Table S1. Review sample of e-LCA studies applied to apparel (research and industry wide)

Reference	Universe/ context	Scope	Boundaries	Functional unit (FU)	Impact category	CO2eq excluding use and EoL	Difference including use and EoL
[1]	Research	Cradle-to-Grave of cotton knit shirt, polyester knit shirt and wool sweater (production mix China, Bangladesh, Vietnam, India, Indonesia and Cambodia; use and disposal in Australia; recycling 25% of the textile waste is disposed of through the landfill and another 75% textile waste is recovered through recycling and reuse.)	#1; #2; #4 (1, 9, 10); #5; #6 (1).	1 kg of apparel (1.7 kg cotton, 1.4 kg polyester and 2.1 kg wool are required to produce 1 kg of apparel)	1: **Global warming** (CO_{2eq})	23 $kgCO_{2eq}$/wool knit sweater; 7$kgCO_{2eq}$/polyester knit shirt; 8$kgCO_{2eq}$/cotton knit shirt;	+18 $kgCO_{2eq}$/wool knit sweater; +21$kgCO_{2eq}$/polyester knit shirt; +21$kgCO_{2eq}$/cotton knit shirt;
[2]	Research	Cradle-to-Crave in Turkey of a conventional cotton T-shirt;100% Conventional cotton; 100% Organic cotton 75% Organic cotton 50% Organic cotton; disposal by incineration	#1; #2 (1-6); #4 (1-6, 11); #5 (1); #6 (1)	1000 items of knitted and dyed cotton T-shirt with a total weight of 200 kg	4: **Global warming** (CO_{2eq}); terrestrial and aquatic eutrophication and photo-chemical ozone formation potentials	Conventional T-shirt 18 $kgCO_{2eq}$/kg apparel	+21 $kgCO_{2eq}$/kg apparel

[3]	Research	Cradle-to-Grave knitted cotton, PET, nylon, acryl, and elastane; cotton cultivation China; manufacturing, use and EoL Netherlands; 67% ends up in a municipal waste incinerator and 33 % ends up in a recycle bin (in the Netherlands, there is virtually no textile in landfills). Of the recycled material, 20 % is wearable and exported to developing countries and 13 % is not wearable and goes to low value materials.	#1; #2 (1-6); #4 (1); #5 (1-2); #6 (1)	1kg knitted fabric	20: Eco-costs 2012 (a prevention-based indicator), **CO_2 equivalent (carbon footprint)**, cumulative energy demand (CED), and ReCiPe (a damage-based indicator)	Cotton 23 $kgCO_{2eq}$/kg knitted fabric; Acryl 16 $kgCO_{2eq}$/kg knitted fabric; Nylon 22 $kgCO_{2eq}$/kg knitted fabric; PET 16 $kgCO_{2eq}$/kg knitted fabric; elastan 18 $kgCO_{2eq}$/kg knitted fabric	−0.60 kg CO_2 equivalent/kg for cotton
[4]	Research	Cradle-to-Grave 100% cotton T-shirt; cotton cultivation in China, production, use in China and EoL 100% landfill in China;	#1; #2; #3 (2) #4 w/o (7-9,11) #5; #6 (1)	1 T-shirt	10: abiotic depletion elements (ADPe), abiotic depletion fossil (ADPf), acidification potential (AP), **global warming potential** (GWP), photochemical ozone creation	5 kg CO_{2eq}/Tshirt	+1 $kgCO_{2eq}$/T-shirt

					potential (POCP), eutrophication potential (EP), water use (WU), human toxicity (cancer) (HTPC), human toxicity (non-cancer) (HTPNC), and ecotoxicity potential (ECP)		
[5]	Research	Cradle-to-Use of four different sweaters (100% cotton sweater 441 g; 100% wool sweater 350 g; 60% cotton/40% polyester sweater 545 g; 100% acrylic sweater 445 g); generic use and manufacturing data	#1; #2; #3 (2); #4 (w/o 7-11);#5	1 sweater	9: **Global warming**;Acidification;Ozone depleation;Eutrophication;Smog formation;Ecotoxicity; Human particulate; Human carcinogens; Fossil fuel depletion	22 $kgCO_{2eq}$/sweater(100% cotton) 12 $kgCO_{2eq}$/sweater (100% wool) 24 kgCO2eq/sweater (blend) 55 kgCO2eq/sweater (100% acrylic)	+28 kgCO2eq/sweater (100% cotton); +10 kgCO2eq/sweater (100% wool);+38 (blend); +31 kgCO2eq/sweater
[6]	Research	Cradle-to-Grave antibacterial polyester T-shirts containing either 31 mg of pure nanosilver,47 mg of nanoAg-TCP (0.93 mg of pure nanosilver), or	#1;#2; #4 w/o (7, 8, 9,11);#5(1,2);#6 (1,4)	1 year use T-shirt	7: **Global Warming Potential**; Seawater toxicity; Freshwater toxicity; Human	2.55 kgCO2eq/T-shirt (triclosan); 2.7 kgCO2eq/T-shirt (nanosilver – FSP) 7.67 kgCO2eq/T-shirt (nanosilver – PlaSpu)	

	22 mg of triclosan T-shirt; Production yarn China; Production T-shirt; retail, use and EoL (incineration) in Switzerland			toxicity; Terrestrial ecotoxicity; Cumulative Exergy Demand; Non-renewable energy demand		
Research	Cradle-to-Grave leather shoes; Cow leather (for the outsole), bovine leather (for the upper material and/or the insole and stiffener), and goat leather (lining); all stages in Spain; EoL landfill 95% incineration 5%	#1,#2,#4 w/o (7,8,9,11), #6 (1,2,4)	1 pair	7: Non-Renewable Prime Materials Depletion (NRPMD); Water Consumption (WC); Non-Renewable Energy Sources Depletion (NRESD); **Global Warming Potential** (GWP) Acidification Potential (AP) Eutrophization (Nutrification) Potential (EP) Human Toxicity Potential (HTP)	2 $kgCO_{2eq}$/pair	+0.5 $kgCO_{2eq}$/pair

PEF T-shirt [7][8]	Research & industry	Cradle-to-Grave of Men T-shirts - Women T-shirts - Children (2 to 7 years old) T-shirts - Children (8 to 14 years old) T-shirts - Babies T-shirts (raw materials are a blend of Cotton, Polyester, Viscose, Polyamide, Polypropylene, Acrylic, Wool, Elastane, Chlorofibre, Flax, Hemp and Silk). Recycling (11%), Incineration (with energy recovery) (36%), Incineration (without energy recovery) (1.4 %), Landfilling (51.6%); 87% of the T-shirts are recycled into wiping cloths; 13% of the T-shirts are recycled into insulation materials. Recycling into cloths avoids the production of wiping paper. The production of insulation materials avoids the production of glass wool.	#1; #2; #3; #4; #5; #6		1 T-shirt	16:**Climate Change**, Ozone Depletion, Particulate Matter, Ionising Radiation, Photochemical Ozone Formation, Acidification, Eutrophication – terrestrial, Eutrophication – freshwater, Eutrophication – marine, Ecotoxicity for aquatic fresh water, Human Toxicity - cancer effects, Human Toxicity - non-cancer effects, Resource Depletion - mineral, fossil; Resource Depletion – water; Land Use	5.43 -3.18 kg CO_{2eq}/T-shirt (33.9 kg CO_{2eq}/kg Men Tshirt - 42.4 kg CO_{2eq}/kgbaby T-shirt)	+ 0.85 kgCO_{2eq}/man T-shirt, +0.44 kgCO_{2eq}/baby T-shirt (+5.3 kgCO_{2eq}/kg man T-shirt, + 5.87 kgCO_{2eq}/kg baby T-shirt)

PEF footwear [7] [11]	Research & industry	non-leather shoes (any shoes with less than 50% leather by weight) with different functions: Sports, Leisure / Fashion, and Work / Waterproof ; shoes are collected and disposed as household waste in Europe, 58% is sent to landfill and 42% is sent to incineration (no recycling). Assume manufacturing waste is 100% landfilled.	#1; #2; #3; #4 (w/o 11); #6 (1,4)	1 pair non-leather shoes	16: **Climate Change**, Ozone Depletion, Particulate Matter, Ionising Radiation, Photochemical Ozone Formation, Acidification, Eutrophication – terrestrial, Eutrophication – freshwater, Eutrophication – marine, Ecotoxicity for aquatic fresh water, Human Toxicity - cancer effects, Human Toxicity - non-cancer effects, Resource Depletion - mineral, fossil; Resource Depletion – water; Land Use	5.23 - 14.9 kg CO_{2eq}/pair	NA

[9]	Research & industry	Cradle-to-Grave of cotton T-shirt, pair of jeans, dress, jacket and hospital uniform. Retail, use and EoL in Sweden. EoL 100% Municipal incineration with cogeneration of heat and electricity.	#1; #2 (2); #3 (2); #4 (1-6) (9-11); #5; #6 (1)	1 garment	12: **climate change**,water use, non-renewable energy use, agricultural land occupation, freshwater ecotoxicity, freshwater eutrophication, human toxicity (carcinogenic and non-carcinogenic), photochemical oxidant formation, and acidification	17 -2 kg CO_{2eq}/garment	Credits for incineration w/ energy recovery compensate the usage burden

Nudie Jeans[10]	Research/Industry	Cradle-to-Grave life cycle of the Nudie jeans with cotton and elastane, weight 0.720 kg, (0 re-uses and 3 reuses). The raw material extraction mainly takes place in India and Turkey and the production of the jeans mainly takes places in Italy and Tunisia. The geographical boundary for the waste management of the discarded jeans, the storage of the jeans, the use phase of the jeans and the repair system is set to Sweden	#1; #2; #3; #4 (1-6, 10); #5 (1,2); #6 (1)	1 pair of jeans	18: **Climate Change**; Ozone Depletion; Particulate Matter; Ionising Radiation; Photochemical Ozone Formation; Acidification; Euthrophication; Material depleation; Freshwater Toxicity Potential; Human Toxicity Potential; Marine Aquation Ecotoxicity Potential and Terrestric Ecotoxicity Potential	4.0 $kgCO_{2eq}$/jeans (0 reuse) to 2 $kgCO_{2eq}$/jeans (3 reuses)	+0.5 $kgCO_{2eq}$/jeans

GORE[11]	Industry	Cradle-to-Gave GORE-TEX® outdoor garment. Retail, use and EoL in North America, 94 g/m² and 134 g/m² nylon. After the garment has been manufactured in Indonesia it is packed and distributed via a Californian distribution hub to US consumers. Transport is assumed to take place by overland or ship transport (90%) and air transport (10%). The consumer trip to a retailer was estimated as a single 10 km return trip in an average car. After use phase (5 years) the garment is assumed to end up in a landfill in the US.	#1; #2; #4 (9,10); #5 (1); #6 (1)	1 jacket	18: **climate change**, ozone depletion, terrestrial ecotoxicity, terrestrial acidification, freshwater ecotoxicity, freshwater eutrophication, marine eutrophication, marine ecotoxicity, human toxicity, photochemical oxidant formation, particular matter formation, ionising radiation, metal depletion, water depletion, fossil depletion, agricultural land occupation, urban land occupation, natural land transformation	47 kgCO_{2eq}/1 jacket	+25.3 kg CO_{2eq}

Levi Strauss & Co [12]	Industry	Cradle-to-Grave Levi's® 501® jeans,cotton produced in United States/India/Pakistan/Brazil/China/Australia; use and EoL United States/ United Kingdom/ France/ China; landfill and incineration in US	#1; #2; #3; #4; #5; #6	1 pair Levi's® 501® jeans	6: **Climate change**, water intake, water consumption, eutrophication, land occupation, abiotic depletion	US 20 $kgCO_{2eq}$/pair jeans	US +13.4 $kgCO_2eq$/pair jeans

Table S2. Diversity of existing 3rd party certification labels applicable to Fashion products

Label and Creator	Description	Scope
EU Commission Decision 2014/350/EU and Decision 2016/1349/EU	EU Ecolabel Textiles: Limited use of harmful substances; Reduction in water and air pollution; tested for durability[13] EU Ecolabel Footwear products: Natural origin raw materials sustainably managed, reduced pollution in production processes, minimized use of hazardous substances, tested for durability, care labeling, repair recommendations, dispose instructions. [14]	Clothing, Textile and Footwear Materials – Tier 3 Environmental- Tier 2 Social Audit- Tier 1 Hazardous Substances- final product Packaging User information Durability
I.CE.C - Institute of Quality Certification for the Leather Sector	Product certification for low environmental impact leathers (“ecoleathers” or "ecological leathers") based on UNI 11427 standard [15]	Leather Environmental- Tier 2
LWG-Leather working group	Develop and maintain a protocol that assesses environmental compliance and business practices regarding sustainability by promoting improvements in the leather industry. [16]	Leather Companies Environmental- Tier 2
CSCB- Brazilian Leather Certification of Sustainability	Understands sustainable tanneries to be those that develop their activities with economic results, seek to reduce the inherent environmental impact of activities while providing better working conditions for their employees, and respect the community in which they operate. [17]	Leather companies Economic, Environmental and Social- Tier 2

 Textile Exchange global	Tool to recognize the best practices of farmers; ensuring that wool comes from farms that have a progressive approach to managing their land, practice holistic respect for animal welfare of the sheep and respect the Five Freedoms of animal welfare. [18]	Wool Animal Welfare, Land management and Social welfare- Tier 3 Chain of Custody
 Fairtrade Labelling Organization	Cotton grown and sold under Fairtrade conditions is tracked through the supply chain and is eligible to carry the "Fairtrade Certified Cotton Mark" on end products. [19]	Fiber crops (including cotton) Social, Economic and Environmental- Tier 3 Chain of custody
 Better Cotton Initiative	BCI Farmers produce cotton in a in a way that is measurably better for the environment and farming communities. [20]	Cotton Environmental and Social- Tier 1
 Aid by Trade Foundation	Promotes environmental protection and aims to combat poverty in smallholder cotton farms in participating African countries. [21]	Cotton Environmental, Social and Economy, No GMO's- Tier 3 Chain of Custody
 GOTS-Global Organic Textile standard	Requires the use of certified organic fibers; provides both demanding environmental and social criteria applicable to all processing stages and certification must base on independent on-site inspections. This Standard covers the processing, manufacturing, packaging, labelling, trading and distribution of all textiles made from at least 70% certified organic natural fibres. [22]	Textile Products Environmental, Social, No GMO's- Tier 3, 2, 1, 0 Packaging, labeling
 Textile exchange	Intended for companies that are making and/or selling products with recycled content. The standard applies to the full supply-chain and addresses traceability, environmental principles, social requirements. [23]	Product with recycled content Environmental and Social- Tier 3, 2, 1, 0 Chain of Custody

OEKO-TEX® company	Sets benchmarks with regard to transparency: the manufacture of a textile can be tracked. Labelled textiles are tested for harmful substances, manufactured in an environmentally friendly way and produced under fair working conditions.The product has been tested for harmful substances and therefore is harmless in human ecological terms. It also guarantees that the textile or leather product has been manufactured using sustainable processes under socially responsible working conditions. [24]	Textile and leather products Environmental and social- Tier 2, Tier1 Tested for harmful substances
Cradle to Cradle Products Innovation Institute	Demonstrate efforts in eco-intelligent product design: eco materials, recycling, renewable energy, water efficiency and social responsibility and are awarded either Basic, Silver, Gold, or Platinum level certification. This applies to materials, sub-assemblies and finished products. [25]	Products Environmental and Social- Tier 2, 1 Chemicals content, material reutilization
PETA-People for The Ethical Treatment of Animals association	Can be placed on tags and labels and on webpages of products made with all-vegan materials, alternatives to animal-derived materials. [26]	Products Free of animal derived materials- Tier 3
Nordic Swan Ecolabel	Nordic countries ecolabel includes criteria related with include environmental, quality and health. [27]	Products Environmental, Safety and quality- Tier 1, 2, 3
Biodynamic Federation – Demeter International	This label aims to ensure that the raw materials (plant and animal) are produced according to the principles of biodynamic agriculture. [28]	Textile- raw materials and products Environmental and social- Tier 3, 2, 1 No GMO's
	Textile collections and product ranges produced CO_2-neutrally and from fair-trading bioRe® organic cotton in a fully transparent[29] **chain that is traceable online right back to farmers..**	Cotton Textile Products Environmental, Social- Tier 3, 2, 1

Remei company	This label aims to ensure that ecological and recycled garments ecological ad respect the environment and people throughout their life cycle. [30]	Textile Product Environmental, social, packaging, chemical safety, performance- Tier 3, 2, 1
Ecocert company		
Bluesign company	This label aims to ensure that the manufacture of clothing respects the environment. It relates only to the manufacture of textile articles. [31]	Textile Product Environmental, Social, chemicals safety, packaging- Tier 1
Forest Stewardship Council	All the materials used in the products bearing this labels are sourced from forests that have been audited by an independent third party to confirm they are managed according to FSC's rigorous social and environmental standards. [32]	Forest products Environmental and social Tier 3 Chain of custody
Programme for Endorsement of Forest Certification	The PEFC label on a product, it means that it comes from a PEFC-certified forest (obviously, only the forest-based material within the product). A PEFC-certified forest is a forest that is managed in line with the strictest environmental, social and economic requirements. [33]	Forest products Environmental and social Tier 3 Chain of custody

Table S3. Checklist of criteria and evaluation methodologies for a Sustainable Fashion Product

Step (according to Figure 2) /HiggTier/Category	Criteria	Tentative Evaluation Method	Comments
Step #1/Tier #3/ Raw materials	Made with low environmental impact materials	e-LCA, Higg MSI, Eco-cost, EP&L, % of raw materials certified (eg Ecopelle, GOTS, GRS, Organic blended, Organic 100, BSI, Demeter, Remei),	Can be considered, for example, raw materials produced from recycled, biodegradable, organic or renewable materials and/or materials produced through less impact processes [34,35]
	Reduced use of synthetic fibers	% synthetic fiber	Reduce the use of synthetic fibers that can release microplastics during laundering. [36]
	Reduce or eliminate materials from social risky sources	s-LCA, % of origin certified raw materials (eg GOTS, GRS, BSI, Cotton Africa, Demeter, Remei, FairTrade), social audits, suppliers self-declarations or commitments as CoC signed, DNA tests [37], blockchain systems [38]	For example, should be avoided cotton from Uzbekistan or conflict minerals in buttons or zippers as well as exotic animal's skin or fur. [39][40][41] Prefer known origin (eg certified raw materials.)
	Animal origin Materials from responsible sources	% of Certified raw materials for animal welfare (eg RWS), public suppliers list, audits to suppliers, suppliers self-declarations/commitments (eg CoC signed), DNA tests, blockchain systems	Prefer leather from animals raised for their food not solely for their hide, as well as down, wood or exotic leather from farms complying with minimum welfare requirements and protecting biodiversity. [41][42] Certified Animal origin Materials or controlled with audits to the production locations.
	Forests origin Materials from responsible sources	% Certified raw materials (eg. FSC, PEFC), CanopyStyle Audits to viscosis producers, suppliers self-declarations/commitments (eg CoC signed), blockchain systems	Prefer responsible viscose/rayon and other wood products from more responsible suppliers can protest ancient forest and biodiversity [35]

Step #2&3/ Tier #1 &2/Processing and Production	Materials free from Restricted Chemicals substances	Chemical tests (eg according ZDHC, AFIRM)	Materials tested according applicable chemicals legislation and/or other standards as ZDHC or AFIRM. Wastewater tested under the ZDHC Guidelines. [43]
	Low environmental impact Materials or substances	e-LCA, Higg MSI, Eco-cost, EP&L, certified materials or substances	Can be considered, for example, materials or substances produced from recycled, biodegradable, organic or renewable materials and/or materials produced through less impact processes [44]
	Materials and products from suppliers with reduced social risks	sLCA and Social audits according recognized standards (e.g. Smeta, Amfori BSCI, ETI, vHigg FSLM, SA8000), suppliers self-commitment/declaration (eg CoC signed)	Corrective action plans and zero-tolerance policies against severe human rights violations (e.g. no forced labor, adequate Health and Safety conditions, living wages) are important tools to reduce social risks on the production. [45]
	Materials and products from suppliers with processes with reduced environmental impact.	Environmental audits according recognized standards (e.g. ISO 14001, vHigg FEM, EMAS) specially concerning Mills, Laundries and Tanneries	Corrective action plans and improvement specific programs for critical production steps (including energy use, harmful chemical substances, water use, waste water and waste managements) are important tools to reduce environmental impacts on the production. [46]
	Packaging with low impact	e-LCA, Higg PM, Eco-cost; EP&L, FSC, PEFC, other product certifications	Should be reusable, reduced and made with repurposed, recyclable, biodegradable materials and produced in a responsible manner. [47]
	Good Quality and Durable	Performance and durability tests	Stronger products by process, quality of the materials, no defects, easy to use, suitable for purpose and adequate performance. Durability can be evaluated with laboratory tests (as colour resistance to perspiration, washing, light) [13]
	Product conform with applicable legislation	Tests on materials and/or final products (including labelling, chemicals, Flammability, security and other applicable requirements)	Conformity with legislation will depend on the markets where product is going to be sold (for example the United States, Europe and China have different legal requirements)
Step #4/ Tier #0/ Retail	Retailer/Brand with a sustainability management system	Company certification/audits (eg ISO 14001, EMAS, SA8000) and/or Sustainability report/assessment (eg GRI, report, ISO 26000, Higg BRM)	Certification, assessments and public information about how Retailer/Brand is managing environmental, social and financial aspects of sustainability assures transparency and promotes the improvement.

	Retailer offices, warehouses and stores with reduced environmental impact	Environmental Audits and/or certifications (e.g. LEED, BREEAM)	Corrective action plans and improvement specific programs for critical steps (including energy use, harmful chemical substances, waste, water use, and wastewater managements) are important tools to reduce environmental impacts on the retailer and logistic activity.
	Public Supply Chain	Public list of suppliers (Tier 1, 2 and 3); Transparency index score	Considering transparency as the main driver to promote Fashion sustainability
	Product with low environmental impact (including packaging)	e-LCA, Higg PM, Eco-cost; EP&L, product certification (e.g. Cradle to Cradle, Oeko-tex made in Green, Ecolabel)	Product development process that considers sustainability principles along the product and packaging life cycle. [48][49]
	New business models	Rent, swapping, second hand market, collaborative consumption models	Promote and give the alternative to clients to have access to more sustainable business models [50]
	Equivalent to Carbon offsets	Carbon sinks initiatives	For example initiatives to plant trees to offset the product carbon footprint [51]
Step#5/ Consumer	Product with easy care/maintenance.	Low wash temperatures, easy ironing,	For example lower wash temperatures, easy ironing, suitable to use with eco-friendly laundry detergents and other low impact cleaning products (confirmed with performance tests.
	Care Labels	Care labels with cleaning and care instructions to increase the product life	Including instructions to avoid microplastics release during washing (if applicable). [52]
	Labelling Information	Fiber composition, "made in", other legal requirements, product certifications, disposal/recycle instruction, code bar (or other way to assure traceability), suggestion about donation for product 2nd life	To comply with legal requirement and give consumer the possibility to do more conscience choices when buying, using or to disposal and well as clearly assure the product traceability (specially in case of a recall and/or certification control process). [50]

	Clear information about the product (for on-line sales)	Clear pictures, product characteristics, functionalities, demo videos, materials and sizes details, instructions as well as other useful information.	Clear information to consumer in order to minimize products return and reverse logistics. [53]
	Product easy to customize, adapt, repair and/or repurpose (including package)	Make possible some product customization, spare parts available, instructions to consumer about how to do it	For example, trousers with drawstrings to easily adapt waist, elastic jeans adaptable to different sizes, packaging possible to be used to store or convert in other products (e.g. toys)[54]
	Positive appreciation from consumer about the brand and product sustainability	Sustainable Brand Index, Sustainability fashion index with ACSI	Should be considered the end consumer perception about product sustainability
Step#6/ Waste management	Easy to disassembly and recognized value of each component	Monofiber fabrics, mono-materials, fewer components and/or parts, instructions for consumers on how to disassembly and disposal	For example, use just 1 fiber fabrics, fewer seams, yarns that disintegrates with heating or microwave, stitching rather than gluing are good methods to make the disassembly easier. [55]
	Easy to disposal	Take-back programs and/or separate waste collection systems	For example, discounts on the purchase of a new products when delivering an old product and separate waste collection can promote the product circularity. [56]

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