

[Original Article]

## Climate change messages in the fashion industry discussed at COP28

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### Abstract

The aim of this study is to investigate the fashion industry's response to climate change and how these discussions unfolded at the 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC). Climate change response projects by B Corp-certified fashion companies are examined, focusing on stakeholder efforts and reviewing online media reports. Text data were collected from web documents, interviews, and op-eds relating to COP28 from December 2018 to April 2024 and analyzed using text mining and semantic network analysis to identify critical keywords and contexts. The analysis revealed that the fashion industry is fulfilling its environmental responsibilities through various strategies, prompting changes in consumer behavior by advocating sustainable consumption, including carbon removal, energy transition, and recycling promotion. Stakeholders in online media and those present at COP28 discussed issues relating to climate change in the fashion industry, focusing on environmental protection, energy, greenhouse gas emissions, sustainable material usage, and social responsibility. Key issues at COP28 included policy and regulation, climate change response, energy transition, carbon emissions management, and environmental, social, and governance (ESG) standards. Additionally, by examining the main collections exhibited at the fashion show during COP28, the study analyzed how messages about climate change were conveyed. Fashion companies communicated the industry's response through exhibitions and fashion shows, suggesting a move toward balancing environmental protection and economic growth through the development of sustainable materials, the expansion of recycling and reuse practices, and the modern reinterpretation of cultural heritage.

*Keywords: conference of the parties 28 (COP28), sustainable development goals (SDGs), united nations framework convention on climate change (UNFCCC), climate change and fashion*

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## I. Introduction

In 2019, the Oxford Dictionary named 'climate emergency' as its word of the year, and The Times named Swedish environmentalist Greta Thunberg as its 2019 Person of the Year (Chung & Yim, 2020). This suggests that global warming and climate change are among the most significant challenges facing modern society.

The Paris Agreement stands at the forefront of global initiatives to address this crisis. A primary objective is to restrict the increase in global average temperature to well under 2°C compared to pre-industrial levels, necessitating a reduction in global greenhouse gas emissions by at least 28% from current levels. A 42% reduction is needed to limit the temperature increase to a more stringent 1.5°C (UNEP, 2019). Recently, the UN explicitly stated that the burning of fossil fuels is the primary cause of climate change and a direct contributor to rising greenhouse gas concentrations (IEA, 2023). This underscores the global challenge of reducing dependence on fossil fuels.

The fashion industry is a significant user of fossil fuels. Although there is a heavy reliance on fossil fuels for daily energy use and transportation, it is relatively less known that clothing is also made from fossil fuels (e.g., oil and gas). Polyester, nylon, acrylic, and polyvinyl chloride (PVC) — the main raw materials used in clothing — are fossil fuel-based (Nguyen, 2021). The production of synthetic fibers consumes as much oil each year as the entire country of Spain, and polyester production alone is equivalent to the annual oil use of 180 coal-fired power plants (Fossil Fuel Fashion, n.d.). Additionally, fossil fuels such as oil and coal are the primary energy sources for the apparel production process and product distribution (Reese, 2023). Furthermore, the Synthetics Anonymous 2.0 report highlights the overwhelming lack of transparency in the current synthetic fiber supply chain and criticizes brands for greenwashing by using slogans like ‘sustainable’ and ‘eco-friendly’ without committing to phasing out fossil fuel-based synthetic fibers (Changing Markets Foundation, n.d.).

COP28 is a critical international event that addresses global concerns and responses to climate change. Historically, the fashion industry has received relatively less attention compared to other major sectors such as energy, transportation, and agriculture during previous COP events. However, at COP28, the fashion industry emerged as a significant topic of discussion

(Pattinson, 2023). This shift underscores the industry’s substantial environmental impact, including energy consumption, carbon emissions, and waste management, as well as the growing interest in sustainable fashion. The discussions, exhibitions, and fashion shows at COP28 highlighted the fashion industry’s roles and responsibilities, marking a pivotal moment that emphasizes the need for new policies and regulations to guide the industry towards more sustainable practices.

This is evident from the world’s largest climate summit, the 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC), hosting the first sustainability-themed fashion show since the conference began (Arora, 2024). Given this timely context, it is necessary to further explore the challenges and opportunities in reducing the fashion industry’s dependence on fossil fuels and transitioning to a more sustainable direction. As various strategies and actions to reduce the fashion industry’s impact on climate change are emphasized, events such as the fashion shows at COP28 provide an important visual example of how the industry is changing. Therefore, this study aims to examine how the fashion industry is responding to climate change and how these discussions unfolded at COP28, the international climate change conference. By doing so, this study seeks to understand how sustainability efforts within the fashion industry are being integrated with global environmental policy.

This study aims to provide a comprehensive understanding of how the fashion industry is actively responding to climate change through COP28. By exploring specific initiatives, online media coverage, stakeholder discussions, and fashion show messages, this research seeks to offer practical and collaborative approaches for a sustainable future. It aims to thoroughly understand the industry’s strategies and challenges, contributing to the development of effective and sustainable solutions.

The research questions are as follows. First, this

study investigates the projects and campaigns undertaken by the global fashion industry to address climate change. By examining these initiatives, the study aims to uncover how various efforts are being implemented, providing valuable case studies that can inform other industries and policy developments. Second, this study analyzes online media coverage of the fashion industry's climate change agenda. Online media plays a crucial role in shaping public perception. By identifying the main themes and trends in online media reports, the study offers strategic insights into how sustainable practices within the fashion industry are communicated. Third, this study analyzes fashion-related discussions and events at COP28 through interviews and op-eds from stakeholders who participated in the conference. Capturing these discussions helps understand collaborative efforts and dialogues that shape sustainable practices within the industry. Finally, this study examines the major collections from the fashion shows at COP28 to analyze how climate change messages are conveyed. Fashion shows are powerful platforms for conveying messages and influencing consumer behavior. By analyzing the themes and messages in these collections, the study explores how the fashion industry visualizes climate change issues.

This study utilizes multiple types of media sources (e.g., industry case studies, online media coverage, and images from fashion events) to analyze the fashion industry's responses to climate change. It examines cases from B Corp-certified fashion companies, non-profit organizations, and environmental activists. To assess online media coverage of fashion and climate change, web documents, interviews, and op-eds were analyzed. Additionally, news articles and images related to fashion events at COP28 were collected to evaluate the fashion agenda at the conference. The analysis employed text mining and semantic network analysis (SNA). Text mining effectively integrates data from diverse sources and identifies key themes, while SNA visualizes the relationships between key-

words, highlighting influential factors. Through these methodologies, the study aims to comprehensively understand the fashion industry's responses to climate change and provide strategic insights for sustainable development.

## II. Theoretical Background

### 1. The climate change council and the fashion industry

The UNFCCC, adopted in June 1992 in Rio de Janeiro, Brazil, is an international agreement designed to reduce global warming caused by greenhouse gases. The 197 parties to the agreement — both developed (Annex I and II) and developing (non-Annex I) countries — have committed to reducing greenhouse gases according to their respective capabilities, a principle known as 'common but differentiated responsibilities' (CBDR). The purpose of the UNFCCC is to limit the emission of six greenhouse gases, including carbon dioxide, in the atmosphere to stop global warming (Kim & Ko, 2022). The problem is defined as 'climate change,' and there is an international consensus to control greenhouse gas concentrations at a point that prevents hazardous human-induced disruptions to the climate system.

The Conference of the Parties (COP) serves as a forum for nations worldwide to engage in discussions, conduct reviews, and make critical decisions required to accomplish the objectives of the UNFCCC. Under the expansive umbrella of the UNFCCC, global climate change governance is segmented into two primary regimes: the Kyoto regime, initiated by the Kyoto Protocol at the third Conference of the Parties (COP3) in 1997, and the new climate regime, derived from the Paris Agreement established at the 21st Conference of the Parties (COP21) in 2015. From 2020 onwards, the Paris Agreement will direct international efforts to address climate change (CTis, n.d.).

The Paris Agreement was adopted by 196 parties at COP21 in Paris on December 12, 2015. This legally

binding international treaty aims to keep the global average temperature increase to considerably below 2°C compared to pre-industrial levels, while striving to keep it below 1.5°C (UNFCCC, n.d.a; UNFCCC, n.d.b). Starting in 2020, nations have been presenting their climate action plans, called Nationally Determined Contributions (NDCs), in order to comply with the Paris Agreement. These plans specify the measures that nations will undertake to cut greenhouse gas emissions and describe the strategies they will implement to build resilience and adapt to the effects of climate change (Kim & Ko, 2022).

In December 2018, through the UNFCCC, fashion brands released a new 'Fashion Industry Charter for Climate Action,' which was signed by more than 130 global fashion brands, including LVMH, Nike, H&M, and Fast Retailing, the parent company of Uniqlo. These brands are implementing various pro-environmental policies to achieve their goal of reducing greenhouse gas emissions by 30% to 50% by 2030 (Hong, 2023). For example, LVMH has launched an in-house startup called Nona Source to prevent waste and effectively redistribute its high-end stock fabrics by selling them to small fashion brands and other companies. In addition, Uniqlo has implemented policies to improve logistics efficiency, install solar panels in new stores, and reduce water and energy use in processing.

The COP brings together representatives from 199 parties to discuss ways to limit global warming. During COP28 in 2023, the primary agenda focused on enhancing climate finance, speeding up the transition to clean energy, cutting greenhouse gas emissions, adapting to climate change, and promoting inclusiveness (UNFCCC, 2023). The initial global review of implementation specifically revealed that GHG emission reductions are falling short of the Paris Agreement targets. This underscores the need for enhanced mitigation efforts, including transitioning the energy system away from fossil fuels, expanding renewable energy capacity, and adopting zero- and low-carbon

technologies (Hwang, 2023).

Starting with the COP28 summit in 2023, fashion celebrities such as Stella McCartney and Ellen MacArthur, along with organizations like Fashion Revolution and Global Fashion Agenda, began to get involved. The panel discussion, "How to Clothe 10 Billion People Sustainably," invited influential figures from various supply chain sectors to explore viable solutions (Douglass, 2023a). Key takeaways from COP28 included the importance of EU policies and regulations in facilitating the shift to sustainability, the necessity of government incentives to address the financial costs of implementing sustainable solutions, and the recognition that the cost of obtaining sustainable certification can be prohibitive for small businesses, which should be supported in building due diligence systems (Douglass, 2023b).

In the context of the fashion industry, Sofia Kiani's campaign at COP28 highlighted the fashion industry's dependence on fossil fuels and the importance of using alternatives to synthetic fibers for an environmentally sustainable future. For example, Patagonia and Trillion Bees, through their "Bee the change" campaign, communicated their message with collections dedicated to protecting bees and other pollinators, highlighting the impact of the fashion industry's use of pesticides, habitat loss, and contribution to climate change on insects (Pattinson, 2023). In addition, fashion companies and brands such as Stella McCartney and LVMH have introduced plant-based and renewable materials (e.g., grape leather, cellulose sequins, and algae fibers), raising awareness of material innovation, smart design, and circular economy models (Kim, 2023).

For the first time, COP28 hosted a fashion show aimed at highlighting sustainability in the fashion industry. The show featured designers from around the world showcasing collections made from upcycled fabrics, biodegradable materials, natural dyes, and closed-loop production systems (AFI Insider, 2023). Additionally, companies such as Bestseller and H&M

have agreed to invest in Bangladesh's first offshore wind project, along with energy companies, to help increase access to renewable energy in manufacturing countries (Douglass, 2023a).

## 2. Climate change in fashion studies

Previous studies in the fashion field have extensively explored how climate change intersects with the industry's environmental impact, highlighting the necessity for sustainable practices and technological innovations. Key research areas include environmental impact, supply chain, consumer behavior, and technological solutions.

First, studies have highlighted the significant contribution of the fashion industry to climate change, emphasizing the importance of sustainable fashion practices. Niinimäki et al. (2020) highlighted the impact of the fashion industry on climate change by comparing overall fashion product production with the utilization of these products, which resulted in increased environmental waste and global warming. They argued that the current fast fashion business model encourages overconsumption and excessive waste generation. The study discussed several indicators of the fashion industry's contribution to environmental concerns, such as increased water consumption, carbon emissions, soil degradation, and micro-fiber pollution from synthetic textiles. They proposed solutions including sustainable design, better quality garments, and the development of circular systems. Bick, Halsey, and Ekenga (2018) examined the environmental and social costs of fast fashion, particularly environmental justice issues. Fast fashion's negative impacts disproportionately affect people in developing countries, causing environmental issues such as water pollution from textile dyeing and exposure to toxic chemicals. They linked fast fashion to global wealth inequality and exploitative labor practices, calling for greater regulation, industry reform, and consumer awareness to address these issues. Kalambura, Pedro, and Paixão (2020) further emphasize the need for a

circular economy through enhanced textile recycling and investment in recycling technologies.

Second, studies have explored the environmental role of sustainable practices in clothing production, from raw material sourcing to manufacturing and distribution. Li, Zhao, Shi, and Li (2014) explored sustainable supply chain management practices in the fashion industry by examining how fast fashion companies adopt governance mechanisms and identifying barriers to sustainable supply chain management, such as cost pressures and lack of supplier capability. They proposed a framework for sustainable supply chain governance in fast fashion. Bag, Rahman, Rogers, Srivastava, and Pretorius (2023) have shown that pressures from multinational enterprises (MNEs) and non-MNE customers play a significant role in influencing garment industry suppliers' compliance and commitment to climate change adaptation and disaster risk reduction goals. Additionally, the implementation of green supply chain management (GSCM) practices, such as responding to demands from buyers and adhering to government regulations, has been highlighted as crucial in the apparel manufacturing industry for mitigating negative environmental impacts and achieving long-term sustainability (Debnath et al., 2023).

Third, studies have investigated consumer attitudes towards sustainable fashion and factors influencing purchasing decisions. Lundblad and Davies (2016) explored consumer motivations for purchasing sustainable fashion through in-depth interviews. They found that consumers are driven by both self-oriented values, such as uniqueness, authenticity, and self-expression, and others-oriented values, such as environmental protection and social justice. The study suggested that marketing sustainable fashion should appeal to both types of motivations. Son (2017) analyzed the relationship between consumers' climate change awareness and climate-related fashion behaviors, indicating that groups with high climate change awareness were more likely to experiment with new

dressing styles and pursue ethical and functional fashion.

Lastly, studies have emphasized technological solutions to climate change in the fashion field. Technology innovation and digitalization play crucial roles in addressing the climate risk challenges posed by national industry operations (Baek, Lee, & Chung, 2023; Lee & Choi, 2024). In the fashion industry context, sustainable practices such as recycling technologies and product lifecycle extension strategies, coupled with advancements in digitalization, can significantly mitigate the environmental footprint of fashion production. Ikram (2022) introduced a theoretical framework aimed at enhancing the comprehension of how technological innovations can promote sustainable fashion and improve sustainability practices. This model suggests that sustainable fashion technologies can markedly decrease waste by utilizing advanced materials, products, and consumer experiences. Additionally, businesses that prioritize environmental consciousness can extend the lifespan of materials and reduce resource consumption.

From a perspective of fashion design, Lee and Park (2009) explored trends in multifunctional fashion design in response to climate change and environmental consciousness. They proposed multifunctional fashion designs that address these issues, suggesting the use of energy-saving materials and recycled clothing fabrics, the production of handmade products, and the creation of practical, multifunctional designs. Jang (2015) identified types and characteristics of fashion design that can adapt to climate change, categorizing them as functional, layered, seasonless, and crossover. Functional design involves applying materials, designs, and details derived from sports/outdoor wear to everyday clothing. Layered design expands usage according to season and climate through the proportion, color, and texture contrast of various items. Seasonless design features styles that transcend seasons in terms of color, material, and design. Crossover design allows for flexible dressing for various cli-

mates by mixing multiple styles within a single item or styling.

Previous research has extensively highlighted the multifaceted challenges the fashion industry faces in addressing climate change and sustainability. These studies have underscored the need for systemic changes across the entire lifecycle of fashion products, from design and production to consumption and disposal. Moreover, they have stressed the importance of balancing environmental and social impacts to achieve a more sustainable fashion industry. However, a few critical gaps remain unaddressed.

This study addresses the gaps in previous research by examining current initiatives, stakeholder perspectives, and communication strategies related to climate change in the fashion industry. While previous studies have focused on systemic changes, they have not sufficiently explored specific projects and campaigns. This study provides concrete examples and practices that can serve as models for other industry players. Additionally, previous research has lacked analysis on how the fashion agenda is addressed in international climate discussions. Since COP28, the fashion industry has gained attention in climate change discussions. To fill this gap, this study deeply explores current initiatives within the fashion industry. Lastly, the study analyzes how major fashion collections and shows communicate climate change messages, presenting examples of how sustainability can be concretely implemented in fashion collections.

### III. Research Methods

#### 1. Climate change and fashion projects and campaigns

The analysis of these cases emphasizes the integration of the fashion industry into global climate change discussions, particularly through events like COP28. This highlights the necessity for the fashion industry to engage in carbon reduction initiatives. In this context, B Corp certification plays a crucial role.

A ‘B Corp’ is a company certified by B Lab, a US-based non-profit organization, to be socially responsible, considerate of its stakeholders, and committed to both social and environmental performance alongside financial profit. To achieve certification, a company must complete a B Impact Assessment (BIA) with a score of 80 or higher out of 200. The assessment covers various areas including governance, workers, communities, environment, and customers. Examples of questions include the percentage of full-time workers, representation of vulnerable populations in management, monitoring of waste production, and assessment of customer impact. Companies then conduct a self-assessment and submit relevant documentation based on the B Impact Assessment (B Corporation, n.d.).

B Corp schemes share similarities with carbon neutrality initiatives in that they aim to promote environmental sustainability to combat climate change and emphasize transparency in accurately measuring and publicly reporting a company’s environmental impact. They require a commitment to prioritize long-term sustainability and environmental protection over short-term profits. This study examines examples from B Corp certified fashion companies to showcase current and impactful initiatives addressing climate change. Patagonia and Chloé, both B Corp certified fashion brands, were selected as case study subjects to illustrate substantial and impactful initiatives by fashion companies addressing climate change. A quick check of the fashion companies registered with B Corp reveals that some of the most prominent ones include Patagonia (February 2011), Maison Chloé (November 2018), TOMS (October 2021), Tomboy X (January 2022), and Camper Group (July 2022).

Among the B Corp certified brands, Patagonia and Chloé have conducted large-scale projects related to climate change. Patagonia has a longstanding commitment to environmental activism, demonstrated through initiatives like the ‘1% for the Planet’ program, which allocates 1% of sales to environmental causes, as well

as campaigns aimed at protecting public lands and minimizing carbon footprints (Patagonia, n.d.a). Chloé, on the other hand, has been recognized for its commitment to sustainability through its use of eco-friendly materials and its partnerships with environmental organizations (Chloé, n.d.a). These two brands have been B Corp certified longer than other brands.

Addressing climate change in the fashion industry involves not only companies but also individuals and non-profit organizations. In this regard, this study examined examples of fashion projects reported in the online media aimed at combating climate change. As a result, WWF Korea’s project in South Korea in 2020 and the campaign led by American environmental activist Sophia Kiani during COP28 in 2023 were selected as examples.

WWF Korea’s project was selected due to its credibility as an initiative led by an international environmental organization, ensuring high reliability and impact. WWF is globally recognized for its various activities aimed at combating climate change and preserving biodiversity. In particular, WWF’s efforts in 2020 included a range of global initiatives addressing the climate crisis, which are considered significant contributions to climate mitigation and adaptation (World Wide Fund, 2023). Additionally, WWF drives practical solutions to mitigate climate impacts through ecosystem restoration, sustainable agriculture, and renewable energy transitions in various regions (World Wide Fund, n.d.). Therefore, WWF Korea’s project, backed by the internationally recognized reliability and substantial contributions of WWF to climate action, was chosen for its high credibility and impact, making it a pertinent example in this study.

Sophia Kianni’s campaign was selected as a representative case in this study due to her significant influence and public recognition, particularly because of her prominent role as a young climate activist and founder of Climate Cardinals (Climate Cardinals, n.d.). Sophia Kianni is widely recognized for her impactful work in the climate change arena and serves as a

member of the UN Youth Advisory Group on Climate Change. She is also the founder of Climate Cardinals, a nonprofit organization dedicated to translating climate information into numerous languages to ensure global accessibility. Climate Cardinals strives to enhance the reach of the climate movement by making climate information available in over 100 languages (Firth, 2022).

Overall, the selection of these five research subjects was based on objective criteria including B Corp certification standards, online media coverage, and the prominence of the initiatives. The B Corp certification provides a reliable benchmark for evaluating a company's commitment to sustainability. online media coverage ensures that the projects have been recognized and verified by third-party sources. The prominence of the initiatives highlights their impact and relevance in addressing climate change. This approach ensures a comprehensive and credible analysis of how various actors in the fashion industry are responding to climate change.

To ensure the validity and reliability of this study, a mixed-methods approach using methodological triangulation was employed. In social science, triangulation has been employed to examine the same phenomenon by utilizing and integrating multiple data sources, research methodologies, investigators, and theoretical frameworks (Noble & Heale, 2019; Wang & Duffy, 2009). This approach combines quantitative methods, such as text mining and semantic network analysis, with qualitative methods, including case studies and interviews. By analyzing large volumes of

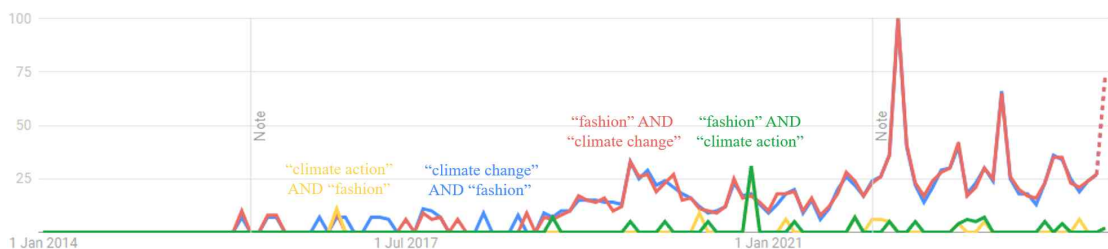
textual data, relationships between key themes and keywords were visualized, providing a broad understanding of the industry's response to climate change. Case studies of prominent sustainability initiatives by key organizations and campaigns, along with interviews and op-eds from key stakeholders, offered in-depth insights into specific strategies and motivations. This enhances the credibility of the research by addressing the problem from multiple perspectives, thus providing robust, comprehensive, and actionable findings for companies and policymakers.

## 2. Data collection and analysis

### 1) Unstructured data collection

To identify the main topics on climate change, this study collected web documents addressing climate change in fashion. This study checked the search volume of keywords containing 'climate change' or 'climate action' and 'fashion' simultaneously from 2014 to 2024 for global users on Google Trends. Fig. 1 shows a sharp increase in the search trend from late 2018 to early 2019. Therefore, this study set the collection period from December 1, 2018, to April 30, 2024, as the time when climate change topics increased in the context of fashion.

To analyze the overall discourse on climate change and fashion, data was collected from news and blog articles on Google, Naver, and other portal sites, including both titles and text information. This analysis aimed to identify key keywords and topics and understand the general trends in discussions related to



<Fig. 1> Google search trends for climate change fashion



climate change within the fashion industry. A total of 4,936 news and blog articles were collected.

Additionally, to study fashion at COP28, data was collected from the Google portal site, including interview articles, reviews, and images from COP28 participants, using search keywords like ‘COP28’ and ‘fashion’ combined with an ‘AND’ condition. Among the news articles, the research team personally verified and collected only those that were editorials or contained expert interviews. A total of 103 articles were collected in both English and Korean. These 103 articles were used to understand specific cases and the context of discussions on fashion and climate change addressed at COP28.

The selection criteria for images used in the analysis of designers and fashion shows are based on the presence of images and descriptions of the works in news or magazine articles about the COP28 fashion show, or the digital archiving of the works show-cased at the COP28 fashion show on the official websites of the designers or brands. The designers and image data that met these criteria include 18 images from Rami Kadi, 11 images from Shantnu and Nikhil (Indra), and 28 images from Gelareh Designs. From these, a total of 11 images were presented as representative images in the study. Descriptions of the designers and the formal characteristics of the works were compiled based on relevant news and magazine articles, as well as interviews with relevant parties.

## 2) Data analysis: Text mining and network analysis

This study used text mining techniques to explore online media discussions on the climate change agenda, environmental activism among fashion brands, and issues related to the fashion industry at COP28. Text mining is essential for handling large volumes of unstructured text data, allowing for the efficient extraction and analysis of relevant keywords from various news articles, event reviews, and stakeholder interviews. To understand the relationships and contextual usage of these keywords, semantic network

analysis was also employed. This combination provides a comprehensive view of the discourse, highlighting key themes and connections that might be overlooked with traditional analysis methods. Identifying major themes across the dataset, text mining and semantic network analysis together offer a robust approach that considers both quantitative and qualitative aspects, ensuring a thorough analysis of online media discussions.

This study used Python libraries such as StanfordNLP (Stanza) for English, KoNLPy (Kkma) for Korean, and Mecab-ko (MeCab.Tagger) analyzer for morphological analysis. The process involved several steps. First, the collected text data was tokenized, and part-of-speech (POS) tagging was applied to identify the grammatical structure of the text. This step was crucial for understanding the context and meaning of the words within the documents. Second, the text data underwent cleaning to remove numbers, punctuation, typos, redundant words, and similar words through word processing and stemming.

The search keywords were chosen based on their relevance to climate change and fashion, and data was manually verified to include only relevant articles. The frequency of each word in the dataset was calculated using a python library such as NLTK (word\_tokenize; stopwords; counter) to identify the most commonly used keywords. This involved counting the occurrences of each word and ranking them based on their frequency. Although the frequency of a particular word is important, frequent use implies commonality. Therefore, the Term Frequency-Inverse Document Frequency (TF-IDF) method was employed to evaluate word importance within the dataset (Choi & Choi, 2022; Choi & Yeom, 2024). TF-IDF is executed using the TfidfVectorizer in the scikit-learn library and is determined by multiplying a word’s frequency within a document (TF) by the inverse of its frequency across all documents (IDF) (Choi & Lee, 2024a).

To understand the context in which the keywords extracted from text mining are discussed together,

semantic network analysis (SNA) was applied. SNA is a method of analyzing the overall context by identifying emphasis and regularity through the frequency of word use and their relationships (Park & Leydesdorff, 2004). In network analysis, centrality metrics such as degree centrality and betweenness centrality were used to identify important influential factors in a context (Choi, 2021; Choi & Lee, 2020). Degree centrality measures the popularity or influence of a node, while betweenness centrality identifies keywords that control the discourse. Additionally, ego network analysis, a specific form of SNA, was used to investigate the connections around key topics, focusing on individual influence, key relationships, connectivity patterns, and network properties.

The primary goal of this study was to identify various keywords (concepts) and topics discussed at COP28 in relation to the fashion industry and to explore the connections between these keywords. While topic modeling could have been utilized, it has limitations in analyzing the interactions and connections between specific keywords. In contrast, SNA is more suitable for analyzing such data as it focuses on the connections and interactions between keywords, allowing for a clearer understanding of their interrelationships. For this reason, SNA was selected as the method for analyzing this data. In previous studies on text mining and semantic network analysis, the top 50 to 100 keywords based on frequency are typically selected as core keywords to ensure visibility and representativeness (Choi & Choi, 2022; Choi & Lee, 2024b). Following this approach, this study also utilized the top 100 keywords based on frequency for the analysis.

When analyzing keywords under the broad theme of climate change and the fashion industry, high-level keywords such as climate change, carbon emissions, and greenhouse gases appear in almost all texts. Utilizing topic modeling would result in these common keywords appearing across all topics, making it difficult to distinguish between them. In contrast, SNA

visualizes the interconnections between keywords and identifies those that play central roles within the network structure. This enables a better understanding of relationships and a clearer analysis of topic interactions. Therefore, SNA was chosen for this study as it aligns with the research objectives and data characteristics, providing deeper insights.

## IV. Results

### 1. A case of fashion campaigns and projects related to climate change

#### 1) Chloé: 'Rewilding'

Chloé is one of the most notable brands in the fashion industry for adopting a sustainability-focused strategy. It publishes its own environmental report (Chloé, 2021) and has implemented initiatives to reduce its impact on the climate, biodiversity, and oceans. Through its 'Vision 2025,' Chloé has declared its aim to reduce its impact on climate and biodiversity by improving carbon emissions, water use, waste, packaging, and animal welfare across its operations and supply chain. Previous goals for 2023 included reducing global emissions per product through three carbon decarbonization projects for biodiversity, reducing water use, and using virgin synthetic fibers in its winter 2024 ready-to-wear collection (Chloé, n.d.a).

Specifically, Chloé aims to reduce its greenhouse gas emissions per product by 30% by 2025, and is already offsetting 100% of its direct emissions (Scope 1-2), with plans to fully offset the remaining emissions, including those from its supply chain. 94% of Chloé stores and offices worldwide are powered by renewable energy, and this study measures energy use and emissions from the key suppliers to help them reduce their environmental impact. It is developing circular economy ideas that promote the elimination of waste and pollution, and the reuse and recycling of products and materials. As part of this effort, it is actively promoting the use of sustainable materials,

including minimizing waste at all design stages, increasing material efficiency, and improving collection management processes to reduce oversupply (Chloé, n.d.a).

Chloé's commitment to the environment is also evident in its fashion shows. Fundamentally, the company accurately assesses the CO2 emissions from its fashion shows and events and is actively working to reduce its environmental impact by 30% by 2025 (Chloé, n.d.a). Since the appointment of Gabriela Hearst as Chloé's creative director, various sustainable projects have been incorporated into the collections. The 'Rewilding' project aims to promote biodiversity and ecosystem health by restoring nature to its original state and restoring ecosystems. In particular, it promotes the introduction of nature-inspired designs and the use of eco-friendly materials in product design and collection development. This is expressed directly in the A/W 2022 collection 'Climate Success,' which combines images of disasters such as forest fires, melting glaciers, and droughts with successes in addressing climate change (Bazaar, 2022) (Fig. 2, 3, 4, and 5).

## 2) Patagonia: 'Don't buy this jacket' & 'Worn wear'

Patagonia utilizes a variety of business, commu-

nity, and messaging strategies to address the climate crisis. Financially, the company supports nonprofit environmental organizations working to protect and revive the world's rivers, streams, forests, and mountains through an internal '1% for the planet' voluntary tax. The company also functions as a networking platform, promoting actions to address environmental issues across the country through 'Patagonia Action Works,' which provides information and activities from environmental organizations.

Patagonia has been active in the Common Threads Initiative since 2011 with its "Don't buy this jacket" ad campaign (Fig. 6). The ad emphasizes the need for consumers to reduce their consumption in order to reduce their environmental footprint, specifically acknowledging that while the brand's products use organic or recycled materials, they emit significant amounts of greenhouse gases during manufacturing, generate scrap fabric many times the weight of the product, and consume large amounts of water (Patagonia, 2011). The ad was published in the New York Times on Black Friday, the day of the sale, and urged consumers to buy less. This was an attempt to demonstrate the authenticity of the Patagonia brand by conveying the message that it would be hypocritical to claim to be committed to environmental change while discouraging purchases.



<Fig. 2>  
'Rewilding' project  
Reprinted from Chloé.  
(n.d.b).  
<https://www.chloe.com>



<Fig. 3>  
'Rewilding' project  
Reprinted from Chloé.  
(n.d.b).  
<https://www.chloe.com>



<Fig. 4>  
'Rewilding' project  
Reprinted from Chloé.  
(n.d.b).  
<https://www.chloe.com>



<Fig. 5>  
'Rewilding' project  
Reprinted from Chloé.  
(n.d.b).  
<https://www.chloe.com>

In addition to attempting to reduce apparel consumption, Patagonia also emphasizes extending the life of clothing as a strategy to combat climate change. Patagonia’s ‘Worn wear’ campaign aims to create quality products so that consumers can wear their clothes for as long as possible, thus reducing unnecessary consumption (Patagonia, n.d.b). The campaign offers free repairs on any clothing item, regardless of brand, to encourage people to keep their clothes longer by repairing them rather than buying new ones. The brand’s website offers one-wear repair tutorials, such as patching pants holes, shortening hems, shrinking waists, and patching sock holes (Fig. 7).

On the other hand, Patagonia also functions as a journalistic organization, recently collaborating with Samsung Electronics to develop micro-synthetic fiber reduction technology for home washing machines (Stanley, 2023), interviewing people involved in sustainable fishing, marine reserve designation, river and stream revitalization projects, and indigenous rights, and reporting on them on its official website (Patagonia, n.d.c). This indicates that Patagonia is concerned with not only environmental matters but also addressing global challenges like poverty, social inequality, climate change, ecological degradation, peace, and justice, all within the framework of the Sustainable Development Goals (SDGs).

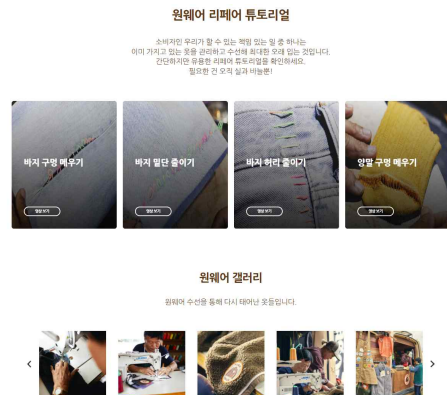


<Fig. 6> ‘Don’t buy this jacket’ campaign  
 Reprinted from Patagonia Korea (n.d.).  
<https://www.patagonia.co.kr>

### 3) British Fashion Council, Mayor of London, and Vivien Westwoods: ‘Fashion Switch Campaign’

The Fashion Switch Campaign is a large-scale environmental movement co-led by designer Vivienne Westwood, the British Fashion Council, and the Mayor of London, involving influential figures and associations in the fashion industry to promote sustainable fashion globally. The campaign proposes that fashion brands convert the energy they use to green energy by 2020 or introduce green energy tariffs (Cook, 2017). Green energy (also known as renewable energy) includes natural energy such as solar, geothermal, hydroelectric, tidal, and wave power, as well as hydrogen energy and biomass, and is a sustainable and environmentally friendly alternative to fossil fuels such as oil and coal, which cause pollution (Yoo, 2017). The campaign was launched during London Fashion Week in September 2017 with the collaboration of major fashion brands and companies, including Vivienne Westwood, Belstaff, Marks & Spencer, Selfridges, and Stella McCartney (Lee, 2017). Significantly, it has been recognized as a fashion initiative through its connection to the Paris Agreement under the United Nations Framework Convention on Climate Change (British Fashion Council, n.d.).

Vivienne Westwood, who participated in the campaign, has a long history of climate change activism,



<Fig. 7> ‘Worn wear’ project  
 Reprinted from Patagonia. (n.d.d).  
<https://www.patagonia.co.kr/wornwear>

including a long-term relationship with Cool Earth, a charity that works with communities to reduce deforestation and the impacts of climate change, and her ‘Back to Earth’ campaign to raise funds for climate change-related charities (Cook, 2017). This can be seen as activism that supports local communities and indigenous knowledge and addresses threats to forests while making communities stronger and more resilient. In addition, several fashion shows, including the “Homo Loquax” fashion show in 2019, have criticized the fashion industry for environmental pollution by showing clothes printed with anti-consumerism or climate change slogans (Figs. 8, 9, 10, and 11). The 2021 campaign emphasizes the need for cooperation in the fight against climate change, stating, “The rainforest is the lungs of the world, it breathes for us and gives us life. We need to nurture and respect them, and rely on collaboration to maximize our impact. We need to act now, and what’s good for the planet is good for the economy” (Serpentine, 2021).

#### 4) WWF Korea: ‘Re:Textile’

Re:Textile is an initiative driven by the Korean office of the World Wide Fund for Nature (WWF), the world’s largest international conservation non-profit organization, aimed at promoting resource circular-

ity and increasing consumer awareness in the textile and fashion sector. The project targets non-quality apparel waste that would otherwise end up in landfills or incineration due to seasonal changes, overproduction, and declining exports. It is designed to find ways to reduce the environmental impact of these fabrics by giving them a new purpose without other chemical recycling processes (WWF Korea, 2020a; WWF Korea, 2020b).

In total, 2,322 yards of fabric were recycled through the project, and according to the Higg Index FEM, which assesses the sustainability of production sites, the project saved approximately 48,854 kilograms of carbon emissions compared to using new fabric. The Higg Index was developed by WWF, a member of the Sustainable Apparel Coalition, to quantify and assess the environmental and social impacts of apparel, footwear, and textile products through life cycle assessment (LCA). The Higg Index FEM used in this project assesses seven dimensions of a manufacturing site’s environmental management system (EMS), energy, water, wastewater, air emissions, waste, and chemicals management.

In addition, the ‘Listen to Clothes’ campaign, an omnibus drama film about the past and future of clothes, conveyed a variety of messages that reflected



<Fig. 8>

Homo Loquax I  
Reprinted from  
Pownall. (2019).

<https://www.dezeen.com>



<Fig. 9>

Homo Loquax II  
Reprinted from  
Pownall. (2019).

<https://www.dezeen.com>



<Fig. 10>

Homo Loquax III  
Reprinted from  
Pownall. (2019).

<https://www.dezeen.com>



<Fig. 11>

Homo Loquax IV  
Reprinted from  
Pownall. (2019).

<https://www.dezeen.com>

the nature of the materials utilized in the re-textile project (Fig. 12). The film explores how discarded plastic bottles can be turned into high-end fabrics, only to be thrown away again; how discarded bedding can be turned into clothes; and how fabrics mass-produced for export are often discarded due to declining exports or changing seasons. By using the voices of famous actors to anthropomorphize waste, the film hopes to trigger people’s emotions and raise awareness about waste.

5) Sofia Kiaani: ‘We wear oil’

Sophia Kianni, an American social entrepreneur, was named one of the most influential female ESG leaders in 2023 (Richford, 2023). She is involved in various activities to combat climate change, most notably as the face of the “We wear oil” campaign at COP28. In the campaign, Kianni is covered in black dye that makes her look as if she is drenched in oil, visually communicating environmental awareness (Fig. 13). The campaign was launched at COP28 in collaboration with Vogue Arabia, and Kianni covered herself in fake oil to visually demonstrate how fossil fuels are widely used in synthetic fibers (e.g., polyester). Kianni’s campaign also pointed out that the fast fashion industry is part of the fossil fuel industry, urging people to choose quality over quantity and secondhand over new (Richford, 2023).

Through a series of activities and panels at major events, including Climate Week NYC and the European Parliament, Sophia Kianni highlighted the need for change in the fashion industry. During Climate

Week NYC in 2023, an expert panel discussion on fashion’s over-reliance on fossil fuels was held to discuss fashion’s impact on the climate, which has traditionally been underrepresented in major climate negotiations, and the campaign’s call to phase out fossil fuels from the fashion industry (Fossil Fuel Fashion, n.d.). The phase-out of fossil fuels was also highlighted at “Fossil Fuel Fashion” in New York City in 2023. The campaign, supported by organizations such as Eco-Age, calls for the fashion industry to reduce its reliance on fossil fuels and transition to sustainable materials (Fig. 14). These examples send a strong message that the fashion industry needs to move away from fossil fuels.

2. The climate change agenda in the fashion industry in the online media

The general topics related to climate change in the fashion industry discussed in the online media were environmental protection, energy and greenhouse gas emissions, plastic (petroleum-based) materials, waste, and carbon neutrality. Given that the trends of frequency and TF-IDF are nearly identical, TF-IDF was used as the standard for description in this paper (Table 1). To analyze the climate change agenda in the fashion industry, this study employed both TF-IDF and ego network analysis.

Ego network analysis is a method used to understand the central role of a specific node (in this case, ‘fast fashion’). Initially, ‘fast fashion’ is set as the central node, and various topics and terms connected to this node are collected. Next, these connections are



<Fig. 12> ‘Listen to clothes’ video  
 Reprinted from WWF Korea. (2020b). <https://www.youtube.com>



<Fig. 13> 'We wear oil' campaign  
Reprinted from Richford. (2023).  
<https://wwd.com>



<Fig. 14> Fossil fuel and fashion image  
Reprinted from Fossil Fuel Fashion. (n.d.).  
<https://www.fossilfuelcampaign.com>

<Table 1> Climate change and fashion industry agendas (macro perspective)

Word	TF-IDF	Freq	Word	TF-IDF	Freq	Word	TF-IDF	Freq
Environment	1,765.33	1,363	Ocean	444.06	127	Flood	184.08	41
Sustainable	1,517.50	895	Circular economy	439.44	124	Vegan	177.10	39
Eco	1,382.21	688	Project	398.50	107	Labor	175.69	38
Fast fashion	1,121.34	482	Water	396.25	109	Heavy rain	175.55	37
Emission	956.90	397	Certification	389.11	89	Regulation	173.57	38
Energy	793.14	272	Ecosystem	384.94	104	Human right	171.99	36
Material	782.82	287	Renewable	355.44	93	Resilience	169.66	36
Green house gas	781.83	296	Cop	326.51	86	Electric power	163.67	33
Plastic	754.14	260	Leather	297.75	64	Carbon footprint	158.77	33
Waste	651.54	217	Biodiversity	291.18	71	Slow fashion	158.71	32
Unfccc	633.56	226	Collaboration	274.77	67	Recycling	149.15	31
Animal	554.23	161	Disaster	270.23	68	Funk	148.89	29
Global warming	521.16	161	Demonstration	262.32	60	Fossil fuel	148.10	31
Carbon neutrality	511.38	153	Forest	243.65	51	Solar power	148.07	28
Campaign	508.97	153	Hydrogen	237.27	51	Metaverse	147.71	27
Resource	501.73	155	Green washing	235.65	50	Over spending	142.70	29
Upcycling	500.06	146	Digital	232.91	53	Initiative	137.78	28
Fashion charter	491.71	141	Co2	206.54	47	Low carbon	137.78	28
Temperature	485.56	148	Zero waste	197.59	43	Vintage	115.15	22
Mitigation	475.84	147	Wildfire	195.31	40	Oil	114.02	22

represented as edges with weights to construct the network. By visualizing and analyzing the network, it is possible to determine how fast fashion interacts with other topics in the climate change discourse. This process allows for an understanding of the impact fast fashion has on key climate change issues.

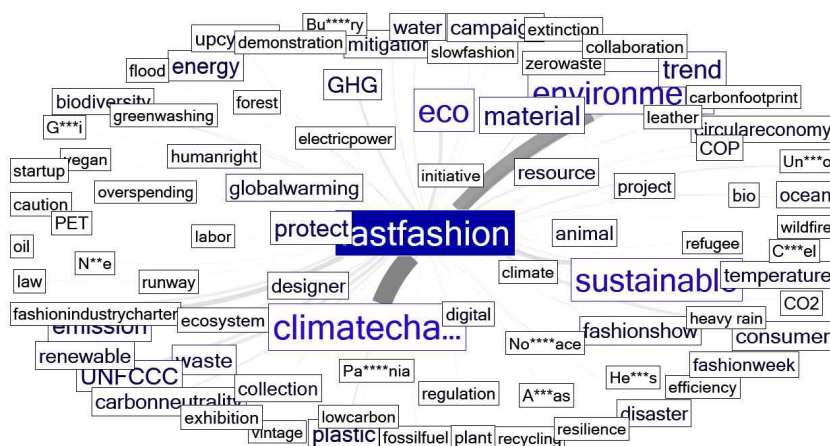
Fast fashion (TF-IDF=1,121.34) is connected to a variety of topics, with the following edge weights ( $\omega$ ): trends ( $\omega=120$ ), emissions (119), waste (82), unfccc (71), green house gas (58), fashion industry charter (56), plastics (47), and carbon neutrality (42), resources (37), reduction (28), biodiversity (24), global warming (24), oceans (21), green washing (20), carbon dioxide (15), ecosystems (15), disasters (14), energy (14), human rights (10), fossil fuels (8), labor (8), and so on (Fig. 15). These findings suggest that the fast fashion industry presents a significant challenge to climate change mitigation efforts, contributing to a range of environmental and social issues such as carbon emissions from production and disposal, energy consumption, impacts on resources and ecosystems, greenwashing, and labor rights issues.

The prominent emphasis in online media coverage suggests that key issues related to fast fashion are being highlighted in the climate change discourse. This indicates that fast fashion is currently recognized as a significant challenge in climate change mitiga-

tion, and the online media's focus on this issue underscores its emergence as a major point of concern within climate change efforts.

Material production (TF-IDF=782.82) is also high on the agenda, with eco-friendly materials and alternatives such as vegan (animal 554.23; vegan 117.10), upcycled (500.06), recycled (355.44), zero waste (197.59), and recycled (149.15), while petroleum-based materials (plastic 754.14; plastic 148.10; fossil fuel 114.02) are highlighted as materials that should be banned to combat climate change.

Through keywords such as unfccc (633.56), fashion industry charter (491.71), cop (326.51), and initiatives (137.78), this study can see that the issue of climate change is constantly being tracked and emphasized from a global perspective as a challenge for the fashion industry. This reflects the fact that climate change councils and related forums are also emphasizing the importance of the fashion industry's climate change response and energy emissions monitoring, which may explain the discussion on fossil fuels in the fashion industry at COP28. In addition, keywords such as disaster (270.23), labor (175.69), and human rights (171.99) show that climate change response in the fashion industry is not only about the environment, ecosystems, and fossil fuel use, but also about the social dimension of the Sustainable Development



<Fig. 15> Fast fashion ego network



Goals (SDGs).

Green washing (235.65) was seen as a major challenge, which refers to the practice of making false or exaggerated representations and advertisements about the environmental attributes or efficacy of goods or services in order to gain economic benefits solely on the basis of a green image (Visser, 2014). This suggests that it is not enough for fashion companies to simply adopt green strategies, but that regulatory measures are needed to ensure that they are truly sustainable. Digital (232.91) and metaverse (147.71) have also been identified as climate change responses in the fashion industry, indicating that these technologies can reduce the physical production and transportation stages of clothing, and minimize resource

and inventory management (Kim, 2022). Therefore, these approaches are highlighted as key directions for climate change responses in the fashion industry.

### 3. Discussion of the COP28 climate change response

While previous research has addressed climate change agendas in the fashion industry from a macro perspective, COP28, as an event that focuses on different specific topics each year, necessitates a more detailed and nuanced explanation. Similar to previous research findings, and given that the trends of frequency and TF-IDF are almost the same, this paper will utilize TF-IDF as the basis for description (Table 2). In Table 2, cells filled in gray represent common

<Table 2> Climate change and fashion industry agendas (COP28 perspective)

Word	TF-IDF	Freq	Word	TF-IDF	Freq	Word	TF-IDF	Freq
Fossil fuel	561.96	233	Environment	261.12	85	Paris agreement	170.68	47
Stella mccartney	511.85	248	Technology	255.27	78	Esg	165.27	39
Material	506.49	221	Crisis	254.53	80	Activist	162.90	44
Emission	502.23	214	Waste	252.51	79	Plant	156.53	42
Energy	502.10	200	Indra	235.90	62	Decarbonisation	156.41	22
Sustainability	493.01	214	Government	235.82	71	Unfccc	153.84	41
Climate change	486.63	231	Water	225.53	64	Initiative	153.84	41
Oil	416.98	169	Flood	222.48	54	Wind power	151.09	36
Action	374.51	137	Fabric	222.48	54	Agriculture	142.20	36
Leather	354.18	121	Polyester	216.18	56	Eco	141.79	37
Plastic	319.90	101	Collaboration	212.72	65	Temperature	141.70	35
Green house gas	299.79	98	Investment	205.59	58	Shantnu nikhil	141.70	35
Collection	298.54	98	Policy	202.18	59	Adaptation	137.20	33
Innovation	294.34	99	Lvmh	193.82	55	Ecosystem	137.17	35
Animal	286.93	91	Biomass	182.65	55	Petrochemical	131.24	29
Fund	285.98	91	Fur	180.77	51	Regulation	127.13	30
Textile	283.55	87	Nature	179.07	49	Bangladesh	125.91	30
Project	282.20	81	Partnership	176.85	49	Coal	123.73	27
Alternative	273.10	87	Chemical	175.59	43	Transparency	121.71	29
Transition	261.81	80	India	172.45	45	Recycling	115.36	28

words found in Table 1: Climate change and fashion industry agendas in the online media. While more words may appear as common terms, those that frequently appear at the top in both Table 1 and Table 2, based on TF-IDF and frequency, indicate signi-

ficant fashion agendas within the broader climate change discourse.

〈Table 3〉 summarizes the detailed keywords by topic, based on the researchers' examination and synthesis of various opinions. The analysis showed that

<Table 3> Climate change and fashion industry agendas by topic at COP28

Topic	Word	Explanation
Policy and regulation	Government, policy, transparency, paris agreement, unfccc, regulation, monitor, cdp	<ul style="list-style-type: none"> <li>· Government environmental policies, international agreements, and regulations</li> <li>· Enhancing transparency and monitoring environmental initiatives</li> <li>· Carbon disclosure project (CDP) for global compliance</li> </ul>
Climate change response	Climate change, crisis, flood, decarbonisation, mitigation, temperature, adaptation, global warming, resilience	<ul style="list-style-type: none"> <li>· Impacts of climate change</li> <li>· Resilience against global warming and temperature fluctuations</li> <li>· Tackles adaptation and mitigation strategies related to increasing temperatures and floods</li> </ul>
Sustainable actions (Climate actions)	Sustainability, action, fund, environment, collaboration, investment, partnership, activist, initiative, activation, incentive	<ul style="list-style-type: none"> <li>· Sustainable practices through green projects</li> <li>· Promotes forming partnerships to further environmental goals</li> <li>· Incentives for eco-friendly initiatives</li> <li>· Encourages sustainable behaviors</li> </ul>
Natural resources and ecosystems	Waste, water, biomass, agriculture, ecosystem, landfill, sea, circular economy, biodiversity, forest	<ul style="list-style-type: none"> <li>· Management of natural resources</li> <li>· Sustainable agriculture, water management, and ecosystem conservation</li> <li>· Aims to maintain biodiversity and promote effective resource stewardship</li> </ul>
Social responsibility	Esg, woman, responsibility, labor	<ul style="list-style-type: none"> <li>· ESG (environmental, social, and governance)</li> <li>· The role of corporations in fostering sustainable development and ethical practices</li> </ul>
Energy transition	Energy transition, innovation, technology, wind, efficiency, hydrogen	<ul style="list-style-type: none"> <li>· The shift towards renewable energy sources and technological innovations</li> <li>· Energy efficiency and alternative energies like wind and hydrogen to reduce fossil fuel</li> </ul>
Carbon emission management	Emission, green house gas, carbon footprint, dioxide, methane, carbon neutrality, low carbon	<ul style="list-style-type: none"> <li>· To reducing greenhouse gas emissions</li> <li>· Carbon neutrality and implementing low-carbon practices</li> </ul>
Sustainable materials	Leather, plastic, animal, alternative, polyester, fur, chemical, plant, petrochemical, cotton, recycling, seaweed, cruelty	<ul style="list-style-type: none"> <li>· The use of sustainable materials in industries such as fashion and manufacturing</li> <li>· Reducing environmental impacts by replacing traditional materials with eco-friendly alternatives</li> </ul>
Sustainable fashion and industry (COP28)	Fossil fuel, stella mccartney, oil, collection, indra, lvmh, nature, india, shantnu nikhil, bangladesh, coal, hearst, gelareh, startup, rami	<ul style="list-style-type: none"> <li>· Sustainable practices within the fashion industry</li> <li>· Reducing fossil fuel usage and the adoption of sustainable materials</li> <li>· COP28 event and participants</li> </ul>

the keywords mainly spanned the following topics: policy and regulation, climate change response, sustainable behavior, natural resources and ecosystems, social responsibility, energy transition, carbon emissions management, sustainable materials, and sustainability in the fashion industry and COP28.

With respect to policies and regulations, keywords such as government (TF-IDF=235.82), policy (202.18), paris agreement (170.68), unfccc (153.84), regulation (127.13), transparency (121.71), monitor (98.37), and carbon disclosure project (CDP, 92.17) were identified. These keywords emphasized the importance of government environmental policies, international agreements, and regulations, and included themes such as promoting transparency and monitoring environmental initiatives, with references to platforms such as the CDP to facilitate global compliance and reporting, and climate change bodies such as the UNFCCC. In relation to climate change response, the following keywords were identified: climate change (486.83), climate crisis (254.53), flooding (222.48), decarbonization (156.41), mitigation (146.70), temperature (141.70), adaptation (137.20), warming (84.96), and climate resilience (63.06). These can be seen to be about strengthening resilience to global warming and temperature variability, and developing and implementing adaptation and mitigation strategies in response to rising temperatures and flooding.

With respect to sustainable behavior, the following keywords were identified: sustainability (493.01), action (374.51), fund (285.98), environment (261.12), collaboration (212.72), investment (205.59), partnership (176.85), activist (162.90), initiative (153.84), enablement (130.35), and incentive (67.97). This can be seen to be about promoting sustainable practices through investments in green projects, forming partnerships to achieve environmental goals, and providing incentives for green initiatives. Regarding natural resources and ecosystems, the following keywords were identified: waste (252.51), water (225.53), biomass (182.65), agriculture (142.20), ecosystems

(137.17), landfills (112.26), oceans (80.03), circular economy (77.90), biodiversity (75.32), and forests (74.71). This can be seen as a reflection of the importance of maintaining biodiversity and effective resource management, emphasizing the management and conservation of natural resources, sustainable agriculture, water management, and ecosystem preservation.

In terms of social responsibility, keywords such as esg (165.27), women (119.15), responsibility (116.42), and labor (75.27) were identified. This can be seen as a focus on environmental, social, and governance (ESG) criteria, emphasizing responsible consumption patterns, promoting sustainable development and ethical labor practices. Regarding the energy transition, the following keywords were identified: innovation (294.34), energy transition (261.81), technology (255.27), wind (151.09), efficiency (98.86), and hydrogen (88.72). These can be seen to be about the transition to renewable energy sources and technological innovation, improving energy efficiency and developing alternative energy to reduce dependence on fossil fuels.

In relation to carbon emissions management, the following keywords were identified: emissions (502.23), greenhouse gas (299.79), carbon footprint (110.18), carbon dioxide (84.74), carbon neutrality (75.32), methane (70.25), and low carbon (59.17). This can be seen as content aimed at reducing greenhouse gas emissions, achieving carbon neutrality, and implementing low-carbon practices to mitigate the effects of climate change. In terms of sustainable fashion materials, the following keywords were identified: leather (354.18), plastic (319.90), animal (286.93), alternative (273.10), polyester (216.18), fur (180.77), chemical (175.59), plant (156.53), petrochemical (131.24), cotton (125.42), recycled (115.36), seaweed (87.31), and cruelty (73.96). This can be seen as a strategy to reduce environmental impact by replacing traditional materials with eco-friendly alternatives in the fashion and manufacturing industries.

In relation to the COP28 event, fossil fuels (561.96), stella mccartney (511.85), oil (416.98), collections (298.54), indra (235.90), lvmh (193.82), nature (179.07), india (172.45), shantanu and nihil (141.70), bangladesh (125.91), coal (123.73), gabriella hearst (74.29), gelare design (72.76), startup (64.10), and rami khadi (59.17). This is a result of COP28's emphasis on using sustainable materials, increasing energy efficiency, and applying new design and technology to protect the environment. Brands and designers are emphasizing environmental protection and social responsibility in their latest collections, reflecting the discussion of the fashion industry's role in the transition to sustainability. It also highlights how fashion events at COP28 are integrating different strategies and innovative approaches to combat climate change.

Media coverage can shape public opinion and perception by portraying events and providing reflective information, while public feedback can influence media coverage, creating an interdependent relationship (Peter, 2022; Wang, 2022). In this study, the analysis indicates that online media coverage can contribute to shaping public perception by frequently highlighting key issues such as fast fashion, eco-friendly materials, and greenwashing. This frequent emphasis may increase public awareness and drive conversations around these topics, as evidenced by the alignment between online media-reported issues and the themes discussed at COP28. For instance, the focus on fast fashion's environmental impact highlighted by online media aligns with COP28's discussions on reducing carbon emissions and promoting sustainable practices. This suggests that media may play a role in setting the agenda and priorities at global events like COP28.

#### 4. Climate change messaging in COP28 exhibits and sustainable fashion design

##### 1) Sustainable market at COP28

During COP28, the Sustainable Market highlighted various alternative materials designed to lessen the environmental footprint of the fashion industry. For example, Stella McCartney showcased a range of innovative materials, including leather made from grapes, threads made from fibers harvested from algae, and sequins made from wood cellulose (Fig. 16). These materials were developed as part of a material innovation project in partnership with LVMH (Griffiths, 2023). In particular, Stella McCartney's BioSequins are plant cellulose-based sequins developed by UK-based company Radiant Matter that are renewable, biodegradable, and non-toxic (Fig. 17). Conventional sequins have been pointed out as a major source of environmental pollution because they contribute to microplastics, and their small size (1-6 mm) makes them difficult to separate and dispose of, so they are often discarded with clothing. Therefore, bio sequins have attracted great attention as an innovative alternative (Stella McCartney, n.d.).

Natural Fiber Welding introduced a bag made from Mirum, a plant-based leather alternative (Fig. 18). Mirum is made using natural rubber, plant and mineral pigments, vegetable oils and waxes, and natural fabric lining, and utilizes natural rubber and vegetable oils as glue instead of PU binders used in leather alternatives. Dyeing is done with a variety of natural ingredients such as charcoal, clay, cork powder, rice husk, coconut fiber, recycled denim, and seaweed, and at the end of the product's life cycle, it is recycled into new products or crushed and returned to nature (Tencel, n.d.).

##### 2) Sustainable fashion designers and their works at COP28

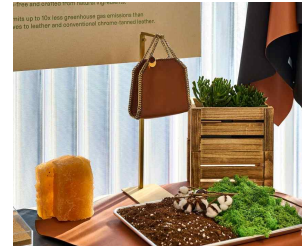
To analyze the climate change messaging from the sustainable fashion shows at COP28, this study examined three collections clearly identified through online news articles, reviews from event participants, and collection images. The analysis of the designers and fashion shows was conducted based on reviews



<Fig. 16> Seaweed-based yarn by Stella McCartney  
Reprinted from Griffiths. (2023).  
<https://www.dezeen.com>



<Fig. 17> BioSequins beads by Stella McCartney  
Reprinted from Griffiths. (2023).  
<https://www.dezeen.com>



<Fig. 18> Plant-based leather by Stella McCartney  
Reprinted from Griffiths. (2023).  
<https://www.dezeen.com>

from COP28 participants and interviews with the designers.

Rami Kadi is a Lebanese-American fashion designer whose line focuses on sustainability and uses eco-friendly materials and methods, such as using post-consumer plastics and recycled materials. She is known for creating dresses from plastic collected from the ocean, or using fabrics from previous collections and re-dyeing them to create new collections (Kumar, 2023). The COP28 fashion show reflected this designer's identity and philosophy, with each dress made from recycled fabrics and detailed with bio-based sequins, crystals, and holographic embroidery (Fig. 19, 20, and 21). The theme of the COP28 collection was the sea, and it was hailed as a perfect example of sustainability combining elegance and environmental protection (Rami Kadi, 2023c).

The Indian designer duo Shantnu and Nikhil created a separate line called 'Indra' to develop their collection (Fig. 22 and 23). Indra is the god of weather and war in Indian mythology, symbolized by strength and courage, royalty and nobility, and the designers used the collection to translate his attributes and symbolism into modern, sustainable fashion. The color palette of ivory and off-white and the use of natural material touches, such as hand-woven silk, conveyed the message of returning to nature (roots) (Kumar, 2023). By using colors and materials associated with these natural elements, the brand was able to connect with the image of Indra while also con-

veying a message of environmental sustainability.

Gelareh Alam is a fashion designer with her own eponymous brand, Gelareh Designs, whose designs are characterized by sculptural layers and structured silhouettes, by varying the shape of fabrics to create unique textures, and by combining different fabrics and leathers. He is considered progressive and forward-thinking because he creates original collections that don't follow trends, and his designs are about purity, liberation, and freedom (Leigh, 2022). The COP28 fashion shows also emphasized the reuse and recycling of natural resources by utilizing different types of materials to create unique textures and shapes, demonstrating the versatility of natural resources (Fig. 24, 25, 26, 27, 28, and 29).

## V. Discussion

The fashion events and climate change discussions at COP28 highlighted the significant role the fashion industry plays in meeting global climate objectives and offered an essential platform for advancing the industry's sustainability efforts. This study explores how the fashion industry is responding to climate change through various projects, campaigns, and discussions at COP28. The study analyzed initiatives in the global fashion industry, online media coverage, interviews and op-eds by fashion insiders at COP28, and major exhibitions and collections.

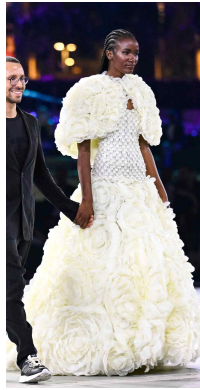
First, the study found that the fashion industry has



<Fig. 19>  
Rami Kadi I  
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Rami Kadi. (2023a).  
<https://www.rami-kadi.com>



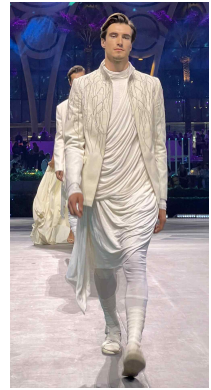
<Fig. 20>  
Rami Kadi II  
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<https://www.rami-kadi.com>



<Fig. 21>  
Rami Kadi III  
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<https://www.rami-kadi.com>



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<Fig. 23>  
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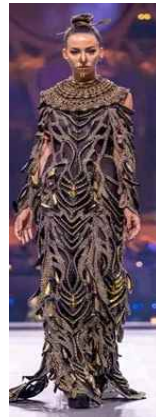
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responded to climate change through targeted, brand-specific environmental strategies. Chloé focused on promoting biodiversity through carbon removal and ecosystem restoration, while Patagonia strengthened the resource cycle by discouraging overconsumption

and promoting recycling. The British Fashion Council, the Mayor of London, and Vivienne Westwood called for the transition to green energy. In South Korea, WWF Korea recycles garment waste to reduce environmental impact, and Sophia Kiani from the United

States highlighted the need for sustainable consumption, pointing out fast fashion's link to fossil fuels. These efforts suggest that the fashion industry is fulfilling its environmental responsibilities and driving changes in consumer behavior.

Second, key issues discussed in the online media and at COP28 included environmental protection, energy and greenhouse gas emissions, sustainable material use, social responsibility, and sustainable behavior. Fast fashion was identified as a significant challenge due to its multiple impacts. Eco-friendly, vegan, and renewable materials were presented as alternatives, while petroleum-based materials were emphasized as ones to be banned. Policy and regulation, climate change response, energy transition, carbon emissions management, and ESG standards were also critical issues. These discussions underscore the need for policy support, innovative technologies, social responsibility, and consumer awareness for the industry's sustainable future.

Third, the COP28 discussions revealed a significant shift in the fashion industry's approach to sustainability. Unlike previous studies primarily focusing on environmental impacts and consumer behavior, this study highlights a shift in the fashion industry's approach to climate change, moving from addressing weather-related impacts to focusing on energy transitions and supply chain sustainability. Previous research has concentrated on adaptive fashion design (Jang, 2015; Lee & Park, 2009), consumer behavior (Son, 2017), and waste management (Boykoff, Chandler, Church, & Osnes, 2021; Kalambura et al., 2020). Bick et al. (2018) and Niinimäki et al. (2020) examined the environmental and social costs of fast fashion, while Li et al. (2014) and Lundblad and Davies (2016) focused on sustainable supply chain management and consumer motivations. This study also identified 'digital' and 'metaverse' as primary keywords in discourses on climate change responses in the fashion industry. This finding aligns with previous studies that highlight the critical role of the metaverse

in providing a platform for digital sustainability in fashion, enabling the communication of sustainable practices and aligning with climate change agendas through immersive virtual experiences and consistent messaging (Blázquez, 2024; Profumo Profumo, Testa, Viassone, & Ben Youssef, 2024). This finding delves into systemic changes, emphasizing the use of digital technologies (e.g., metaverse, blockchain, and digital twin) for resource management and energy optimization in the fashion industry. By addressing these broader issues, this study fills a critical gap in the literature, offering comprehensive strategies for the entire production and distribution process and new perspectives on long-term sustainability.

Lastly, the 'Sustainable Market' exhibition and fashion show at COP28 sent a clear message that the fashion industry is taking innovative and decisive action on climate change. Unlike previous collections that primarily focused on the aesthetic integration of eco-friendly materials, the COP28 collections by designers such as Stella McCartney, Rami Kadi, Shantanu and Nikhil, and Gelareh Alam emphasized a holistic approach to sustainability. Stella McCartney show-cased advanced plant-based, biodegradable textiles, while Rami Kadi and Shantanu and Nikhil integrated recycled materials and natural resources with modern cultural storytelling. These collections at COP28 are distinguished from previous efforts by integrating environmental consciousness, innovative design, and technological advancements, suggesting that the fashion industry will need to balance environmental protection and economic growth through sustainable materials, increased recycling, and reuse.

## VI. Conclusion

This study reveals that the fashion industry is actively responding to climate change through regulatory compliance, resilience strategies, and sustainable practices. Key efforts include adherence to international agreements like the Paris Agreement, decarbo-

nization, resource management, and the adoption of renewable energy and sustainable materials. Emphasis on social responsibility and ESG criteria promotes ethical practices. Highlights from COP28 showcase industry leaders and startups committed to reducing environmental impacts and innovating for sustainability. These actions collectively demonstrate the fashion industry's dedication to addressing climate change and promoting a sustainable future.

Climate change discussions have often focused on sectors with higher carbon emissions, such as energy, transportation, and industrial processes, relegating the fashion industry to a relatively peripheral role. In previous studies have primarily concentrated on consumer behavior and environmental impacts, leaving a gap in in-depth analysis of the fashion industry's role. This study confirms that the fashion industry can play a significant role in addressing climate change, as evidenced by the sustainability initiatives highlighted at COP28, including the development of sustainable materials, the transition to green energy, and the adoption of carbon-reducing technologies. The research suggests that the fashion industry can transition from a peripheral to a central topic within climate change discourse and that global events like COP28 can serve as crucial platforms for advancing this role.

Additionally, digital technologies such as the metaverse, blockchain, and digital twin show significant potential for resource management and inventory control. In the pursuit of sustainability within the fashion industry, previous studies have largely focused on topics such as eco-friendly materials, zero waste, and ethical production. While these efforts are crucial, it is also important to highlight the role of digital technologies in achieving sustainability goals. Blockchain enhances supply chain transparency, ensures adherence to sustainability standards, and provides immutable records that prevent fraud and promote ethical sourcing. Digital twin technology facilitates real-time monitoring and optimization, allowing for waste reduction through proactive maintenance efforts. The meta-

verse offers opportunities for virtual fashion shows and digital design, cutting down the environmental impact of traditional fashion events and physical samples. As shown by this study, integrating digital innovation with sustainability practices enhances the fashion industry's response to climate change. These technologies represent new possibilities for achieving long-term sustainability and demonstrate how the fashion industry can adapt and thrive in a rapidly changing environment.

This study advances academic understanding by offering an in-depth analysis of how the fashion industry responds to climate change. By examining current initiatives, media impact, and stakeholder viewpoints, it enriches our insight into the fashion industry's role in climate action. The empirical data and case studies presented provide critical benchmarks for evaluating ongoing and future sustainability efforts. The findings deliver actionable insights and practical recommendations for industry stakeholders and policymakers, aiding the development and implementation of more effective sustainability strategies.

The limitations of this study are as follows. This study analyzes climate change adaptation strategies in the fashion industry based on discussions at COP28 and key examples, which may lack detailed analysis of specific regions or individual companies. Five cases were selected and analyzed, but there may be insufficient explanation regarding the appropriateness of the number of cases. Future studies should include more cases or incorporate various perspectives to enhance the comprehensiveness of the analysis. Additionally, relying primarily on online media and publicly available data limits the depth of analysis of internal company strategies and practices. Online media sources may contain subjective views or exaggerations, affecting objectivity. Therefore, follow-up studies should utilize a wider variety of data sources and methodologies, including field research and interviews, to examine the actual sustainability strategies and practices of fashion brands.



Finally, a specific limitation of the current study is the difficulty in accurately capturing the context of interview data during text mining. While text mining is effective for extracting patterns and themes from large datasets, it may not fully reflect the detailed context of individual interviews, leading to potential gaps in the interpretation of the findings. Future research should address this by integrating case studies to explore specific examples in-depth and combining text mining with qualitative analysis to better align interview content with results. Adding contextual information during the data preprocessing stage could also enhance how text mining algorithms reflect the context of interview data.

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