PROMOTING SUSTAINABILITY IN THE LUXURY FASHION INDUSTRY: THE CASE OF BIELLA

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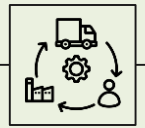
01

Figure 1 (Circular, 2021)

THE PROBLEM

THE RISE OF THE FASHION INDUSTRY

RAPID GROWTH IN THE LAST CENTURY



HIGHER DEMAND

INCREASED SUPPLY & PRODUCT DIVERSITY

INCREASED USE OF CHEMICALS IN THE MANUFACTURING PROCESS

NEGATIVE IMPACTS ON THE ENVIRONMENT

(Palacios-Mateo et al., 2021; Shishoo, 2012)

TOPIC SUMMARY

Figure 2 (Cultural Heritage Online, n.d.)

Location: Biella, Italy

Industry: Italian Luxury Fashion Industry (Webb, 2022)

Industrial Process: Textile Wet Processing

Textiles: Wool

Types of Impact: Environmental, Health and Economic

Related SDGs: SDG6, SDG9, SDG12, SDG13

RQ: How does the wet processing of wool in Biella impact its environment, and to what extent can this process become more sustainable?

DECONSTRUCTING THE RESEARCH QUESTION

STEPS OF WET PROCESSING

Scouring

–

Bleaching

–

Dyeing

–

Finishing

(Li et al., 2011; UNEP, 2020)

"Processing stage at which textile substrate is treated with colourants and/or chemicals" (Global Organic Textile Standard, n.d.)

Figure 3 (Textile School, 2018)

DECONSTRUCTING THE RESEARCH QUESTION

Biella, Italy → Historical fashion symbol

Figure 4 (Textile Value Chain, 2020)

WOOL

Staples of the Italian luxury textile industry

-

Large amounts of research

-

Used mainly in luxury brands

(Consorzio Biella, n.d.; I.T.B., n.d.)

02

RELEVANCE

Historical and Current

THE HISTORY OF BIELLA

Textile Industry going back to before Roman times

High geographical relevance for the region

Association of “Made in Italy” with timeless quality, luxury, and natural products only (Colasante & D’Adamo, 2021)

(Biella, n.d.; Consorzio Biella, n.d.; I.T.B., n.d.)

Figure 5 (Wikipedia, n.d.)

THE REALITY OF 'MADE IN ITALY'

(Li et al., 2011; Palacios-Mateo et al., 2021)

Chemical residues in the water
Micro-fibre air pollution
Inadequate waste disposal

Energy intensive
Health impact on workers from dye toxicity
High fabric waste

Figures 6, 7, 8, & 9 (United Nations, n.d.)

03

REVIEW OF CASE STUDIES

RELEVANT CASE STUDIES

(Angelis-Dimakis et al., 2016)	(Bernardi et al., 2022)	(Guercini & Ranfagni, 2013)	(EMCC, 2013) Marchi&Fildi
Eco-efficiency Environmental impact (LCIA) for dyeing in Biella Different assessment type	Two Italian Luxury Brands Importance of protecting the industrial district & territory (in Italy) Sustainability is beneficial for brands	Sustainable supply chain management for wool Importance and Implementation of a sustainable supply chain	Goal to make Italy the leading sustainable fashion industry Recycled yarn for their cotton Good example of sustainability in Biella

04

ENVIRONMENTAL ASSESSMENT

WHAT IS AN ENVIRONMENTAL ASSESSMENT?

01

BACKGROUND

What processes are currently occurring in Biella

02

PURPOSE & NEED

Why the project is needed & the (general) goal of the project and future goal

03

ALTERNATIVES CONSIDERED

Different projects & different approaches

04

IMPACTS

Description of environment & impacts of each alternative

*structure altered for format of presentation

(FEMA, 2020)

WHY AN ENVIRONMENTAL ASSESSMENT?

RESOURCE LIMITATIONS

Appropriate given time constraints and research available

APPLICABILITY

Compiling relevant information and alternatives available about the topic

FURTHER RESEARCH

Key to Finding of No Significant Impact or an EIS and/or potential improvements

BACKGROUND: DESCRIPTION OF BIELLA

- 650 Textile Factories (Angelis-Dimakis et al., 2016)
- Significant economic aspect
- Waterways → Cervo River Basin
- Conventional Practices for wet-processing (Angelis-Dimakis et al., 2016)

Figure 10: The Po River Basin (Pham et al., 2018)

PURPOSE & NEED

PURPOSE:
Reduce negative health and environmental impacts caused by traditional wet processing of wool

NEED:
To lessen future risks to the environment and human health

05

ALTERNATIVES FOR BIELLA

ALTERNATIVES CONSIDERED

1. No- Action
2. Natural Dyes
3. Recycled Wastewater

* Will not be discussing dismissed alternatives

ALTERNATIVE 1: NO-ACTION

- Conventional methods continue
- Geography (The Compass, 2016)
- Industrial water pollution

  (Meffe & De Bustamante, 2014)
- Hard water & product quality

  (The Compass, 2016)

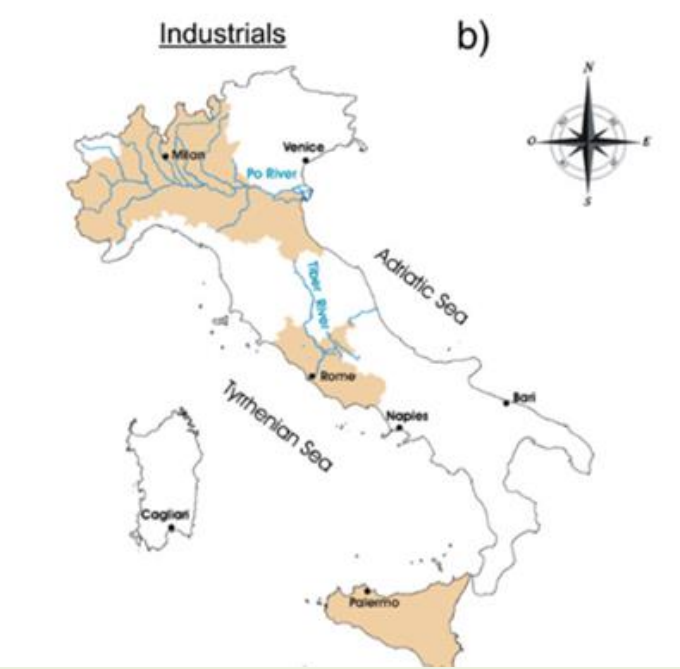


Figure 11: Industrial pollutants Italy (Meffe & De Bustamante, 2014)

ALTERNATIVE 1: NO-ACTION

- Environmental and health impacts (Angelis-Dimakis et al., 2016)
- What will the future look like?
- Economic focus
- Deindustrialization & crisis (La Città di Biella presenta il progetto Green Deal City Fashion, 2021)

Table 1
Contribution of the foreground and the background systems in the overall environmental impact for the baseline scenario.

Midpoint impact category	Environmental performance indicator	Foreground contribution	Background contribution
Climate change	0.01 $kgCO_{2eq}/m^3$	51%	49%
Freshwater resource depletion	0.15 m^3/m^3	100%	0%
Eutrophication	0.02 $kgPO_4^{3-}{}_{,eq}/m^3$	90%	10%
Human toxicity	2.68 $kg1,4DCB_{,eq}/m^3$	73%	27%
Acidification	0.05 $kgSO_{2,eq}^{-}/m^3$	28%	72%
Aquatic ecotoxicity	22.45 $kg1,4DCB_{,eq}/m^3$	99%	1%
Terrestrial ecotoxicity	1.94 $kg1,4DCB_{,eq}/m^3$	99%	1%
Photochemical ozone formation	0.003 kg $C_2H_{4,eq}/m^3$	25%	75%

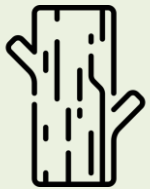
Figure 12: Environmental impacts Biella (Angelis-Dimakis et al., 2016)

ALTERNATIVE 2: NATURAL DYES

Natural Dyes: non-toxic, biodegradable (Shahmoradi Ghaheh et al., 2014, Imani et al., 2022)

Properties: Anti-bacterial (Rather et al., 2019), Anti-Moth (Tian, et al., 2022), UV-Protection (Dulo et al., 2020)

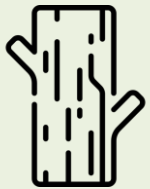
Can achieve desired results **without adding (metal salt) mordants**
(Hosseinnezhad et al., 2021)

ALTERNATIVE 2: NATURAL DYES

Many sources for natural pigments (for wool) :

- Neem Tree Bark (Tian et al., 2022)
- Shells of: peanuts, coconuts, macadamia nut, walnut, cashew (Dulo et al., 2020)
- Variety of Plants (Rather et al., 2019)
- Madder & Reseda (Hosseinnezhad et al., 2021)

ALTERNATIVE 2: NATURAL DYES

Madder & Reseda Plant

Walnut Shell

ALTERNATIVE 2: NATURAL DYES

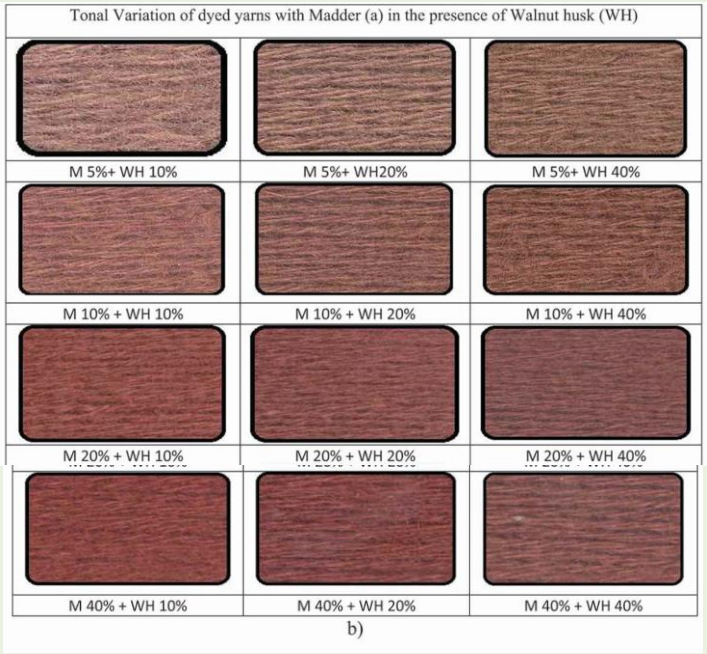


Figure 13: Samples of Natural Dye Combinations on Wool (Hosseinnezhad et al., 2021)

ALTERNATIVE 2: NATURAL DYES

Figure 14: Walnut-Shell Dye Samples (Ellis, 2016)

Walnuts are grown throughout Italy (Di Pierro et al., 2022) → use agricultural by-product for dyeing

IMPACT ON BIELLA: NATURAL DYES

- Reduction in human & eco toxicity → reduced river pollution (Angelis-Dimakis et al., 2016)
- Reduction in carbon emissions → less energy needed
- Reduction in water use

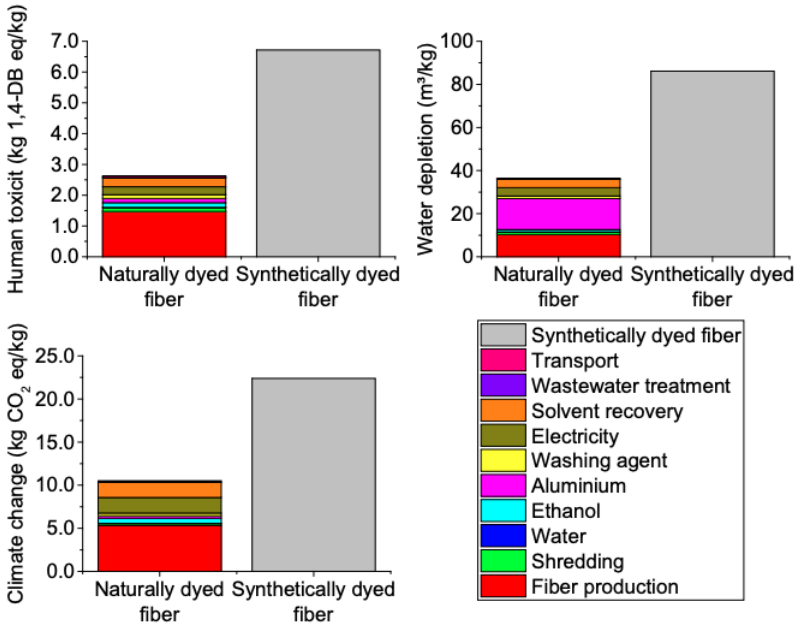
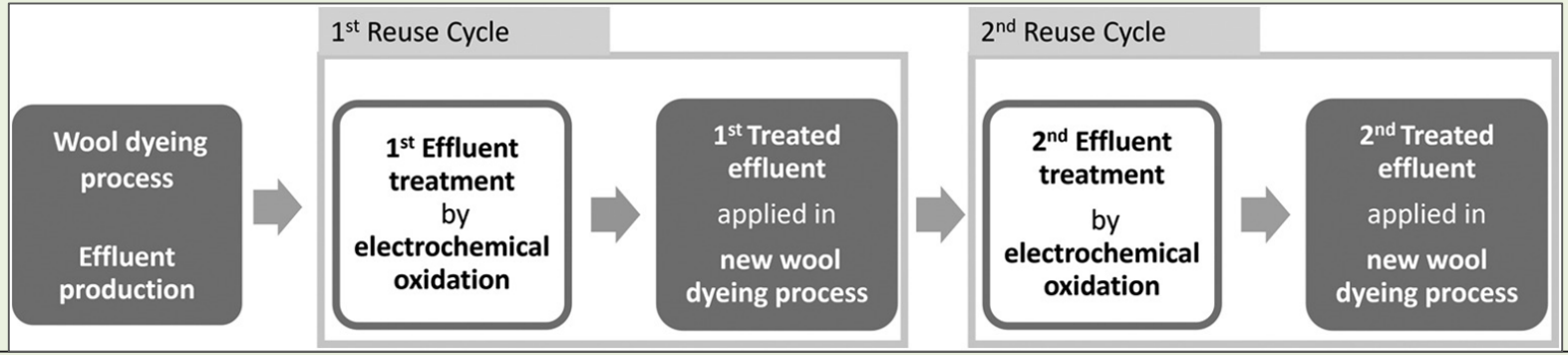


Fig. 7. Effect of dyeing 1 kg of fabric using agro-nut waste extract and the breakdown of the different processes included in the analysed value chain.

Figure 15: (Dulo et al., 2020)

ALTERNATIVE 3: ELECTROCHEMICAL TREATMENT

- **Electrochemical** treatment plants (Electrochemical Oxidation)
  - Treating the wastewater
  - Reusing the wastewater
  - Saves resources



Pinto et al., 2022

ALTERNATIVE 3: ELECTROCHEMICAL TREATMENT

- **Implementation Advantages** (Brilla Martínez-Huitle, 2015)
  - Energy efficiency
  - Can be automated
  - Easy handling
  - Safe

- **Environmental Advantages**
  (Chaplin, 2019)
  - Treat multiple types of contaminants
  - On-site production
  - Flexibility
  - Possible energy recovery

IMPACT ON BIELLA: ELECTROCHEMICAL TREATMENT

- **Less** freshwater use for dyeing and finishing processes
- **Less** chemical use
  - Less chemicals potentially ending up in the environment
- **Less** use of additives (such as salt)
  - Reduces consumption in dyeing baths

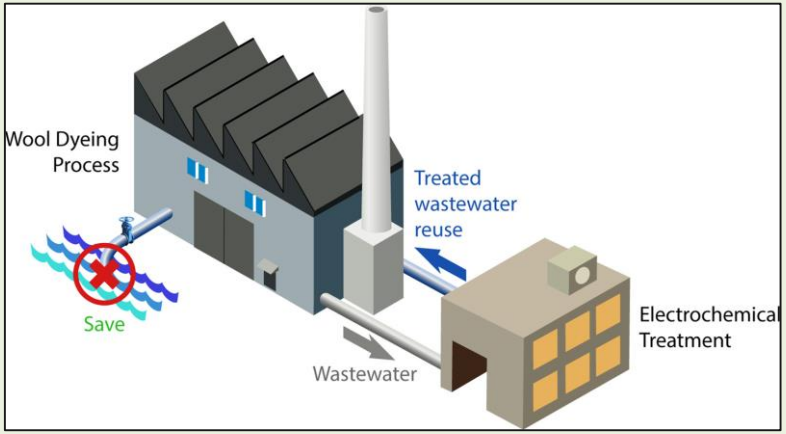


Figure 16: (Pinto et al., 2022)

06

FINAL RECOMMENDATIONS

RECOMMENDATIONS: ALTERNATIVE 2

NATURAL DYES

Steps for implementation:

- Experiment with sources for dyes
- Swap out synthetic dyes within processes

Feasibility:

- Using Italian agro-waste
- Resource-saving
- Sourcing natural dyes
- Lack of colour range
- Cost of process & product

(Angelis-Dimakis et al., 2016)

RECOMMENDATIONS: ALTERNATIVE 3

RECYCLING WASTEWATER

Steps for implementation:

- Assess the need
- Plan out the costs

Feasibility:

- Higher costs
- Development
- Energy demands
- Potential consequences

(Chaplin, 2019)

CONCLUSION

- “Made in Italy”
- Benefit of an EA
- Case Studies
- Change in current wet-processes of wool
  - Recommend: Natural dyes and electrochemical treatment
- **Further research:**
  - Cashmere
  - Range of colours
  - other steps of wet-processing
- **Luxury as the role-model for sustainability** (Kunz et al., 2020)

REFERENCES

Amatulli, C., De Angelis, M., Costabile, M., & Guido, G. (2017). Sustainable luxury brands: Evidence from research and implications for managers. Springer.

Angelis-Dimakis, A., Alexandratou, A., & Balzarini, A. (2016). Value chain upgrading in a textile dyeing industry. Journal of Cleaner Production, 138, 237-247.https://www-sciencedirect-com.mu.idm.oclc.org/science/article/pii/S0959652616300531

Barbaritano, M., Bravi, L., & Savelli, E. (2019). Sustainability and Quality Management in the Italian Luxury Furniture Sector: A Circular Economy Perspective. Sustainability, 11(11), 3089. https://doi.org/10.3390/su11113089

Bernardi, A., Cantù, C. L., & Cedrola, E. (2022). Key success factors to be sustainable and innovative in the textile and fashion industry: Evidence from two Italian luxury brands. Journal of Global Fashion Marketing, 13(2), 116-133. https://doi.org/10.1080/20932685.2021.2011766

Brillas, E., & Martínez-Huitle, C. A. (2015). Decontamination of wastewaters containing synthetic organic dyes by electrochemical methods. An updated review. *Applied Catalysis B: Environmental*, *166–167*, 603–643. https://doi.org/10.1016/j.apcatb.2014.11.016

Colasante, A., & D'Adamo, I. (2021). The circular economy and bioeconomy in the fashion sector: Emergence of a "sustainability bias." Journal of Cleaner Production, 329, 129774. https://doi.org/10.1016/j.jclepro.2021.129774

Chaplin, B. P. (2019). The Prospect of Electrochemical Technologies Advancing Worldwide Water Treatment. *Accounts of Chemical Research*, *52*(3), 596–604. https://doi.org/10.1021/acs.accounts.8b00611

REFERENCES (continued)

Di Pierro, E. A., Franceschi, P., Endrizzi, I., Farneti, B., Poles, L., Masuero, D., Khomenko, I., Trenti, F., Marrano, A., Vrhovsek, U., Gasperi, F., Biasioli, F., Guella, G., Bianco, L., & Troggio, M. (2022). Valorization of Traditional Italian Walnut (Juglans regia L.) Production: Genetic, Nutritional and Sensory Characterization of Locally Grown Varieties in the Trentino Region. Plants, 11(15), 1986. https://www.mdpi.com/2223-7747/11/15/1986

Dulo, B., De Somer, T., Phan, K., Roosen, M., Githaiga, J., Raes, K., & De Meester, S. (2022, 2022/12/01/). Evaluating the potential of natural dyes from nutshell wastes: Sustainable colouration and functional finishing of wool fabric. Sustainable Materials and Technologies, 34, e00518. https://doi.org/https://doi.org/10.1016/j.susmat.2022.e00518

EMCC. (2013). Italy: Ecotec yarns, Marchi &Fildi, case study. https://www.eurofound.europa.eu/nl/observatories/emcc/case-studies/the-greening-of-industries-in-the-eu/italy-ecotec-yarns-marchi-fildi-case-study

FEMA. (2020). Anatomy of an environmental assessment. https://www.fema.gov/emergency-managers/practitioners/environmental-historic/assessments/anatomy

Guercini, S., & Ranfagni, S. (2013). Sustainability and Luxury: The Italian Case of a Supply Chain Based on Native Wools. The Journal of Corporate Citizenship, 52, 76–89. http://www.jstor.org/stable/jcorpciti.52.76

Hosseinnezhad, M., Gharanjig, K., Rouhani, S., Imani, H., & Razani, N. (2022, 2022/11/23). Environmentally Dyeing Using Dried Walnut Husk as Bio-Mordant: Investigation of Creating New Red and Yellow Shades on Wool. Journal of Natural Fibers, 19(15), 10953-10963. https://doi.org/10.1080/15440478.2021.2002783

REFERENCES (continued)

Imani, H., Gharanjig, K., & Ahmadi, Z. (2022, 2022/09/01/). A novel efficient method for eco-friendly deep dyeing of wool yarns by extracted madder dyes in the presence of additives. Industrial Crops and Products, 183, 114970. https://doi.org/https://doi.org/10.1016/j.indcrop.2022.114970

Labfresh. (2016). Fashion waste index. Retrieved January 12, 2023, from https://labfresh.nl/en/pages/fashion-waste-index

La Città di Biella presenta il progetto Green Deal City Fashion. (2021, januari 30). Comune di Biella. https://www.comune.biella.it/news/citta-biella-presenta-progetto-green-deal-city-fashion

Kunz, J., May, S., & Schmidt, H. J. (2020). Sustainable luxury: Current status and perspectives for future research. Business Research, 13(2), 541–601. https://doi.org/10.1007/s40685-020-00111-3

Meffe, R., & de Bustamante, I. (2014). Emerging organic contaminants in surface water and groundwater: a first overview of the situation in Italy. Science of the Total Environment, 481, 280-295.Moretto, A.,

Macchion, L., Lion, A., Caniato, F., Danese, P., & Vinelli, A. (2018). Designing a roadmap towards a sustainable supply chain: A focus on the fashion industry. Journal of Cleaner Production, 193, 169-184. https://doi.org/https://doi.org/10.1016/j.jclepro.2018.04.273

Palacios-Mateo, C., van der Meer, Y., & Seide, G. (2021). Analysis of the polyester clothing value chain to identify key intervention points for sustainability. Environmental Sciences Europe, 33(1), 2. https://doi.org/10.1186/s12302-020-00447-x

REFERENCES (continued)

Pinto, C., Fernandes, A., Marques, A., Ciríaco, L., Miguel, R. A., Lopes, A., & Pacheco, M. J. (2022). Reuse of wool dyeing wastewater after electrochemical treatment at a BDD anode. *Journal of Water Process Engineering*, *49*, 102972. https://doi.org/10.1016/j.jwpe.2022.102972

Pham, V., Torresan, S., Critto, A., & Marcomini, A. (2018, 10/01). Alteration of freshwater ecosystem services under global change – A review focusing on the Po River basin (Italy) and the Red River basin (Vietnam). Science of the Total Environment, 652. https://doi.org/10.1016/j.scitotenv.2018.10.303

Rather, L. J., Shabbir, M., Li, Q., & Mohammad, F. (2019). Coloration, UV Protective, and Antioxidant Finishing of Wool Fabric Via Natural Dye Extracts: Cleaner Production of Bioactive Textiles. Environmental Progress & Sustainable Energy, 38(5), 13187. https://doi.org/https://doi.org/10.1002/ep.13187

Shahmoradi Ghaheh, F., Mortazavi, S. M., Alihosseini, F., Fassihi, A., Shams Nateri, A., & Abedi, D. (2014) Assessment of antibacterial activity of wool fabrics dyed with natural dyes. Journal of Cleaner Production, 72, 139-145. https://doi.org/https://doi.org/10.1016/j.jclepro.2014.02.050

The Compass. (2016, 14 juni). How Biella, Italy Became The Wool Capital of the World. https://blacklapel.com/thecompass/biella-became-wool-capital-world/

The Global Climate and Health Alliance (2022). Cradle to grave: The health harms of fossil fuel dependence and the case for a just phase-out. https://climateandhealthalliance.org/wp-content/uploads/2022/07/Cradle-To-Grave-Fossil-Fuels-Brief.pdf

UN Environment Programme (2020). Sustainability and Circularity in the Textile Value Chain - Global Stocktaking. Nairobi, Kenya.

REFERENCES (continued)

Webb, B. (2022, November 1). Could Made in Italy become synonymous with sustainability? Vogue Business. Retrieved January 12, 2023, from https://www.voguebusiness.com/sustainability/could-made-in-italy-become-synonymous-with-sustainability-fendi-prada-cnmi.

FIGURE REFERENCES

Circular. (2021). Building a second-hand strategy for luxury fashion. Circular - For resource and waste professionals https://www.circularonline.co.uk/insight/building-a-second-hand-strategy-for-luxury-fashion/

Cultural Heritage Online. (n.d.). Biella https://www.culturalheritageonline.com/location-241_Biella.php

Ellis, C. (2016, September 11). [Photograph]. Ellis Textiles. https://blog.ellistextiles.com/2016/09/11/black-walnut-season/

Sustainable Development. https://sdgs.un.org/

Textile School. (2018). Fabric wet processing techniques. https://www.textileschool.com/343/fabric-wet-processing-techniques/

Textile Value Chain. (2020). Italian luxurious heritage fashion brand, Moda Biella, is here with its festive & winter collection. https://textilevaluechain.in/news-insights/italian-luxurious-heritage-fashion-brand-moda-biella-is-here-with-its-festive-winter-collection/

United Nations. (n.d.). Make the SDGs a reality United Nations - Department of Economic and Social Affairs -

Wikipedia. (n.d.). Province of Biella. https://en.wikipedia.org/wiki/Province_of_Biella

THANK YOU FOR LISTENING!

Any questions or comments?