of these connections and how they can support decarbonization efforts. For example, the costs of decarbonization efforts can be built into new, innovative product launches. There is likely a higher willingness to pay for innovative products when the new product brings additional value to the consumer, such better performance, quality or thoughtful and sustainable design. Developing plans to phase out older products with newer versions that are net zero will also encourage value chain actors to favor and prioritize partnerships with companies taking climate action and reducing their emissions. This type of partnership on decarbonization would lead to outcomes such as:

- **Building decarbonization strategies into product design and innovation:** this approach will help build the net cost of decarbonization strategies into product costing models and encourage value chain actors to favor and prioritize partnerships built on investment in actions to reduce GHG emissions from energy use, as well as identifying impact reductions through thoughtful, more sustainable design.
- **Sharing resources, information and challenges:** strong partnerships share knowledge

and resources, and support each other through challenges. It is important that there is open communication and listening between value chain actors to support each other.

- **A 'whole of company' approach towards the partnership:** a partnership approach would embed responsibility for achieving climate action goals company-wide, rather than having it siloed in sustainability departments. Each department should have clear roles and responsibilities to meet in order to bring low-carbon products to market.

- **Establishing guidelines for low-carbon products:** an industry aligned definition of a low-carbon product from both a manufacturing and consumer use perspective should be developed utilizing a science-based methodology. Once the definitions are agreed upon then effort should be made to embed them into regulations.

- **Commit to fairness:** the roles and responsibilities for decarbonization should be embedded within value chain partner based on fairness of specialization to the problem. Each partner holds a key to the solution and can provide specialized knowledge or resources.

2. Develop country and regional forums for knowledge and best practice sharing.

Decarbonization costs and challenges are highly context-specific yet can also rapidly change. Therefore, companies need access to up-to-date country or region-specific knowledge, guidance, and training programmes that cover the current available strategies, technologies, case studies, and funding opportunities and should also include the different contexts in which manufacturers operate.

The following factors should be considered when organizing these forums:

- **Holding more multi-stakeholder forums on a more frequent basis:** the industry needs more frequent events that cover all regions, as well as some that have an individual country focus. Multi-stakeholder initiatives should coordinate their efforts to organize these forumsfor sharing pre competitive knowledge.

- **Varying the size of these forums from conference settings to workshops:** both types are useful, and each one can focus on specific audiences, from business leaders to technical managers involved in implementation.

- **Having platforms for up-to-date country and region-specific guidance and case studies:** the industry needs access to country or region-specific guidance that provides information on the available strategies, cost challenges and funding opportunities.

Unlike the commercial partnership approach, these forums help share knowledge to ensure all companies are aware of what is available to them in real time. Yet, investment is needed in order to maintain these forums. Multi-stakeholder initiatives, including the Fashion Charter, can and should take the lead in organizing these forums, and should collaborate with their partners to fund these forums, guidance documents, and case studies. Companies can benefit from positive outcomes from these types of forums such as:

- Real-time knowledge of the latest news, practices and available solutions.

- Real-time feedback on contextual challenges faced by companies.

3. Create robust industry-wide policies and incentives.

Consistent and clear policies and incentives should be developed for brands and manufacturers in order to reduce emissions. The two other action items previously mentioned highlight the need for the fashion industry to establish leading commercial partnerships and benchmarks for best practices for decarbonization. Governments can support these practices and partnerships through appropriate policies and regulations. Governments also need to know which effective policy and economic incentives are most helpful for companies to reduce their emissions. Some activities that the private sector can undertake to encourage effective policy and economic incentives include:

- **Organizing public-private forums:** these forums will deepen engagement between governments and the private sector through regional and global knowledge sharing of best practices, effective policies and incentives that encourage climate action. These forums should include producing country governments and manufacturers.

- **Advocating supportive policies:** these policies should align cross-industry efforts to incentivize renewable energy, expand PPAs and phase out coal across priority countries. The recent approval of a DPPA in Viet Nam is an example of a successful cross-sector alignment that could provide a road map for more coordinated policy engagement.

- **Research the development of an industry specific carbon market:** a global carbon price could help unify fragmented efforts, create a consistent cost for emissions across markets, and ensure fair competition. Research should be conducted into how carbon markets can be implemented in the industry and how their use can help to finance decarbonization efforts. Momentum is building to explore this solution, and the fashion industry's coordinated support is critical for it to succeed.

- **Partnering with governments on creative new financial models and markets:** when ROIs become challenging, governments, the financial sector and the fashion industry should work together to develop innovative financing models to scale newer technology and solutions which may cause higher OpEx. These new financing models would involve linking the financing of decarbonization solutions to the sales generated by bringing new products to market. In addition, carbon markets that include concepts such as insetting should be evaluated and piloted. Such models can help finance a manufacturer's decarbonization efforts by providing a revenue stream from the GHG reductions generated by those decarbonization efforts.

The purpose of this report is simple: to highlight the direct and indirect cost challenges that apparel and textile manufacturers are currently facing. There is growing recognition in the fashion industry of these challenges and steps are being introduced to address them. However, this report delves further into the issue and calls for the decarbonization challenge to be solved at the pre-competitive stage, and to also take into consideration how these costs can and should be built into commercial relationships and treated as a business innovation challenge between companies. This will help align purpose and share risks and rewards more evenly between companies, as well as creating an 'all of company, all of value chain' approach towards climate action.

ANNEX

LIST OF COMPANIES CONSULTED

4A Yarn Dyeing Ltd. (TEAM Group)
Aquitex
Artistic Milliners
CIEL Textile
Crystal Group
Elevate Textiles
Epic Group
Hansoll Textile Ltd.
HWASEUNG Enterprise
Lenzing
Maxport LTD
SLN Tekstil ve Moda San. Tic. A.Ş
TAL Apparel
YKK

Fashion for Climate