13. Fashion in the metaverse

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1. INTRODUCTION

In recent years, especially since the pandemic affected the fashion world, the most famous brands in the fashion industry have begun to develop new digital marketing strategies.[2] There are many examples of experimentation in this field, including those that support online gaming and platforms for experiencing alternative worlds with avatars that provide spaces that can be used to sell or entertain.[3] Balenciaga collaborated with the video game Fortnite on a range of character outfits, known as 'skins'; Burberry is collaborating with Mythical games; Dolce & Gabbana created the Genesis NFT collection by selling tokens at auction; Adidas has created the 'Into the metaverse' collection to create an exclusive club for its customers; and Nike recently purchased a virtual shoe company that produces sneakers for the metaverse.[4]

Blended techniques are also becoming more widespread, where digital experiences are integrated with physical ones. The term 'phygital' (physical plus digital) describes an experience where customers can make phone calls, communicate on a social media platform and send email without the company losing the thread of communication or a sense of the customer's interest. In June 2023, Louis Vuitton announced a new collection of phygital 'Treasure Trunks', which grant owners access to future products and experiences, as well as a community of fellow owners. Each piece costs €39,000, and only several hundred trunks will be made available.[5]

That the metaverse is now a part of the fashion world is also evident in the virtual blogger Lil Miquela, a Californian influencer, model and singer who happens to be a robot. She is

[2] Abu Sadat Muhammad Sayem, 'Digital fashion innovations for the real world and metaverse' (2022) 15 International J. of Fashion Design, Technology and Education 139; Daria Casciani, Olga Chkanikova and Rudrajeet Pal (2022) 'Exploring the nature of digital transformation in the fashion industry: opportunities for supply chains, business models, and sustainability-oriented innovations' (2022) 18 Sustainability: Science, Practice and Policy 773.

[3] Valeria Volponi, *Moda e metaverso, Costruire identità di marca tra NFT, Communities e social commerce* (Franco Angeli 2022), 9.

[4] Paola Ungaro, 'Il Metaverso renderà davvero il mondo della moda più sostenibile?' Agenzia Italia (6 January 2022), www.agi.it/blog-italia/idee/post/2022-01-06/metaverso-rendera-moda-piu-sostenibile-15142039.

[5] Maghan McDowell, 'Louis Vuitton to sell €39,000 NFTs', Vogue Business (6 June 2023), www.voguebusiness.com/technology/louis-vuitton-to-sell-euro39000-nfts.

a creation of complex computer-processed images.[6] In the same vein, Prada launched Candy, created in 2011, who looks real but is a computer-generated avatar created for the purpose of promoting the perfume that bears her name,[7] while Daisy has been created by Yoox and Maya by Puma to promote its new Future Rider trainers in South-East Asia.[8] One of the most followed virtual influencers is Lu do Magalu, with more than 5 million Instagram followers, 14 million on Facebook, 2 million on YouTube and 1 million on Twitter and TikTok. Lu do Magalu originated more than a decade ago on the Brazilian retailer Magalu's website.[9]

The first metaverse Fashion Week took place in March 2022 on Decentraland,[10] a virtual 3D world where users register and organize events, attend shows, go shopping (using Mana cryptocurrency, equal to 2.20 euro) and buy land to construct buildings, neighbourhoods and streets. 'The State of Fashion 2023', a joint report from the Business of Fashion and McKinsey,[11] concluded that metaverse-related initiatives will play a growing role in the industry in the years to come.[12] Brands will embrace creative campaigns, retail media networks and the metaverse to remain competitive.[13] Beyond marketing issues, the question is how the metaverse can meet the sustainability requirements that the global fashion market is embracing and increasingly appear to be the focus of legislative initiatives. The purpose of this chapter is to review the current debate on sustainability in the fashion industry and to analyse how the metaverse can contribute to making the fashion world more sustainable.

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[6] Raymond Blanton and Darlene Carbajal, 'Not a girl, not yet a woman: a critical case study on social media, deception, and Lil Miquela', *Research Anthology on Usage, Identity, and Impact Social Media on Society and Culture* (IGI Global 2022), 894; Jenna Drenten and Gillian Brooks, 'Celebrity 2.0: Lil Miquela and the rise of a virtual star system' (2020) 20 Feminist Media Studies 1319; Luis Rodrigo-Martín, Isabela Rodrigo-Martín and Daniel Muñoz-Sastre, 'Influencers virtuales como herramienta publicitaria en la promoción de marcas y productos. Estudio de la actividad comercial de Lil Miquela' (2021) 79 Revista Latina de Comunicación Social 69.

[7] Sean Sands, Carla Ferraro, Vlad Demsar and Garreth Chandler, 'False idols: unpacking the opportunities and challenges of falsity in the context of virtual influencers' (2022) 65 Business Horizons 777.

[8] Gaurav Gupt, Anubhuti Gupta and Mahesh Chandra Joshi, 'A conceptual and bibliometric study to understand marketing in metaverse: a new paradigm' (2002) 5th International Conference on Contemporary Computing and Informatics (IC3I) IEEE 1486, 1487.

[9] Mauro Conti, Jenil Gathani and Pier Paolo Tricomi, 'Virtual influencers in online social media' (2022) 60 IEEE Communications Magazine, 86.

[10] Barbara Guidi and Andrea Michienzi, 'Social games and Blockchain: exploring the metaverse of Decentraland' (2022) IEEE 42nd International Conference on Distributed Computing Systems Workshops (ICDCSW) IEEE 199.

[11] See www.mckinsey.com/industries/retail/our-insights/state-of-fashion.

[12] ibid at 16.

[13] ibid at 19.

2.   RECENT INITIATIVES TO COPE WITH SUSTAINABLE FASHION

Over the past few decades, the environmental impact of the fashion industry has gained more attention through challenges to traditional fashion consumption and production practices,[14] while scrutiny of related social and human rights issues has become more widespread.[15] The fashion industry currently accounts for 5 per cent of CO_2 emissions globally, making it the third most polluting industry worldwide.[16] The textile and clothing industry is a high-impact sector due to a variety of factors: it has long and complicated supply chains that include major polluters and users of water, as well as being plagued by labour abuses and unsafe work conditions.

Fast fashion companies, such as H&M, Zara, Uniqlo, Topshop, Primark and SHEIN, offering low-price products have changed fashion consumption patterns, which has contributed to unsustainable practices in the industry.[17] Although fast fashion can be considered a process of 'democratisation of fashion', it has also had consequences in terms of sustainability. In the first decades of the twenty-first century, prices of clothing fell by 26.2 per cent in Europe and 17.1 per cent in the US. In the same period, the purchase of garments in the UK increased by one-third. Approximately 85 per cent of the clothing Americans consume, nearly 3.8 billion lbs annually, is sent to landfills, amounting to nearly 80lbs per American per year. However, the continuous changes in fashion have changed the consumer view that clothing is a seasonal good which is simply thrown away after that season has passed.[18] Ambassador Inga Rhonda King, President of the United Nations Economic and Social Council, introduced the 2019 Sustainable Fashion Summit by stating that 'sustainable fashion is critical to achieving the 2030 Agenda'.[19]

Several initiatives have been taken to achieve better market engagement on the business and consumer sides.[20] In 2018, under the auspices of UN Climate Change, a set of fashion stakeholders identified ways for the textile, clothing and manufacturing industry to move towards a holistic commitment to climate action. They launched the Fashion Industry Charter for Climate Action at the 24th Conference of Parties (COP24) in Katowice, Poland. The subsequent Fashion Charter aims to achieve net-zero greenhouse gas (GHG) emissions in the sector

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[14]   Amira Mukendi, Iain Davies, Sarah Glozer and Pierre McDonagh, 'Sustainable fashion: current and future research directions' (2022) 54 European Journal of Marketing 2873.

[15]   John Hobson, 'To die for? The health and safety of fast fashion' (2013) 63 Occupational Medicine 317.

[16]   Ellen MacArthur Foundation, 'A new textiles economy: redesigning fashion's future' (2017), www.ellenmacarthurfoundation.org/publications.

[17]   Rachel Bick, Erika Halsey and Christine Ekenga, 'The global environmental injustice of fast fashion' (2018) Environmental Health 1.

[18]   Mark Brewer, 'Slow fashion in a fast fashion world: promoting sustainability and responsibility' (2019) 8 Laws 24.

[19]   H.E. Ambassador and Inga Rhonda King, 'Remarks', Sustainable Fashion Summit ECOSOC Chamber (1 February 2019), www.un.org/ecosoc/sites/www.un.org.ecosoc/files/files/en/president/2019/remarks-ecosoc-president-sustainable-fashion-summit-01-feb-2019.pdf.

[20]   Meital Peleg Mizrachi and Alon Tal, 'Sustainable fashion – rationale and policies' (2022) Encyclopedia 1154. https://doi.org/10.3390/ encyclopedia2020077

by 2050. As the third-largest manufacturing sector in the world, scaling climate action across the fashion value chain is key to aligning the industry with a 1.5ºC pathway. In 2019, some 32 industry leaders signed the Fashion Pact ahead of the G7 Summit in Biarritz. The, launched by French President Emmanuel Macron, charged Kering chief François-Henri Pinault with the development of practical objectives for reducing the environmental impact of the fashion industry. At the United Nations Climate Change Conference (COP26) in November 2021, 130 retailers and 41 organizations signed the Fashion Industry Charter for Climate Action, pledging to cut emissions by 50 per cent in the next ten years. Beyond these voluntary agreements, a complex set of regulations and institutional initiatives has developed in recent years.

3.   EU LEGAL FRAMEWORK

In the EU, current legislation provides for a number of measures to achieve a more sustainable textile industry. The REACH regulation,[21] which came into force on 1 June 2007, constitutes an important step towards the objectives of health and environmental protection. In particular, the regulation makes the registration of chemicals mandatory, requiring companies to prepare dossiers containing the full chemical, toxicological and environmental profiles of products and restricting professional use to chemicals registered for that particular use. This obligation also has significant repercussions for the importation of chemical products, which have to be registered to enter the European market. In 2011 the EU adopted a regulation establishing harmonized provisions on the labelling and marking of textile products in order to eliminate barriers to the internal market in the textile sector.[22] The regulation makes labelling or marking of the fibre composition compulsory to ensure that correct and uniform information is made available to all consumers in the Union, to enable them to make informed choices.[23] In order to place a textile product on the market its fibre composition shall be indicated in a label or mark, which is durable, easily legible, visible, accessible and, in the case of a label, securely attached. The information must be accurate, easily understandable and provided in the official language or languages of the Member State where the product is sold. All products containing at least 80 per cent textile fibres, including raw, semi-worked, worked, semi-manufactured, semi-made and made-up products, are covered by the regulation.

In 2015 the European Commission launched its First Circular Economy Action Plan,[24] which includes a new economic model of production and consumption that involves sharing,

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[21]   Regulation (EC) No 1907/2006 – 'Registration, Evaluation, Authorisation and Restriction of Chemicals' (REACH) [2006] OJ L 396/1, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1907.

[22]   Regulation (EU) No 1007/2011 of the European Parliament and of the Council of 27 September 2011 'on textile fiber names and related labelling and marking of the fiber composition of textile products' and repealing Council Directive 73/44/EEC and Directives 96/73/EC and 2008/121/EC of the European Parliament and of the Council, [2011] OJ L 272, 1–64, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1007&qid=1687213468346.

[23]   See (10) in Regulation 1007/2011 (n 22).

[24]   Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'Closing the loop: an EU action plan for the circular economy', COM (2015) 614 final.

leasing, reusing, repairing, refurbishing and recycling existing materials and products. The purposes is to extend the life cycle of products and thereby reduce waste. When a product reaches the end of its life, its materials are kept within the economy through recycling, thereby creating further value. This is a departure from the traditional, linear economic model, which is based on a take–make–consume–throw away process. This model relies on large quantities of cheap, easily accessible materials and energy. In March 2020 the Commission published a Circular Economy Action Plan,[25] which will further enable transition to a circular economy, reducing pressure on natural resources and creating sustainable growth and jobs. The new action plan includes initiatives along the entire life cycle of products. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption and aims to ensure that waste is prevented by keeping resources in the EU economy for as long as possible.

The Commission launched the 2022 European Strategy for Sustainable and Circular Textiles[26] that recommends specific actions in this sector. It aims to ensure that by 2030, textile products placed on the EU market are recyclable and long-lasting, made from recycled fibres, free of hazardous substances and produced in a way favorable to social and environmental rights. It further promotes reuse and repair to avoid the production of textile waste and microplastics, introducing extended producer responsibility.

The Strategy seeks to introduce mandatory Ecodesign requirements to extend the life of textile products. Failures in quality such as colour fastness, tear strength or the quality of zippers and seams are among the main reasons for consumers to discard textiles. Increased durability will enable consumers to use clothing for longer and incentivize circular business models such as reuse, renting and repair, take-back services and second-hand retail, in a way that creates cost-saving opportunities to citizens.[27] The Strategy further declares that the Commission will introduce bans on the destruction of unsold products, including unsold or returned textiles.[28] In addition, the Commission will support initiatives to address the unintentional release of microplastics in the environment.[29]

Another initiative envisaged by the Strategy targets greenwashing, the Commission will introduce a Digital Product Passport for textiles based on mandatory information requirements on circularity and other key environmental aspects of products. To ensure consistency, the Commission will review the Textile Labelling Regulation, which requires textiles sold on the EU market to carry a label identifying the fibre composition and any non-textile parts of animal origin. As part of this review and subject to an impact assessment, the Commission will introduce mandatory disclosures of other types of information, such as sustainability and

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[25]   Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'A new Circular Economy Action Plan for a cleaner and more competitive Europe,' COM/2020/98 final.

[26]   Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'EU Strategy for Sustainable and Circular Textiles' (Strategy) [2022] Brussels, COM (2022) 141 final, available at https://eur -lex.europa.eu/resource.html?uri=cellar:9d2e47d1-b0f3-11ec-83e1-01aa75ed71a1.0001.02/DOC _1&format=PDF.

[27]   ibid., no. 69 above at p.3.

[28]   ibid., at 4.

[29]   ibid., at 5.

circularity parameters, products' size and, where applicable, the country where manufacturing processes took place ('made in').[30]

New EU rules will be introduced to ensure that consumers are provided a guarantee of durability at point of sale, as well as information relevant to repair, including a reparability score. The use of environmental claims, such as 'green', 'eco-friendly', 'good for the environment', will be restricted to products recognized for excellence in environmental performance under the EU Ecolabel, type I ecolabels, or specific EU legislation relevant to such claims. As foreseen in the Proposal of the Green Claims Directive, voluntary sustainability labels must rely on a third-party verification or certifications established by public authorities. There will be conditions for making green claims related to future environmental performance, such as 'climate neutral by 2030', and for comparative advertising.[31] The Commission also plans to review the EU Ecolabel criteria for textiles and footwear[32] to offer consumers an easily recognizable and reliable way to choose eco-friendly textile products. Finally, the Strategy foresees the introduction of harmonized EU extended producer responsibility rules for textiles with eco-modulation of fees. The objective is to create an economy for collection, sorting, reuse, preparation for reuse and recycling, as well as incentives for producers and brands to ensure that their products are designed according to circularity principles.

4. AMERICAN INITIATIVES

There is no federal law in the US that comprehensively considers the issue of sustainability in the textile industry, but there have been some recent initiatives. The Fair Labor Standards Act of 1938 (FLSA) prohibits garment manufacturers in the US from paying workers by a sum per piece rate. California's Garment Worker Protection Act,[33] which become effective on 1 January 2022, aims to ensure that workers in the garment industry are paid fairly, also prohibiting garment manufacturer or contractors from paying workers by piece or unit, which could result in hourly pay below California's minimum wage law. The new rules also expand protections afforded to garment workers and broadens the definition of garment manufacturing.[34]

A proposed law, the New York Fashion Sustainability Act, if passed would be the first US law to explicitly place sustainability requirements on large fashion companies doing business in New York and having global revenues in excess of $100 million. Companies subject to the proposed Act would be required to disclose their environmental and social due diligence policies, processes, and outcomes. According to Article 4, four disclosures are required under

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[30] ibid.

[31] ibid., at 6.

[32] 'EU Ecolabel', European Commission, https:// environment .ec .europa .eu/ topics/ circular -economy/eu-ecolabel-home_en.

[33] Senate Bill No. 62, CHAPTER 329, An act to amend Sections 1174.1, 2670, 2671, 2673, 2673.1, and 2675.5 of, and to add Section 2673.2 to, the Labor Code, relating to employment [Filed with Secretary of State 27 September 2021].

[34] A proposed federal bill, Fashioning Accountability and Building Real Institutional Change Act (FABRIC Act), aims to protect American garment workers and revitalize the domestic garment industry by improving working conditions, reforming the piece rate pay scale and investing in domestic apparel production. The bill has not been enacted into law.

the Act. First, companies are required to conduct 'supply chain mapping' involving mapping at least 50 per cent of their supply chains, focusing on suppliers with higher social and environmental risks. Second, companies will be required to publish a Social and Environmental Sustainability Report, describing what they did to identify, prevent, and account for potential adverse impacts. These reports would need to comply with global principles, such as the UN Guiding Principles on Business and Human Rights, the ILO Declaration on Fundamental Principles and Rights at Work, the OECD Guidelines for Multinational Enterprises and the OECD Due Diligence Guidance for Responsible Business Conduct. Third, an Impact Disclosure on Prioritized Adverse Environmental and Social Impacts would have to be made within 18 months of the Act's enactment. The impact disclosure would have to include quantitative baseline and reduction targets on energy and greenhouse gas emissions; annual volume of materials produced, including breakdown by material type; median wages of workers of prioritized suppliers and how this compares with local minimum wage and living wage; and the company's approach for incentivizing supplier performance with respect to workers' rights. Fourth, the Act expects fashion retail sellers and fashion manufacturers to disclose their targets for impact reductions, and for due diligence implementation and reporting the results, including estimated timelines and benchmarks for improvement. In this approach, climate change targets are considered absolute targets, to be aligned with the apparel and footwear sector science-based targets guidance promulgated by world research institutes. The Act, whether or not enacted, provides a plausible scheme.

5.   SOCIAL DRIVERS TOWARDS SUSTAINABILITY

Besides the various initiatives that have been launched, the topic of sustainability in fashion has attracted public interest related to movements that emphasize sustainability and the rights of future generations (such as Fridays for Future)*.* These movements have had social and environmental impacts on the textile supply chain. The Greenpeace Detox Campaign, launched in 2011, highlighted the links between global clothing brands, their suppliers and toxic water pollution around the world. Greenpeace asserted that companies have used nature, and in particular rivers and oceans, as a dumping ground for hazardous chemicals. Communities living near textile manufacturing facilities face water pollution as a daily reality, where regulations have not always prevented the release of toxic chemicals, particularly in the Global South.

Greenpeace is calling on companies to end the release of chemicals into rivers, lakes, lands, oceans and people. Since its launch, Greenpeace has challenged some of the world's most popular clothing brands to eliminate their releases of hazardous chemicals (supply chains and products).[35] The Clean Clothes Campaign, an alliance of various organizations, including trade unions and NGOs, in 16 European countries, is dedicated to improving working conditions in the global garment and sportswear industries.[36] It drew the attention of public opinion to the disaster which occurred at the Rana Plaza building in Dhaka, Bangladesh in 2013, which

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[35] 'Detox My Fashion', Greenpeace, www.greenpeace.org/international/en/campaigns/detox.
[36] Clean Clothes Campaign, www.cleanclothes.org.

housed several shops, a bank and five garment factories. The collapse of the building killed 1,138 and thousands suffered life-changing injuries.[37]

5.1   Digitization and Sustainable Fashion

The fashion industry has been revolutionized by digitization technology. The aim of digitalizing the fashion industry is to streamline the design, production and business of physical products for the real world and to achieve sustainability with the help of different digital tools.[38] In particular, efforts have been made to avoid the creation of waste in garment production by using new techniques to avoid or at least minimize fabric waste. This approach sees fabric waste not merely as an economic problem,[39] but also as an ethical and environmental problem.[40] It recognizes the two categories of textile waste: created by industry and created by consumers.[41] Pre-consumer textile waste is created during the manufacture of fibre, yarn, fabric, and garments. Post-consumer textile waste comprises garments and household textiles. The way in which the fashion industry uses fabric to create garments is arguably wasteful and inefficient. Conventional design approaches waste about 15 per cent of the fabric used to produce a cut-and-sew garments.[42] It is in this context that the 'Zero Waste Fashion Design' initiative developed, which refers to fashion design that creates no fabric waste.[43] The question becomes how new digitization techniques can be used to reduce textile waste in the modern fashion industry.[44]

Among the first digital elements to enter the fashion industry was computer-aided design (CAD). CAD is a technique that is used for pattern cutting (materializing a design into a real product using technical drawings).[45] In a mass production scenario, the pattern pieces of multiple sizes of the same style of a garment are arranged into a rectangular area, known as a marker, matching the dimension of the cutting table and fabric width.[46] The pattern cutting process is one of the most crucial in terms of waste generation and is responsible for an

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[37]   Ramona Vijeyarasa and Mark Liu, 'Fast fashion for 2030: using the pattern of the sustainable development goals (SDGs) to cut a more gender-just fashion sector' (2022) 7 Business and Human Rights J. 45.

[38]   Sayem, *'*Digital fashion' (n 1), 139.

[39]   Gerry Cooklin, *Garment Technology for Fashion Designers* (Iowa University Press, 1997), 9.

[40]   Kate Fletcher, *Sustainable Textiles – Design Journeys* (2d ed Earthscan, 2014).

[41]   Timo Rissanen, 'Zero-waste fashion design: a study at the intersection of cloth, fashion design and pattern cutting,' PhD, (University of Technology, Sydney 2013).

[42]   ibid., 19.

[43]   See Timo Rissanen and Holly McQuillan, *Zero Waste Fashion Design* (Bloomsbury Publishing, 2018).

[44]   Rissanen (n 42), at 14 ff.

[45]   Virginia Rolling, 'Wearable accessory designers' perceptions using 3D printing technology' (2022) 15 International Journal of Fashion Design, Technology and Education 158.

[46]   Shreshta Ramkalaon and Abu Sadat Muhammad Sayem, 'Zero-waste pattern utting (ZWPC) to tackle over sixty billion square metres of fabric wastage during mass production of apparel' (2021) 112 The Journal of Tthe Textile Institute 809.

average of 15 per cent of fabric wastage. In this field CAD is considered an important tool in achieving zero-waste design.[47]

A new technology used to reduce waste in the fashion industry is 3D technology. 3D printing represents a novel manufacturing technology associated with sustainability. 3D printing is an automated additive manufacturing process that builds a product by depositing material into successive layers until the garment is completed:

> The product is formed inside a 3D printer, in a similar manner to a traditional, 2D inkjet printer. To transform a 2D design into a 3D product, digital 3D computer-aided design (CAD) software is used to create the design sketch, which is then virtually sliced into the appropriate amount of horizontal layers needed to complete the product. Only the necessary amount of materials used to create each layer is deposited from the printer; no tooling is needed. Therefore, 3DP is the opposite of traditional, subtractive manufacturing, which cuts away unnecessary material to create the desired shape.[48]

Blockchain technology has also become popular in the fashion industry, as it facilitates proof of prior rights, provides evidence of creatorship, ensures the traceability of transactions and, with smart contracts, facilitates management of copyrights and other IP rights.[49] Blockchain technology's digital ledger allows tracking and tracing a fashion item from its creation to its acquisition. It can also guarantee the conditions in which goods are manufactured and verify that items were produced in compliance with ethical and environmental rules. From a consumer point of view, a scannable blockchain could be connected to tags or to tamper-proof QR codes that reveal whether or not the fashion item is genuine.[50]

A literature review shows that virtual fashion can reduce waste in the textile value chain, minimizing energy consumption and supporting sustainable business models.[51] Prior to COVID, digital technologies were proving useful in dealing with criticism of the fashion industry in relation to transparency and sustainability, reducing waste, time production and costs, while blockchain technologies are able to overcome the complexity of supply chains and to improve traceability.[52] In the post-pandemic era, digitalization and the rise of virtual communities with interactive gaming worlds and mixed reality offer new means for innovation. New developments in digital social experiences are laying the groundwork for virtual life in the metaverse.[53]

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[47] ibid.

[48] Alyson Vanderploeg, Seung-Eun Lee and Michael Mamp, 'The application of 3D printing technology in the fashion industry' (2017) 10 International Journal of Fashion Design, Technology and Education 170.

[49] Marie Malaurie-Vignal, 'Blockchain, intellectual property and fashion' (2020) 15 Journal of Intellectual Property Law and Practice 92.

[50] ibid., at 94.

[51] See Jonas Karl Johan Larsson, 'Digital innovation for sustainable apparel systems: experiences based on projects in textile value chain development' (2018) 22 Research J. of Textile and Apparel 370; Phuc Hong Huynh, 'Enabling circular business models in the fashion industry: the role of digital innovation' (2022) 71 International J. of Productivity and Performance Management 870.

[52] Pilar Gonzalez, 'Digital fashion in the metaverse' (Master's thesis, Politecnico di Milano, June 2022), www.politesi.polimi.it/handle/10589/188809.

[53] ibid., at 11.

5.2   Metaverse and Sustainable Fashion: Opportunity or Threat?

A key question becomes whether the metaverse can meet the current needs for greater sustainability in the fashion industry.[54] According to recent studies, clothing existing in the digital world was found to be more environmentally friendly than its physical counterpart, with the former emitting 97 per cent less CO_2 and consuming 3,300 litres less water per item. In particular, in the production stage, virtual design and product release can significantly reduce the textile industry's heavy use of water and reduce water pollution, landfill poisoning of soil and animal rights violations, as well as improving the working environment of employees and reduce the pollution in the supply chain.[55]

By replacing physical samples with digital ones during a company's design and development phases, a brand's carbon footprint can be reduced by 30 per cent.[56] Virtual items can be used for modelling, sampling and marketing before their physical iterations are placed in production, greatly minimizing the overall environmental impact of the lifecycle of a fashion item. Finally, when it comes to the sales side of accessories, digital models can help alleviate problems associated with overproduction and textile wastes, that are contrary to the EU Strategy for Sustainable and Circular Textiles.

Another issue centres on the use of fashion by newer generations. According to Boston Consulting Group,[57] in 2021, 20 per cent of digitally aware people aged 18 to 25 purchased physical clothing for the purpose of taking a picture or video and posting it on their social media accounts. At the same time, physical clothes are often bought for one-time use and later returned or discarded.[58] In the same vein, Daria Shapovalova and Natalia Modenova, the founders of Dress-X, a virtual fashion e-commerce site, state that according to their research, 9 per cent of customers in developed countries buy new clothes just to take pictures for their social profiles.[59] The site allows influencers and those who buy clothes just to take a photo or for a special occasion to move from fast fashion to 'digital fast fashion'. Dress-X launched a series of pop-up shops with specific content in Los Angeles to test this idea and concluded that a lot of fashion products are only used for the creation of content, and do not have to be produced physically.

Virtual runways may contribute to reduce the environmental impact of fashion. Fashion week takes place in succession in many cities around the world, twice a year with a significant environmental impact. The carbon emissions of the journeys undertaken by shoppers and designers to attend the four major fashion weeks (New York, London, Paris, Milan) are

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[54]   Ruobing Yan, 'A sustainable fashion industry business model revolution based on the metaverse: practices and reciprocal processes' (2022) 4 Highlights in Business, Economics and Management 363.

[55]   ibid., at 366.

[56]   Digital Fashion Sustainability Report 2021, https://dressx.com/pages/sustainability.

[57]   'Metaverse and sustainability in fashion, opportunity or threat?' (18 October 2022), www.bcg.com/publications/2022/rise-of-metaverse-fashion-and-sustainability-impact.

[58]   ibid., at 5.

[59]   See www.vogue.it/vogue-talents/article/moda-sostenibile-vestiti-virtuali-intervista-creatrici-ecommerce-dressx.

estimated at 241,000 tons of CO_2, equivalent to 51,000 cars on the road or lighting the Eiffel Tower for 3,060 years.[60]

Another major problem that could be addressed through the metaverse and digital twins[61] concerns companies selling their garments through an e-commerce platform.[62] Clothing purchased online is often returned due to size issues (sometimes consumers order multiple sizes and return the ill-fitting ones) or dissatisfaction with the colour or quality of the garment. A solution would be allowing customers to enter the metaverse and have their digital twin try on the garments before placing an order. The benefits of the metaverse include creating value for the company (customer satisfaction), convenience for customers (facilitating their purchasing choices) and increasing the robustness or service platforms.[63] In sum, the metaverse can be used to build a more sustainable fashion supply chain.[64]

There are also risks and damagers related to digital fashion. The massive consumption of digital fashion could increase energy consumption and related ecological impact. Although many brands are implementing environmental strategies to reduce their carbon footprint, they will have to expand those strategies for the use of new technologies. The Boston Consulting Report shows that consumers often do not realize the environmental impact of digital purchases. Fashion designers and consumers therefore need to consider the energy impact of these technologies in comparison to that of physical garments in order to make reliable sustainability decisions.[65]

5.3   Metaverse Fashion: CO_2 Generator, Reducer, or Force for Good?[66]

For a fashion brand, given the pressure to adopt sustainable production patterns, it is important to understand the different options available in the metaverse. To understand the impact of new technologies in regard to sustainability, three different scenarios should be explored – high-carbon metaverse, light-carbon metaverse and metaverse as a force for good.[67] First, fashion's growth in the metaverse is powered by a proof-of-work consensus mechanism. Consequently, there is a risk that CO_2 emissions could grow by between 0.6 per cent and 1.2 per cent by 2030. To estimate the incremental carbon footprint of fashion in the metaverse, the Boston Consulting Report has focused on the three use cases with the highest growth potential:

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[60]   Valentine Casati, 'Zero to market: measuring the carbon emissions of Fashion Week' (13 February 2020), www.ordre.com/en/news/sustainable-fashion-week-cfda-eco-carbon-travel-1409.

[61]   A digital twin is a virtual representation of a physical entity, living or non-living; of a person or even a complex system connected to a physical part and with which it can exchange data and information.

[62]   McKinsey, 'Digital twins: the foundation of the enterprise metaverse', www .mckinsey .com/ capabilities/ mckinsey -digital/ our -insights/ digital -twins -the -foundation -of -the -enterprise -metaverse#.

[63]   Michela Ornati, Anna Picco-Schwendener and Suzanna Marazza, 'Sizing up the body: virtual fit platform in fashion e-commerce' (2022) 9 International Journal of Fashion Studies 199.

[64]   There are risks related to the promotion of intensive use of immersive technology, including physical and psychological harm to users. Patrick Henz, 'The psychological impact of the metaverse' (2022) 2 Discover Psychology 47.

[65]   Metaverse and Sustainability (n 58), 9.

[66]   ibid.

[67]   ibid., 55.

video game skins, digital fashion and NFTs. It estimated that by 2030, fashion in the metaverse could generate emissions equivalent to between 17 and 34 Mn tonnes of CO_2. The annual CO_2e emissions of Sweden are currently at 35 Mn tonnes.[68] But, this is considerably less than what would be saved in moving away from the traditional model of the fashion industry. Further, this scenario may not materialize, as technology evolves. Ethereum recently changed to a proof-of-stake consensus mechanism, reducing energy usage and its carbon footprint by more than 99 per cent. This change provides a remedy to the criticism that NFTs have a staggering environmental impact.

In the low-carbon metaverse scenario, if blockchain sustainability issues are resolved, fashion in the metaverse would increase CO_2 emissions marginally by no more than 0.1 per cent.[69] The third scenario, digital fashion in the metaverse, provides an opportunity for the fashion industry to substantially reduce the carbon footprint of its traditional business model.[70]

6.   CONCLUSION

It is too early to assess whether digital fashion can make the fashion supply chain more sustainable. The hope is that it could create new business models capable of limiting textile production and waste, while providing new generations with opportunities to express their identity in the virtual world and decrease the throwaway culture in the physical world. The metaverse could lead to enormous benefits in terms of sustainability. However, the energy consumption of new technologies remains an issue of which brands, as well as consumers, must become aware to minimize its environmental impact. The metaverse is likely to only make a difference at the margins, as consumers will still need to dress in the real world. And it is in the real world that urgent solutions will have to be found, such as the innovation of industrial processes, development of sustainable and quality textiles and reuse and recycling of textiles that are currently sent to waste sites or to less wealthy countries.[71]

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[68]   ibid., 56.
[69]   ibid., 60.
[70]   ibid., 601.
[71]   Greenpeace Germany Report, 'Poisoned gifts from donations to the dumpsite: textiles waste disguised as second-hand clothes exported to East Africa' (2022), www .greenpeace .org/ static/ planet4 -international -stateless/ 2022/ 04/ 9f50d3de -greenpeace -germany -poisoned -fast -fashion -briefing-factsheet-april-2022.pdf.