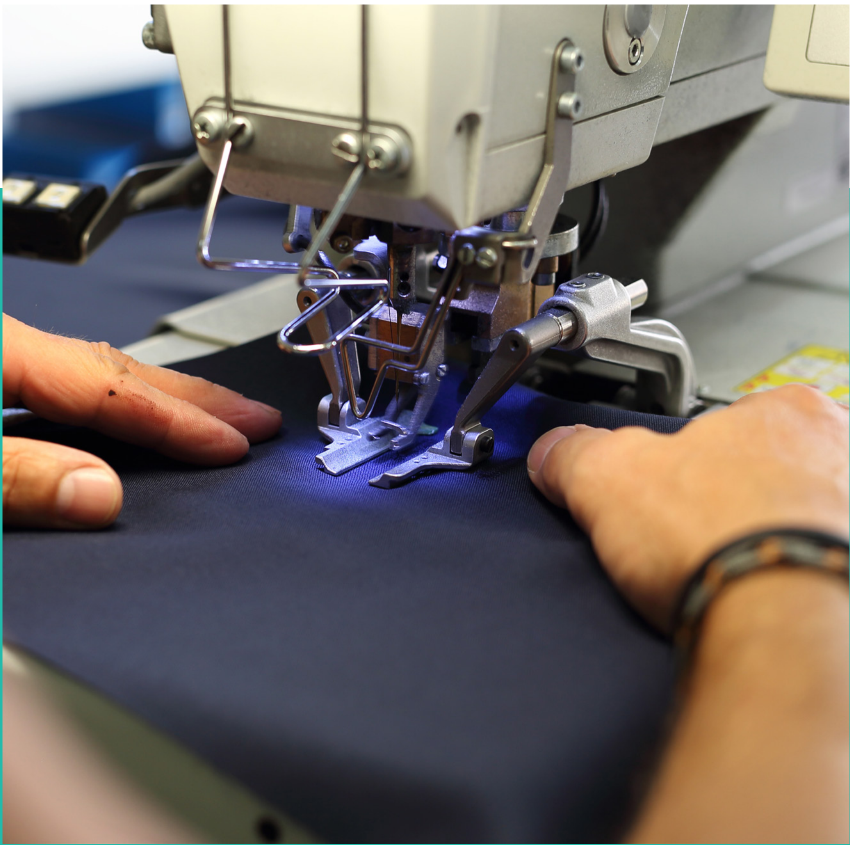
March 2017



FASHION FOR GOOD

C2C Certified™ "How-To" Guide

Handbook for Garment Manufacturers to
Produce Cradle To Cradle (C2C) Certified™ Products

Prepared by Fashion for Good, MBDC and McDonough Innovation based on the Cradle to Cradle Certified ™ Product Standard version 3.1.

For the most recent information on the Product Standard, please visit www.c2ccertified.org.
For feedback, questions and suggestions, please contact contact@fashionforgood.com.

THE STORY OF THE C2C CERTIFIED "HOW-TO" GUIDE

In June 2016, a leading European fashion retailer and Fashion for Good jointly helped two India-based garment manufacturers – Cotton Blossom and Pratibha Syntex – to develop and produce two Cradle to Cradle (C2C) Certified™ T-shirts[1]. The T-shirts were certified GOLD – an achievement level not seen before for a fashion garment. The lessons learned during this collaboration are shared in this "How-To" Guide, in the hope that they will inspire other garment manufacturers to develop C2C Certified products too.

The project team comprised people from the following organisations:

- Fashion for Good – served as overall project manager
- Leading European fashion retailer
  - provided design and development resources
  - identified suitable suppliers
  - built a marketing campaign
  - will sell the T-shirts across Europe, Brazil, and Mexico
- MBDC – served as assessor for the C2C Certified Products Program
- McDonough Innovation (MI) – provided advice on design and production requirements, and supported the development of this "How-To" Guide

In total, the project took nine months. As a first step, the project team visited Cotton Blossom and Pratibha Syntex to develop a baseline assessment of their factories against the C2C Certified criteria. Since both manufacturers already operated best-practice programmes for water treatment, energy efficiency, and renewable energy, the improvements needed in these areas were minimal.

The two manufacturers submitted the T-shirts' Bill of Materials (BoM), including process chemicals, to MBDC for an initial chemical assessment. MBDC then worked with the two manufacturers to optimise the materials and chemicals used, i.e. to replace potentially hazardous or uncharacterized chemicals with chemicals that had been positively assessed.

The project team developed a Material Reutilisation strategy, and coordinated the purchase of Renewable Energy certificates (RECs) and carbon offsets to fulfil C2C Certified criteria for Material Reutilisation and Renewable Energy respectively.

This "How-To" Guide reveals many best practices from Cotton Blossom and Pratibha Syntex, and discusses several of their showcase successes. Those features, together with an outline of the principles and criteria of the C2C Certified Products Program, should make this handbook a valuable resource for garment manufacturers aspiring to produce C2C Certified products.

Thoughts on this handbook are encouraged and welcomed, so please reach out at contact@fashionforgood.com

The Fashion for Good team, March 2017

[1] Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

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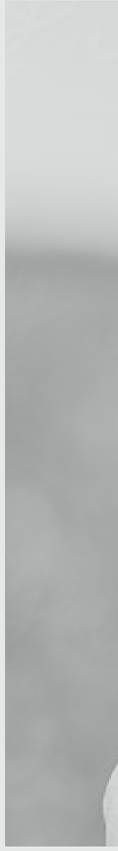

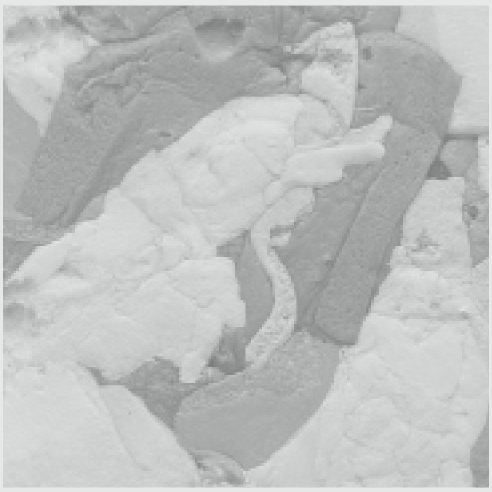

FASHION FOR GOOD

1. INTRODUCTION TO THE CRADLE TO CRADLE CERTIFIED™ PRODUCTS PROGRAM[2]

The Cradle to Cradle (C2C) Certified™ Products Program[2] is a multi-attribute product certification that assesses products and materials for safety to human and ecological health, design for future (re-)use, and sustainable manufacturing.

ASPIRATION OF CRADLE TO CRADLE

The end goal is to create products that support a delightfully diverse, safe, healthy and just world, with clean energy, soil, water and air – equitably, economically, ecologically, and elegantly enjoyed.

APPAREL CONTEXT

The current take-make-waste cycle of fast fashion has several negative effects: it contributes to water pollution and climate change, consigns large volumes of waste to landfills, and poses risks to worker health and safety. End customers are becoming more conscious of the social and environmental impacts that their clothing purchases make, and they are demanding more from the companies that manufacture their clothing.

In response to this rising tide of awareness, a number of sustainability initiatives have emerged. For example, more than 200 brands, manufacturers, retailers and non-profits have come together under the banner of the Sustainable Apparel Coalition to develop new ways of optimising product and supply-chain performance. Many initiatives are also promoting the "circular economy" by closed-loop recycling of materials.

The C2C Certified Products Program is the only product-based certification that is based on rigorous, science-based criteria for all aspects of sustainability. It provides a means for manufacturers to benchmark their current performance and decide how to improve it, and it helps retailers to communicate this continuous improvement strategy to end customers.

BENEFITS TO MANUFACTURERS

The C2C Certified Products Program can help manufacturers by:

- benchmarking a product's design for safety to humans and the environment, for the sustainability of manufacturing processes, and for recycling potential
- identifying ways of optimising apparel design and manufacturing processes
- providing third-party verification of product-sustainability claims

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2. CRADLE TO CRADLE PRINCIPLES

In their 2002 book Cradle to Cradle: Remaking the Way We Make Things, architect William McDonough and chemist Michael Braungart put forward three principles derived from nature:

- **Treat everything as a resource for something else**. In nature, the "waste" of one system becomes food for another. Similarly, in an industry context, everything can be designed to return safely to the soil as biological nutrients, or to return to industry as "technical nutrients" – i.e. as high-quality materials for new products.
- **Use clean and renewable energy**. In nature, all life is powered by the sun Similarly, in an industry context, clean and renewable energy is available in many forms: solar, wind, geothermal, gravitational, and others still being developed.
- **Celebrate diversity**. Nature has no "one size fits all" solution to any design problem. In industry, similarly, designs and solutions should vary according to the specific challenges and opportunities presented by each situation.

Rather than just seeking to minimise harm, Cradle to Cradle proposes a future where design is a positive, regenerative force, producing effects that we want to expand rather than shrink. The C2C Certified Products Program sets the standard; it is the yardstick by which we can measure the progress that our materials and products are making towards this positive future.

3. OVERVIEW TO THE C2C CERTIFIED PRODUCT STANDARD

The C2C Certified Product Standard is administered by the third-party non-profit Cradle to Cradle Products Innovation Institute. The C2C Certified Products Program specifies criteria in five distinct categories:

MATERIAL HEALTH	**Material Health** Knowing the chemical ingredients of every material in a product, and optimising towards safer materials.
MATERIAL REUTILISATION	**Material Reutilisation** Designing products made with materials that come from and can safely return to nature or industry.
RENEWABLE ENERGY	**Renewable Energy and Carbon Management** Envisioning a future in which all manufacturing is powered by 100% clean renewable energy.
WATER STEWARDSHIP	**Water Stewardship** Regarding clean water as a precious resource and an essential human right.
SOCIAL FAIRNESS	**Social Fairness** Designing operations so as to respect all people and natural systems affected by the creation, use, disposal or reuse of a product.

LEVELS OF ACHIEVEMENT

The C2C Certified Products Program recognises five levels of product certification: BASIC, BRONZE, SILVER, GOLD, and PLATINUM. In order to be certified at a certain level, a product must meet the minimum criteria for that level in all five criteria categories. The criteria in each category become increasingly demanding with each level of certification.

CERTIFIED PRODUCTS

Products or materials from any country and nearly any industry are eligible for certification. Since the programme began in 2005, more than 200 companies from 15 countries have participated in the C2C Certified Products Program. As of December 2016, the Institute offers 450 active certificates, covering more than 6,000 certified products in a variety of categories, including building materials, furniture and interior equipment, textiles, cosmetics, home-care products, paper, packaging, and polymers.

The complete C2C Certified Product Standard and supporting information can be found online

4. THE BASIC STEPS TO GETTING A PRODUCT C2C CERTIFIED

Getting a garment C2C Certified involves a process of inventory, assessment and optimisation.
There are five basic steps:

STEP 1: Determine if your product is appropriate for certification

- Does it comply with the Banned List of chemicals?
- Does your product meet eligibility requirements in the C2C Certified Product Standard Ineligible products include:
  - Products from rare or endangered species (e.g. ivory)
  - Products leading to or involving animal abuse
  - Products from companies involved in rainforest damage, child labour, blood metals, or blood diamonds

STEP 2: Select an Accredited Assessment Body for the testing, analysis, and evaluation of your product

- Select from the list of Accredited Assessment Bodies
- Develop a certification plan, including cost, timeline, and necessary resources

STEP 3: Work with your assessor to compile and evaluate data and documentation

- Collaborate with the assessor and supply chain to collect data
- Work with the assessor to develop optimisation strategies
- Submit an Assessment Summary Report, compiled by the assessor, to the Institute for final review and approval

STEP 4: Receive certification for your product

- Sign a Trademark Licence Agreement, and pay the certification fee to the Institute
- Work with the Institute to post products on the product registry

STEP 5: Report your progress

- Every two years, work with the assessor and supply chain to gather new data for re-certification
- Submit the Re-certification Assessment Summary Report to the Institute for review

5. COMPARING C2C CERTIFIED WITH OTHER CERTIFICATIONS

The apparel industry provides a number of sustainability marks and certifications.. This section gives a brief overview of how the C2C Certified Products Program compares with the following standards:

- Bluesign
- ZDHC
- OEKO-TEX Standard 100 (products) / STeP (factories)
- HIGG Facility Module
- Fair Trade USA Factory Standard

Meeting C2C Criteria often means that other standards would be fully met too (indicated as "aligned" in the following table) or at least partially met (indicated as "partial" in the following table).

Table 1: Comparison of C2C Certified Products Program with other standards

C2C Certified	Bluesign	ZDHC	OEKO-TEX 100/STeP	HIGG Facility	Fairtrade USA
3rd party?	Self with 2nd-party audit	Audit tools for brands	Yes	Self with 2nd-party audit	Yes
Multi attribute?	Yes	Yes	Yes	Yes	Yes
Material Health Criteria	Partial	Partial	Aligned	Partial	Partial
Material Reutilisation Criteria	n/a	n/a	n/a	Partial	n/a
Renewable Energy Criteria	Partial	n/a	Partial	Partial	Partial
Water Stewardship Criteria	Partial	Partial	Partial	Partial	n/a
Social Fairness Criteria	Partial	n/a	Partial	n/a	Aligned

Please see detailed comparisons in "Further Resources: Apparel Standards Comparison to C2C Certified"

C2C CERTIFIED™ "HOW-TO" GUIDE

Material Health

MATERIAL HEALTH

1. INTRODUCTION

Material Health is the cornerstone of the Cradle to Cradle (C2C) Certified™ Products Program[1]. The choice of fibres, dyes, finishes and process chemicals has wide-ranging ramifications: it determines if the apparel can eventually be safely composted or reused in industry (Material Reutilisation); it affects the amount of energy required for making garments (Renewable Energy and Carbon Management); it affects the amount of water used and the quality of the wastewater (Water Stewardship); and it influences the health and well-being of the workers, the communities surrounding the factories, and the customers.

ASPIRATION OF CRADLE TO CRADLE

Eliminate all toxic and undefined chemicals so that materials are suitable for safe, continuous cycling.

APPAREL CONTEXT

Many of the chemicals used in today's apparel industry are uncharacterised (their risks are unknown) or potentially harmful to the health of workers, local communities, and/or end-users. In addition, many of the chemical ingredients prevent garments from being safely compostable or usefully recyclable.

The major concerns are these:

- halogenated organic dyestuffs (involving the presence of a non-hydrolysable carbon-halogen bond; i.e. a fluorine, chlorine, bromine, or iodine bond)
- skin-sensitising dyestuffs (inducing an allergic response)
- dyebath and process chemicals that have high toxicity and that end up in effluent
- residues persisting either in bio-based fibres (pesticides in conventional cotton, wool, or linen) or in synthetic fibres (e.g. antimony trioxide catalyst residue in polyethylene terephthalate, or PET)
- stain-proofing, anti-soiling, and waterproofing treatments based on PTFE (Teflon) chemistry

DEMAND FOR SAFER CHEMISTRY

Images and stories abound of toxic discharges from garment factories, and have come to symbolise what is wrong with the current apparel industry. End customers are beginning to hold retailers accountable, and high-visibility initiatives are emerging, such as Greenpeace's Detox Campaign. In response, brands have begun working together to develop stricter chemistry criteria, with a view to eliminating the most hazardous chemicals and improving wastewater discharges.

[1] Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

Table 2: List of green-chemistry-focused initiatives

Initiative	Emphasis	Major Brands Involved
Bluesign	Similar to the approach of the C2C Certified Products Program, but with different rating systems and endpoints; Bluesign studies the combination of hazard and exposure, to determine the risk posed by ingredients and to help in optimising formulations	Adidas, Columbia, GStar Raw, Patagonia, Lands' End, Puma, Nike, Lululemon, Eileen Fisher, and others
ZDHC	Based on a Manufacturing Restricted Substances List to eliminate ingredients of concern, particularly from wastewater	Nike, Adidas, Gap, Inditex, Kering, Levi Strauss, Marks & Spencer, Nike, Puma, C&A, Esprit, H&M, GStar Raw, PVH, Primark, and others
Detox Campaign	A Greenpeace initiative to get brands to adopt a Manufacturing Restricted Substances List and eliminate those substances from their operations by 2020 (with corresponding transparency and management plans); also, to achieve a global ban on PFCs	Inditex, Benetton, H&M, C&A, Fast Retailing, G-Star Raw, Adidas, Levi Strauss, Primark, Puma, Marks & Spenser, Nike, Esprit, Li-Ning, and others
HIGG Material Sustainability Tool (MSI)	Delivers a holistic overview of a product's sustainability performance; HIGG includes in its analysis green-chemistry considerations, and recognises many of the green-chemistry certifications such as OEKO-TEX Standard 100	Adidas, Fast Retailing, Esprit, Eileen Fisher, Gap, H&M, Kering, Hanes, Lands' End, Levi Strauss, Lululemon, Nike, Patagonia, Puma, PVH, Under Armor, VF Corp, and others
CHEM-IQ	Tests samples for the presence of 400 chemicals; if the samples are above set levels, VF Corp works with suppliers to optimise the chemistry	Developed by VF Corp with NRDC
GreenScreen for Safer Chemicals	Focuses on hazard profiling (only) of chemicals, and on developing alternatives to the most objectionable	Nike, Levi Strauss, and others
The Sustainability Consortium	Focuses on optimising chemistry to reduce water pollution, as well as on reducing water and energy consumption	Walmart, Hanes, Marks & Spencer, Wrangler, and others
OEKO-TEX Standard 100	Tests products for ingredients of concern, via four kinds of exposure	Esquel, Hanna Andersson, Pottery Barn, Fruit of the Loom, and others

The C2C Certified Products Program aligns with the goals of all the programmes above, specifically in promoting safe chemistry; however, it goes deeper into the supply chain, and integrates "design for next use" into the chemistry itself.

BENEFITS TO MANUFACTURERS

The C2C Certified Products Program can help manufacturers by:
- assessing apparel ingredients throughout the supply chain for toxicity and usage risks
- identifying ways of optimising product chemistry
- providing third-party verification of product-sustainability claims

2. C2C CERTIFIED CRITERIA FOR MATERIAL HEALTH

The four components of the C2C Certified criteria for Material Health are as follows:
A. knowing the biological or technical "metabolism"
B. confirming the absence of Banned List chemicals
C. knowing what percentage of a product's Bill of Materials (BoM) is characterised (i.e. has a known risk profile)
D. having an optimisation plan for any X-assessed materials

A. Determining the "metabolism"

C2C Certified products eliminate the concept of waste, in the expectation that products and ingredients will be feedstock for new production at the end of each use phase. For all achievement levels, C2C Certified products are categorised by the "metabolism" in which they are designed to cycle; optimisation ensures that both the design and the chemical ingredients support and facilitate that cycling.
- *Biological "nutrients"*: the materials are designed to return safely to the soil, as a "soil amendment" (compost) that could be used to grow new biological materials. The relevant materials here are those that can be consumed by biological processes; e.g. cotton and paper.
- *Technical "nutrients"*: the materials are designed to return to industry for remanufacture at the same quality level or higher. The relevant materials here are those that cannot be consumed by biological processes; e.g. metals and plastics. Note: bio-plastics are regarded as technical nutrients if they remain in technical cycles, even though they come from biological sources.

As part of the process, the assessor will annotate the BoM with an assessment of whether the material is a biological or technical nutrient.

B. Confirming the absence of Banned List chemicals

For a product to meet C2C Certified criteria, it must show that it does not contain certain specified chemicals as intentional inputs above 1000 parts per million (ppm). There are two lists of these banned chemicals: one for technical nutrients and one for biological nutrients. Banned lists can be found in the C2C Certified Product Standard.

For BASIC level certification, manufacturers need to file a declaration that they have not intentionally added Banned List ingredients in concentrations above 1000 ppm. For BRONZE level and above, detailed BoMs may take the place of manufacturers' declarations.

BEST PRACTICE: RECYCLED-CONTENT TESTING

Products may become contaminated through use and recycling. If a product contains recycled ingredients from a source other than a single, post-industrial source, testing is required to demonstrate the absence of Banned List chemicals. Recycled ingredients are tested both at the time of the initial certification and again at re-application. For GOLD level and above, testing is required every six months.

For a list of the required tests, see Table 5 of section 3.3.1. of the C2C Certified Product Standard.

In addition, depending on the source stream and type, assessment of the recycled ingredients may require testing for the presence of other chemicals. For instance, full assessment of recycled polyester, or rPET, requires testing for the presence of antimony. The assessors will always specify the further chemicals for which testing is needed.

How to set up testing
Working with the assessor, identify a suitably qualified lab. The lab must be ISO 17025 certified, have significant experience in materials testing and be capable of providing the following tests:

- Liquid Chromatography Mass Spectrometry (LC/MS)
- Gas chromatography–mass spectrometry (GC-MS)
- CPSC-CH-C1001-09.3 Standard Operating Procedure for Determination of Phthalates (or more recent version)
- Inductively coupled plasma mass spectrometry (ICP-MS) or Cold Vapor Atomic Absorption (CVAA)/direct mercury analysis
- ICP-MS or ICP-Atomic Emission Spectroscopy (AES)

The lab must be able to conduct tests with detection limits of 0.01% (100 ppm) or better.
The test reports will be submitted to the assessor, and will need to include the following items: a list of the contaminants tested for, the detection limits, a description of the material sample(s) tested, the test method(s) used and laboratory contact and certification information.

C. Compiling a Bill of Materials

For C2C certification, detailed information is required for parts or materials present in concentrations of 100 ppm or greater. The assessor might have to check with several suppliers in earlier stages of the supply chain. At each stage, the assessor will request the following information on all ingredients:

- Name of each chemical or specific manufacturer or trade name (and grade, in the case of purchased chemicals or chemical mixtures)
- Unique CAS Number for all raw chemicals
- Concentration or concentration range of each chemical or chemical mixture
- The function that each chemical or chemical mixture serves within the material or product
- The percentage of recycled content, if any, including indication of type (post-end customer or post-industrial)
- The concentrations of lead, mercury, hexavalent chromium, cadmium, pigments, dyes and other colorants, phthalates, halogenated organics, and scarce elements or substances specified in the Material Health Assessment Methodology document (e.g. indium, gold, diamond) when present at any concentration
- Process chemicals used that are textile auxiliaries (i.e. textile process chemicals)

BEST PRACTICE: ENGAGING SUPPLIERS THAT ARE FROM EARLIER STAGES OF THE SUPPLY CHAIN

Translating fuel consumption into carbon footprint requires a conversion rate – the emission factor. Suppliers that are further back in the supply chain will have to be engaged in the process of certification. The garment manufacturer can facilitate this process, as follows:

- Explain the C2C Certified Products Program
- Assure suppliers that their proprietary information will be protected through a non-disclosure agreement (NDA) with the assessor; the specific contents of their product will not be shared – only the overall assessment using the ABC-X methodology
- Explain that participation in the C2C Certified Products Program will help them learn more about their products, and could help them improve their chemistry in ways that better support human and ecological health
- Show them that other major companies are already going through this process, and that participation may give them a competitive advantage; for example, by showing them the Fashion Positive materials collection.

D. Devising an optimisation plan

Some ingredients may be X-assessed (i.e. they consist of or contain highly problematic chemicals, from a C2C Certified perspective) or GREY-assessed (i.e. they cannot undergo a full assessment, owing to incomplete information). For materials containing such ingredients, manufacturers need to create an optimisation strategy if they are to secure BRONZE and SILVER level certification for a product. For GOLD and PLATINUM level, no X-assessed or GREY-assessed materials are allowed to remain in the final BoM. For PLATINUM level, the process chemistry has to be optimised as well.

Optimisation: All hazardous chemicals are identified, all relevant routes of exposure to the biosphere are identified, and there are no relevant high hazards associated with the use of any of the chemicals by the manufacturer of the C2C Certified product.

The optimisation plan should include the following:

- A list of the materials that are X-assessed or GREY-assessed
- An optimisation recommendation from the assessor
- A feasibility assessment (characterising the ease or difficulty of optimisation)
- An action plan, to include an approximate timeline (near-term and long-term) for the implementation, and an estimate of the costs involved

3. LEVELS OF ACHIEVEMENT FOR MATERIAL HEALTH

There are five potential levels of achievement, with each level building on the requirements of the previous one.

BASIC	No Banned List chemicals; identified biological or technical nutrient metabolism; 100% of ingredients characterised
BRONZE	75% assessed using ABC-X ratings (100% for biological-nutrient products), and optimisation strategy developed for materials assessed as X
SILVER	95% assessed using ABC-X ratings; contains no ingredients known or suspected to cause cancer, birth defects, genetic damage or reproductive harm
GOLD	100% assessed (by weight) using ABC ratings; no X assessed ingredients; meets C2C Certified emissions standards
PLATINUM	All process chemicals have been assessed, and none has received an X rating

Detailed information on the requirements and instructions can be found in the C2C Certified Product Standard.

4. C2C CERTIFIED MATERIAL HEALTH ASSESSMENT METHODOLOGY

Once the assessor receives and verifies a manufacturer's BoM, the process of evaluating the chemicals' risk in terms of hazards and exposure begins. The formula is as follows.

Hazards x Exposure = Risk

IDENTIFYING HAZARDS

The first step is to evaluate the chemical ingredients, independent of any of their applications, against the C2C Certified Products Program's human and environmental health hazard "endpoints". The endpoints are objective measurements of a chemical's properties or of the potential results of exposure; e.g. carcinogenicity, dermal toxicity, or neurotoxicity.

The list of human and environmental health hazard endpoints, and more detail on the Material Assessment Methodology, can be found in the C2C Certified Material Health Assessment Methodology.

CHARACTERISING RISK

Once the hazards are assessed for all the chemicals present in an ingredient, the assessor then looks at the context in which those ingredients are used and the relative routes of human exposure to each ingredient (such as inhalation, skin contact, or biodegradation). From this analysis, the assessor develops an assessment of risk for each chemical present in each material.

MATERIAL HEALTH

Once all the chemical risk assessments have been performed, a final assessment is generated for each material, equating to the result of the worst-performing chemical within the material using the ABC-X rating system below:

Table 3: ABC-X rating methodology

A	The material is ideal from a C2C Certified perspective for the product in question
B	The material largely supports C2C Certified objectives for the product
C	Moderately problematic properties of the material, in terms of quality from a C2C Certified perspective, are traced back to the ingredient. The material is still acceptable for use.
X	Highly problematic properties of the material, in terms of quality from a C2C Certified perspective, are traced back to the ingredient. The optimisation of the material requires the phasing out this ingredient.
GREY	This material cannot be fully assessed owing either to incomplete ingredient formulation or to lack of toxicological information for one or more ingredients
BANNED	i.e. banned for use in C2C Certified Products Program This material contains one or more chemical ingredients from the Banned List and cannot be used in a certified product

Here is an example of an ABC-X assessment:
- A: Sodium Sulphate (no hazards or risks as used in textiles)
- B: Sodium Carbonate (moderate irritation and inhalation hazard, no risk as used as dye-bath chemical)
- C: Sodium Hydroxide (highly corrosive hazard, only slight risk of exposure in textile processing)
- X: 7-((5-Chloro-2,4-difluoro-6-pyrimidyl)amino)-4-hydroxy-3-((1,5-disulfo-2-naphthyl)azo)-2-naphthalenesulfonic acid, trisodium salt [Reactive Orange 6]--(halogenated organic azo reactive dyestuff that contains both organochlorine and organofluorine and is persistent in the environment)

BEST PRACTICE: BILL OF MATERIALS OPTIMISATION AT COTTON BLOSSOM AND PRATIBHA SYNTEX

Both Cotton Blossom and Pratibha Syntex worked with MBDC, an accredited assessor, to optimise their materials. The first step in the process was for each company to submit an initial BoM to MBDC for assessment. For both companies, many dye and process chemicals were initially assessed GREY, owing to incomplete formulation. In addition, a few X-assessed materials and X-assessed ingredients were identified.

MBDC followed up with the suppliers from earlier stages of the supply chain (Tier-2 suppliers) for more information for the GREY-assessed materials, and in many instances received complete formulations from the initial inquiry. Where the Tier-2 suppliers would not or could not provide complete formulations for their products, MBDC suggested replacement suppliers – suppliers willing to share their formulations and that already had suitable materials assessed as A, B or C. In this way, all GREY-assessed materials were eliminated from both BoMs. Since A, B, and C materials are considered optimised from a C2C Certified perspective, only the X-assessed materials remained for phase-out and substitution.

The majority of X-assessed ingredients were dyes, specifically reactive dyes for cotton or disperse dyes for polyester. The most common issues with the dyes were:

- skin sensitisation (allergic response)
- halogenated organic molecules (potential for persistent, bio-accumulative, and toxic metabolites)
- lack of mutagenicity testing for many dye molecules (dyes should undergo Ames assay at a minimum)

Many of the dyebath and process chemicals revealed high aquatic toxicity and potential for skin irritation. This underscored the importance of workers' use of appropriate personal protective equipment (PPE) and implementation of measures to prevent molecules with high aquatic toxicity from entering the local waterways.

In this case, both manufacturers have protocols in place to ensure worker safety, and both have completely closed water systems on-site to recycle process effluent. The water-treatment system includes a biological degradation process that allows for microbial digestion of organic effluent chemicals. All problematic molecules – those identified as potentially toxic to fish, aquatic invertebrates, and/or algae – are safely consumed by bacteria on-site, and none of the molecules are released into local waterways.

Cotton Blossom and Pratibha Syntex were able to replace X-assessed dyes with dyes from Dystar that meet the requirements for C2C Certified PLATINUM in Material Health.

Moreover, both manufacturers managed to discontinue dye and process chemicals that contained nonylphenol ethoxylates and organochlorine, replacing them with positively assessed alternative surfactant and scouring/bleaching molecules.

For each company, the resulting BoM was 100% characterised and was stocked entirely of A, B, and C-assessed ingredients; at that point, it was considered optimised. Combined with their effective closed-loop water systems, both Cotton Blossom and Pratibha Syntex achieved PLATINUM level in Material Health.

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Excerpt of Pratibha Syntex's Bill of Material before and after optimization (For the complete BoM for Pratibha and Cotton Blossom, see Further Resources in this guide)

BoM BEFORE OPTIMIZATION		
Generic Material	**Function**	**Assessment**
IMACOL CN	Pretreatment	C
ULTRAVON EL	Pretreatment	C
CLARITE GI	Pretreatment	X
INVAZYME CAT	Pretreatment	X
ACETIC ACID	Pretreatment	B
GULABER SALT	Dyebath Chemicals	B
CLARITE GI	(White)	GREY
TUBOBLANC HA	(White)	GREY

BoM AFTER OPTIMIZATION		
Generic Material	**Function**	**Assessment**
IMACOL CN	Pretreatment	C
ULTRAVON EL	Pretreatment	C
MATEXIL NZPN	Pretreatment	C
LANAPEX SEQUEST	Pretreatment	C
ACETIC ACID	Pretreatment	B
GULABER SALT	Dyebath Chemicals	B
not used	–	–
not used	–	–

5. DESIGN CONSIDERATIONS FOR MATERIAL HEALTH

For textile manufacturers the most important guidelines regarding Material Health criteria are:

A. Choose the right sources of materials
B. Select the right dyes and finishes
C. Avoid incompatible laminations and coatings

A. Choose the right sources of materials

Select sources that will help make a positive impact, and therefore support higher achievement levels in the C2C Certified Products Program.

- *Prefer certified organic and sustainable sources (e.g. GOTS certified)*. Materials from these sources will be (or should be) free of pesticide residues, and that is why they allow higher certification levels in Material Health. In addition, materials derived from sustainable cultivation practices are less likely to have a damaging effect on soil and watershed well-being, worker health, and biodiversity than are materials from more conventional practices.
- *Prefer unbleached or chlorine-free fibres*. Chlorine bleaching can result in the presence of highly toxic dioxins in fibres, and that will limit the material's possible certification levels in Material Health. The toxic effects of dioxins include: adverse effects on the reproductive, developmental and immune systems, endocrine disruption and hormone mimicry, mutagenicity and cancer.
- *Prefer optimised polyester*. Much of the polyester available today uses an antimony trioxide catalyst, which is a suspected human carcinogen, and will limit the material's certification level in Material Health. Alternative catalysts exist (e.g. titanium-based) that do not have these issues.

B. Select the right dyes and finishes

Design parameters such as colour and softness have a major influence on the subsequent processing required, and hence on the amount of energy and water consumed and chemicals used. For a detailed list of considerations for dyeing, performance additives, finishes and printing, see the section 'Further Resources: C2C Certified Considerations for Common Apparel Materials'. For a current list of dyes and finishes that have already been assessed, see the Fashion Positive website.

C. Avoid incompatible laminations and coatings

Many textiles are coated or laminated with substances for the sake of adding performance features such as waterproofing, moisture wicking (sweat removal), and odour control. Laminations are especially problematic in that they prevent reutilisation of the product, unless they come from a source compatible with the base fibre. Thus, a polyester film would be suitable for laminating a polyester-fibre fabric but not a cotton fabric. Frequently, it is possible to avoid these additional treatments by taking steps during the design phase to carefully choose the fibre and textile construction. In some cases, materials using gentler approaches, such as waxed cotton, can outperform their conventional synthetic and laminated counterparts.

6. GETTING STARTED

Manufacturers have contributed to high certification levels in Material Health by adopting practices and activities conducive to optimisation. Some activities are fairly simple and can begin right away, but others will require more time and investment.

In the short term

- Assess the baseline:
  - Develop a BoM that is free of Banned List ingredients, and consider including products that have already been assessed (see Fashion Positive Materials Collection)
  - Approach your customers to collaborate with you on a C2C Certified product
- Collaborate:
  - Identify customers that have strong sustainability strategies, tell them the proportion of your current portfolio that would achieve a high C2C certification, and propose a collaboration
  - Invest in prototypes of products with assessed materials, and present these innovations to your customers

In the medium term

- Optimise:
  - For products with a low Material Health score, investigate with your in-house design team how to change the material composition
  - Share with brand partners and suppliers the costs involved in identifying dyes, finishes and process chemicals that will lead to a high certification level in Material Health

C2C CERTIFIED™ “HOW-TO” GUIDE

Material Reutilisation

MATERIAL REUTILISATION

1. INTRODUCTION

All materials used in making any type of product have economic, environmental and social value. Each time a material is incinerated or consigned to landfill, its inherent value is lost. Material Reutilisation in the Cradle to Cradle (C2C) Certified™ Products Program[1] is about converting linear systems into circular systems, so that the value of good materials is maintained or even increased.

Enabling circular systems takes radically new product design, business models and supply-chain cooperation, but there is a growing global movement to close the loop on materials. Apparel manufacturers have a responsibility, and a unique opportunity, to be at its forefront.

ASPIRATION OF CRADLE TO CRADLE

"Eliminate the concept of waste" – create products that are made entirely from rapidly renewable materials or recycled materials, where 100% of the product can be safely returned to nature or eventually recycled into new products.

APPAREL CONTEXT

The idea of collection and reuse/recycling systems for apparel is not new, but the global apparel trade still loses an estimated 60-70% of annual virgin-fibre production each year[2]. The volume of losses will increase as global apparel production continues to grow – at an estimated 3-5% annually[3].

The most pressing systemic challenges to increasing the reutilisation of textile products are:

- designing and manufacturing clothing for disassembly
- manufacturing clothing using "optimised" chemistry[4]
- maintaining traceability of materials
- scaling up innovations in the sorting and recycling of textiles
- increasing diversion rates of textiles from landfill and incineration

DEMAND FOR MATERIAL REUTILISATION

Mainstream apparel retailers are integrating into their business strategies the reutilisation of textile materials, in the knowledge that it can transform the security of supply and the environmental sustainability of the industry. Many of the largest apparel retailers globally, with an estimated combined market size of $126 billion a year[5], have circular-inspired goals or public commitments in place. Other major retailers of textile products, including Walmart and IKEA, are making similar commitments.

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute
[2]Source: Adapted from Oakdene Hollins, 2014
[3]Source: Euromonitor
[4]See the chapter on Material Health for further information on what optimised chemistry means.
[5]Source: Euromonitor and Company Annual Reports

MATERIAL REUTILISATION

Table 4: Examples of retailers making public commitments to Material Reutilisation

Retailer	Key strategies related to circular	Relevant memberships
H&M	• A vision of becoming a 100% circular company	Ellen MacArthur Foundation SAC
C&A	• Announcing specific targets for circular in 2017 • First brand partner of Fashion for Good	Fashion for Good Ellen MacArthur Foundation SAC
Wal-mart	• Supporting innovations that design out waste, and products designed for reuse, recycling and cascading • Giving customers information on and choice of products with circular attributes • Expanding recycling through support for education and improved infrastructure	Ellen MacArthur Foundation SAC
Nike	• "The Future is Circular" – envisions a transition from linear to circular business models, and products designed with better materials, made with fewer resources, and assembled to allow easy reuse in new products	Ellen MacArthur Foundation SAC
Levi's	• Aiming to establish by 2020 an infrastructure that supports closed-loop products	SAC
Inditex	• An end-of-life strategy informed by a circular economy or closed-loop approach, designed to make its products and operations more sustainable	SAC
LVMH	• A working priority of reducing and recovering waste, as part of increasingly focusing on the circular economy	-
M&S	• The aim of becoming the world's most sustainable retailer, via Plan A, which includes a programme for material reutilisation	Ellen MacArthur Foundation SAC

BENEFITS TO MANUFACTURERS

For manufacturers, the main benefits of recycled materials and recyclable products are price stability and security of raw-material supply. The costs and supply of virgin fibres are highly volatile, owing to changing weather patterns, soil degradation and market interference. By reducing the dependency on virgin materials, recycling makes the supply of raw materials more secure.

2. C2C CERTIFIED CRITERIA FOR MATERIAL REUTILISATION

There are two components to the C2C Certified criteria for Material Reutilisation: the score and the reutilisation plan.

MR SCORE

A minimum Material Reutilisation (MR) score is required for overall BRONZE certification and above. The score measures the proportion of a product's content that is recycled or rapidly renewable (grown and harvested in cycles less than ten years) and the proportion of the product that can be recycled or composted. The higher the score, the higher the certification level.

A distinction is made between recycling and downcycling. Recycled materials are appropriate for use in a product of equivalent quality to products made with virgin materials.

All materials that remain with the product after production must be included in the calculation; so dyes, hardening agents, and pigments, for instance, are all counted.

The MR score is calculated as follows:

CALCULATING THE MR SCORE:

$$\left(\frac{\text{\% of the product considered recyclable or compostable} \times 2 + \text{\% of the recycled or rapidly renewable content in the product}}{3} \right) \times 100$$

EXAMPLES:

- Virgin PET/Elastane not separable – not considered recyclable
- 95% virgin PET with separable elastane – MR score = 63.3 (eligible for C2C SILVER in MR)
- 98% virgin PET with separable elastane – MR score = 65.3 (eligible for C2C GOLD in MR)
- Cotton/Elastane not separable – not considered recyclable
- 95% cotton with separable elastane – MR score = 95 (eligible for C2C GOLD in MR)
- 100% cotton and undyed or dyed with natural dyes = 100 (eligible for C2C PLATINUM in MR)

MATERIAL REUTILISATION

MR PLAN

For GOLD level, a manufacturer must also create a reutilisation plan. The manufacturer must demonstrate how the final retailer will ensure that the products get collected and recycled or composted. For PLATINUM level, products must be actively collected and recycled or composted, and recovery rates must be measured and reported.

CONSIDERATIONS FOR CLAIMING A GARMENT IS COMPOSTABLE

WHEN A GARMENT IS COMPOSTABLE
A garment may be composted only if the materials that cannot be separated are biodegradable. Accessories such as zippers and buttons must be removed. Some allowance is made for synthetic contaminants such as synthetic dyes and hardening agents, but only at very low percentages.

To meet C2C Certified compostability requirements, garments must be appropriate for home composting, and must not be limited to industrial composting facilities. Currently, local authorities will not collect garments for composting, as they are classified as a contaminant.

COMPOSTING STANDARDS
If composting is the chosen end-of-use route, verification is required against the standard of the country where the garment will be sold. EN 13432 is a European standard specification, internationally known and very similar to the international equivalents ISO 17088 and ISO 18606. The European standard is commonly used as a benchmark for other national standards, such as Brazil's, where the standard is equivalent to EN 13432. If the garments are to be sold in USA, they should comply with the ASTM D6400 standard.

Regarding soil toxicity, there is no difference between the ISO criteria and those of the EU. Regarding biodegradation, there is a small difference: ISO requires separate biodegradation testing of (organic) components present in a concentration of 1-10% (on a dry-weight basis), whereas the EU also allows testing of the final product as a whole. Nevertheless, the biodegradation criterion remains the same: 90% within 180 days.

PLANNING FOR A TEST
The test typically takes 3-6 months, and costs $15,000-23,000 per garment.

A list of certified labs can be found at: http://www.bpiworld.org

BEST PRACTICE: C2C CERTIFIED GARMENT FROM PRATIBHA SYNTEX AND COTTON BLOSSOM

MR Score
Pratibha Syntex and Cotton Blossom have both reached GOLD for their value-retailer C2C Certified shirts. The calculated MR score was 99.5; what prevented a score of 100 was the use of synthetic dyes.

MR Plan
Their retail partner has implemented a campaign related to these shirts, which instruct customers how to return the garments. Customers have a choice: either taking them to textile collection points or sending them to the Fashion for Good Centre (to be used in chemical recycling pilots).

3. LEVELS OF ACHIEVEMENT FOR MATERIAL REUTILISATION

There are five potential levels of achievement, with each level building on the requirements of the previous one.

BASIC	Each generic material in the product is clearly defined as an intended part of a biological or technical cycle. (This is covered by the Material Health requirement at Basic level; see Material Health guidance in Section 3.2.)
BRONZE	The product has a Material Reutilisation Score that is ≥ 35.
SILVER	The product has a Material Reutilisation Score that is ≥ 50.
GOLD	The product has a Material Reutilisation Score that is ≥ 65. The manufacturer has completed a “nutrient management” strategy for the product, including scope, timeline and budget.
PLATINUM	The product has a Material Reutilisation Score of 100. The product is actively being recovered and cycled by a technical or biological metabolism.

Detailed information on the requirements and instructions can be found in the C2C Certified Product Standard.

4. DESIGN FOR A HIGH MATERIAL REUTILISATION ACHIEVEMENT LEVEL

There are four useful principles to adopt when aiming for a high MR level:

A. Source recycled content
B. Choose one nutrient path
C. Exploit the inherent properties of the fibres
D. Use textile construction to achieve elasticity

A. Source recycled content

To source the highest quality recycled fibres, look for suppliers who do the following:

- Regularly test their fibres for any hazardous materials, ideally with a screen against C2C's Certified Banned List. The requirements for this test are explained in the chapter on Material Health.
- Use a consistent supply of the same feedstock (pre-end customer waste is the optimum)
- Source their input materials from outside of their factory

If the aim is to achieve SILVER level overall, source recycled materials that are already commercially available, such as rPET and mechanically recycled cotton, cotton/polyester and wool. Several companies supply mechanically recycled fibres that are suitable for a wide range of textile products, especially when blended with virgin materials. The fibres are particularly suitable for less delicate fabrics, such as denim and material for home furnishings. In the recycled-yarn market, the most common natural fibres are wool and cotton, and the most common synthetic fibres are cotton/polyester, wool/acrylic and polyester or recycled polyester (PET or rPET). To facilitate the sourcing of more sustainable fibres, including recycled materials, an online portal for circular fashion, Plan C, has compiled a list of organisations and databases.

Table 5: Examples of suppliers of recycled natural or blended textile yarns

HQ	Supplier	Product
USA	Miller Waste Mills	natural and synthetic fibres
USA	Martex Fiber	recycled cotton blends
Spain	Recover	recycled cotton
India	Usha Yarns Limited	pre-end customer recycled yarn
India	Jindall Woollen Industries	natural and synthetic fibres
USA	ReNEW™	rPET
USA	Repreve™	rPET
Ireland	Wellman	rPET
Italy	Newlife™	rPET
India	Reliance Recron®	rPET
Italy	Q-nova®	nylon
Israel	Nilit	nylon
Italy	Econyl®	nylon

SHOWCASE: ATO-FREE RECYCLED PET PROTOTYPE

Recycled polyester (rPET) often contains a suspected carcinogen called antimony-trioxide (ATO), which is a catalyst used in manufacturing PET. This means that using rPET will bring a product's overall score down to at least SILVER because of its impact on Material Health.

Polyterra, a German research and development company, and Pratibha Syntex therefore collaborated to create the first rPET garment that was developed around the C2C Certified PLATINUM criteria.

Sourcing:
Polyterra sourced post-industrial waste from a polyester manufacturer who used alternative catalysts to antimony-trioxide.

A specific polyester morphology is required for the continuous production of textile fibres. The crystallinity and intrinsic viscosity (IV) are important aspects in this respect. The IV values for textile fibres were in the range of 0.40–0.70 g/dl (pre-treatment steps can be applied if IV values have high deviations).

Preparation for extrusion:
Thermal treatments were applied to the polymer granules to achieve target crystallinity values between 53% and 58%, which was determined by differential scanning calorimetry (DSC) measurements. The grain sizes were adjusted to 2.5 mm for the extrusion process.

Any chemical contaminants and moisture were removed before the processing, and the optical properties adjusted. Titanium dioxide (TiO_2) is a standard additive for fibres to change optical properties from bright to semi-dull; 0.3% was added for the first batch of staple fibres.

Preparation for spinning:
Spin finishes are used to lubricate the surface of the filament fibres in preparation for spinning. The surface properties of the fibre can differ if alternative ATO-free catalysts for the polymer are used. For this project, a lubricant with an aqueous solution of 10–12% concentration was suitable.

Spinning:
Polyterra produced the staple fibres, and Pratibha Syntex then spun and knit the polyester fabric.

B. Choose one nutrient path

To keep materials at the highest level of quality and to facilitate their recapture, choose either a biological or technical nutrient cycle.

- Fabrics. To achieve MR levels above BASIC, avoid technical/biological fibre blends and technical/technical fibre blends. Biological/biological blends (cotton/wool or rayon acetate) are fine, as they can both biodegrade. Avoid elastane blends, as elastane is not biodegradable or recyclable, and it interferes with the recyclability of the fibres with which it is blended.
- Trims. Ribbons, threads, closures, lace, and sequins can interfere with a product's biodegradability or recyclability. Often a "design for disassembly" approach is needed, so that these trims are intuitively and easily removed during reutilisation.
- Printing. Ensure that the materials used for printing are desirable from a C2C Certified perspective, and that they are free from materials that conflict with the garment's compostability or recyclability.
- Labels/Tags. Prefer printed labels to sewn labels. If using a sewn label, ensure that it is made of a material compatible with the rest of the garment.

C. Exploit the inherent properties of the fibres

The table below summarises the typical properties of some of the major fibre types (1=good, 3=poor). It will help identify the fibre that best meets the desired performance criteria, and thereby reduce (or even avoid altogether) mixing fibre types.

Table 6: Basic Textile Properties

Textile Material	comfort	wrinkling	keeps you cool	keeps you warm	machine washable
	[1-3]	[1-3]	[1-3]	[1-3]	[1-3]
Acetate*	2	1	3	2	3
Acrylic	2	2	2	2	1
Cotton (Traditional)	1	3	2	2	2
Flax Linen	1	3	1	3	3
Hemp	3	3	2	2	2
Polyester / PET*	2	1	3	2	1
Rayon*	1	3	1	2	3
Silk	1	3	3	1	3
Wool*	3	1	2	1	3
rPET	2	1	3	2	1

D. Use textile construction to achieve elasticity

Elastane is a highly problematic fibre: it is not recyclable or compostable, but it is incorporated in many garments. Fabric construction can eliminate the need for elastane, and thereby help in achieving levels of certification above BASIC.

- Circular knit textiles link fibres by means of a looping (knitting) method. "Tubes" of fabric are created, and seams are completely avoided. Eventually, this fabric can be slit down one side and laid flat. It will have mechanical stretch, even when made of non-stretch yarns such as cotton. There is a very wide range of knitting methods available, so the textiles vary from lace-like tricot meshes to heavy ribbed double-knits.
- Flat knit textiles also utilise a looping method to join parallel yarns. They have many of the same mechanical stretch features that circular knits have, but can incorporate some features of wovens, such as a flatter and more stable construction. Often flat knits are favoured because they balance durability with stretch.

SHOWCASE: ELIMINATING ELASTANE THROUGH KNIT CONSTRUCTION

To achieve a form-fitting design, a cotton tank top required stretch around the bodice. Common practice is to use a cotton and elastane blended fabric. Instead, the same stretch was achieved with a ribbed knit construction – specifically a 2x1 ribbed knit.

Many apparel designers are not as well-versed in specifying textile constructions as they are in changing material content of the yarn. However, modifying textile constructions is a preferred method of controlling properties.

5. GETTING STARTED

Manufacturers can engage in several enabling activities to support high certification levels in Material Reutilisation. Some activities can begin right away, while others require more time and investment.

In the short term

- Assess the baseline
  - Estimate how much of your production has a high MR score (i.e. what proportion is made of rapidly renewable or easily recyclable materials).
  - For products with a high MR score, complete a bill of materials.
- Collaborate
  - Approach your customers and explain how much of your portfolio already qualifies for a high MR score and propose a certification collaboration.

In the medium term

- Optimise:
  - For products with a low MR score, investigate with your in-house design team how to change their material composition and construction to make them more recyclable or compostable
  - Invest in prototypes of products made with recycled materials, and present these innovations to your customers
  - Share costs with suppliers and retail partners in certifying recycled materials for Material Health
  - Participate in pilot recycling schemes that create new sources of recycled materials
  - As natural dyes are necessary for cotton garments to achieve PLATINUM level for Material Reutilisation, collaborate with natural-dye suppliers to get their chemicals C2C Certified

FASHION FOR GOOD

C2C CERTIFIED™ "HOW-TO" GUIDE

Renewable Energy and Carbon Management

RENEWABLE ENERGY & CARBON MANAGEMENT

1. INTRODUCTION

As part of the UN Climate Conference in Paris in 2015, industrialised and developing countries alike agreed to specific targets on renewable energy and carbon emissions. India, for example, in 2016 committed itself to increase renewable and low-carbon electricity to a 40% share of all electricity generated, while reducing its emissions intensity (emissions per unit of GDP) by 33-35% from its 2005 levels by 2030[1].

The Cradle to Cradle (C2C) Certified™ Products Program[2] addresses the questions of carbon management and the use of renewable energy. Manufacturers measure energy use and develop strategies for improvement as part of the certification process.

ASPIRATION OF CRADLE TO CRADLE

"Cradle to Cradle envisions a future in which industry and commerce positively impact the energy supply, ecosystem balance, and community – a future powered by current solar income and built on circular material flows."

APPAREL CONTEXT

Energy is a critical factor in textile production. From spinning and dyeing to weaving and sewing – all the essential production steps require substantial use of energy and hence emissions of carbon. To meet C2C Certified standards, the garment industry will have to address energy use – specifically, by reducing energy use, sourcing renewable energy, and offsetting the remaining carbon emissions.

DEMAND FOR RENEWABLE ENERGY

In response to the increasing demand for a more sustainable use of energy, global brands are increasingly committing to using renewable energy alone. One example is the RE100 initiative, by which some of the world's most influential companies, from a variety of sectors, have undertaken to use only 100% renewable electricity. Alongside multinationals such as Apple, Google and Unilever are prominent brands from the apparel industry such as Nike and H&M.

MANUFACTURER BENEFITS

For manufacturers, there are two significant advantages in measuring energy usage and improving renewable-energy sourcing and carbon offsetting:

- **Cost savings.** By being able to measure energy consumption in their factories, manufacturers can analyse and identify the most energy-intensive machines and processes. With that information, they can then reduce energy usage by streamlining various processes or by replacing old energy-intensive machines with newer, more efficient ones.
- **Better relationships with brands.** Brands are favouring those manufacturers that source renewable energy and minimise their carbon footprint in the production process.

[1] The Guardian (2015) "India unveils climate change plan", https://www.theguardian.com/world/2015/oct/02/india-pledges-40-percent-electricity-renewables-2030
[2] Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

2. C2C CERTIFIED CRITERIA FOR RENEWABLE ENERGY AND CARBON MANAGEMENT

The four components of the C2C Certified criteria for Renewable Energy and Carbon Management are as follows:

A. assessing total energy demand and GHG emissions
B. developing a Renewable Energy strategy
C. using renewable energy and addressing on-site GHG emissions
D. calculating the embodied energy for the product

A. Assessing total energy demand and GHG emissions

For all levels of certification, manufacturers need to be able to assess and quantify their overall energy demand and GHG emissions. For this purpose, a factory-level audit of energy use and emissions is necessary.

The most accurate measure of energy consumption is through metering. Metering helps to identify opportunities for efficiency improvements, and can improve detection of supply issues or equipment issues.

To measure energy consumption accurately, consider the following two-strand approach

Metering energy consumption
Metering lets you analyse your energy efficiency throughout the product cycle.

Allocating energy consumption to products
To plan and prioritise improvements to your factory's overall energy efficiency, it is helpful to establish the amount of energy required to produce each individual product or product group.

BEST PRACTICE: METERING ENERGY CONSUMPTION IS THE FIRST STEP TO HIGHER EFFICIENCY

Energy measurement is essential for all C2C Certified levels. For BASIC to GOLD levels, manufacturers need to measure the energy used in the final manufacturing stage of the garment; for PLATINUM level, manufacturers need to measure the energy consumed in other parts of the supply chain as well – from "Cradle to Gate".

Step-by-step guide to implementing a metering system:

1. Illustrate all energy flows.
2. From these illustrations, the manufacturer can determine the number of meters needed and select optimum locations.
3. In order to determine data requirements, the manufacturer needs to decide which efficiency ratios are worth calculating (it might also be necessary to measure temperatures, flow rates and pressure rates).
4. When purchasing and installing meters, select durable and high-quality meters.
5. It is important to consistently record data, and regularly check the meters for reliability; the data can be recorded with the help either of Microsoft Excel or of tailor-made software
6. When analysing the data, drivers of inefficiencies can quickly be identified, such as:
   - transport
   - old/outdated machines
   - air conditioning
   - heating
   - inadequate insulation
   - stand-by time

With this information on energy consumption – ideally information on the energy consumption of each individual product – it is then possible to set energy-reduction targets and develop energy-reduction initiatives.

BEST PRACTICE: ALLOCATING ENERGY CONSUMPTION TO PRODUCTS BY USING THE PRODUCT'S STANDARD ALLOWED MINUTES (SAMS)[1]

There are many ways to allocate energy consumption to individual products. Using SAMs is one of the more accurate methods and is recommended especially if the product mix is very heterogeneous.

Detailed example

- A textile manufacturer produces a total of 30 million garments per year: 10 million of these garments are T-shirts and 20 million are jeans
- The company consumes 80 million kWh of electricity per year
- To calculate the amount of electricity needed per garment, the manufacturer allocates the energy consumption based on the SAM per garment. Each T-shirt takes 2 SAMs to make, while each pair of jeans takes 4 SAMs to make; so overall, the manufacturer spends 20 million SAMs each year producing T-shirts and 80 million SAMs producing jeans.

In other words, four-fifths of the manufacturer time is used for jeans production, so the correct figure for jeans is 0.8. Accordingly, the manufacturer should allocate four-fifths of its electricity consumption to jeans, namely 64 million kWh. That equates to an electricity consumption of 3.2 kWh per pair of jeans.

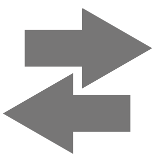
$$\textit{Weight}_i = \frac{\textit{no. of pieces produced}_i \times \textit{SAM}_i}{\sum(\textit{no. of pieces produced}_n \times \textit{SAM}_n)} \qquad \textit{Weight}_i = \frac{20{,}000{,}000 \times 4 \textit{ min.}}{100{,}000{,}000 \textit{ min}} = 0{,}8$$

$$\textit{kWh/piece}_i = \frac{\textit{electricity consumption in kWh} \times \textit{weight}_i}{\textit{no. of pieces produced}_i} \qquad \textit{kWh/piece}_i = \frac{80{,}000{,}000 \textit{ kWh} \times 0.8}{20{,}000{,}000} = 3.2 \textit{ kWh/piece}_i$$

Determining the carbon footprint of your factory is much like determining its energy consumption, as outlined above, with an additional conversion step:

Measuring fuel consumption
To determine the carbon footprint, you need to know how much fuel is being consumed in the production process. The measurement method will depend on the type of fuel used. Where accurate weight or volume information is not available through meters, bills and invoices may be used to document fuel quantity.

Allocating that fuel consumption to products
Again, it is helpful to establish how much fuel is consumed by each individual product. The approach here is exactly the same as that used for allocating the energy consumption (see above).



Converting fuel consumption into a carbon footprint
The final step is to convert the fuel consumption – e.g. x kg of wood – into a carbon footprint, i.e. y kg of CO_2. This calculation is based on a conversion rate per fuel type. See the detailed table below.

[1] The SAM (Standard Allowed Minute) of any particular task is, essentially, the normal time taken by a worker to complete that task.

BEST PRACTICE: CONVERSION RATES FOR CALCULATING THE CARBON FOOTPRINT

Translating fuel consumption into carbon footprint requires a conversion rate – the emission factor.

Emissions (in tCO2e) = fuel consumption (in unit, e.g. kg) x emission factor (in tCO per unit)

The following table shows the emission factors for the most important fuel types; in each case, the factor should be used as a multiplier in the calculation, as shown above.

Fuel type	Quantity (in unit)	Emission factor (in tCO2e per unit)
Natural gas	1 mcf	0.0534 tCO2e per mcf
Liquefied petroleum gas	1 litre	0.00161 tCO2e per litre
Motor gasoline	1 litre	0.00228 tCO2e per litre
Diesel	1 litre	0.00269 tCO2e per litre
Wood	1 kg	0.00178 tCO2e per kg

B. Developing a Renewable Energy strategy

Based on the assessment of their total energy demand and GHG emissions, manufacturers need to develop a plan for increasing renewable-energy use and reducing carbon emissions. The ultimate goal is to use 100% renewable energy in the final manufacturing of the product. The plan should address quantitative targets and include a detailed timeline of when individual initiatives will be launched.

C. Using renewable energy and addressing on-site GHG emissions

For different certification levels from SILVER to PLATINUM, different percentages of energy used at the factory need to be renewably sourced or offset with Renewable Energy projects or else with Renewable Energy certificates (RECs). The same percentage of direct on-site GHG emissions needs to be offset as well. This requirement is in line with the *Cradle to Cradle* principles, and is to “encourage manufacturers to participate in the demand for renewable energy with the goal of producing more than 100% renewable energy for a product”.

Sections 4 and 5 below give detailed information on different ways of sourcing renewable energy and offsetting GHG emissions.

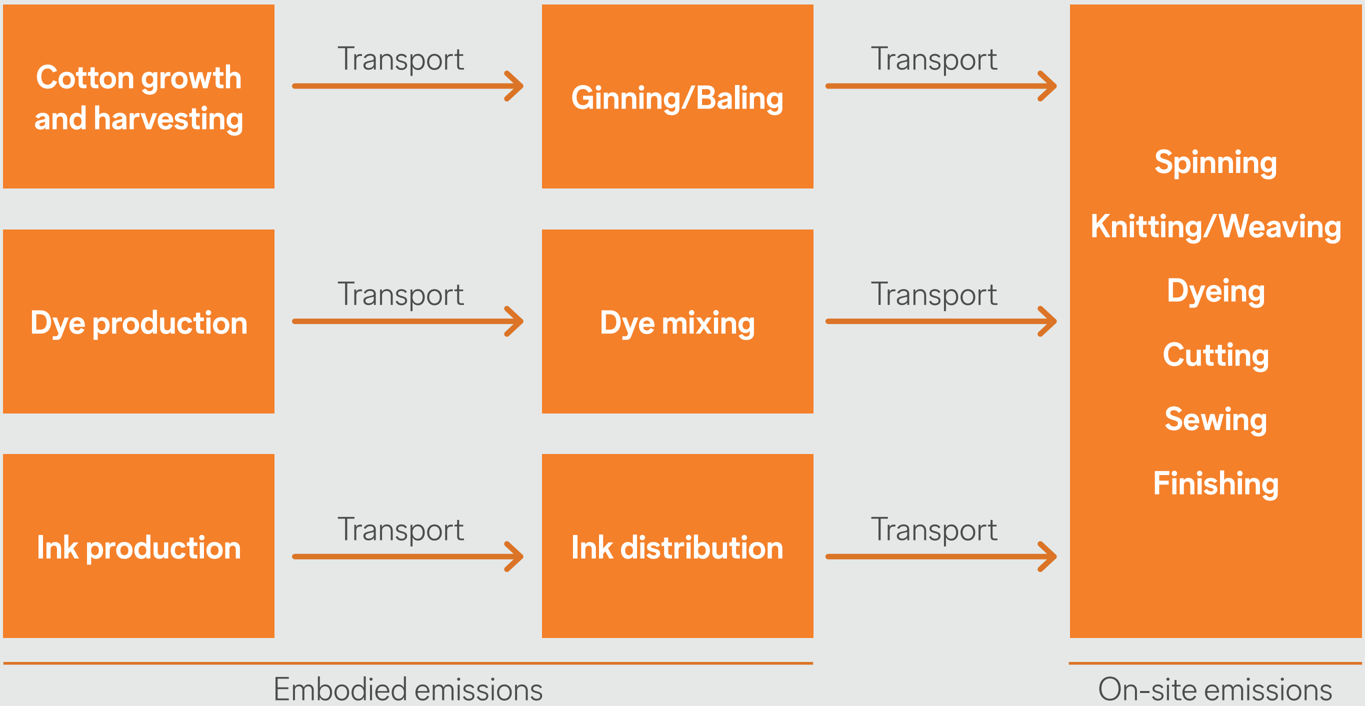
D. Calculating the embodied energy for the product

In order to achieve PLATINUM level, the manufacturer needs to understand the energy – and GHG emissions – associated with the entire supply chain. The manufacturer can then show the relative contributions of each stage, from extraction of raw materials through to final manufacturing, and can identify the choices, e.g. made in the product's design phase, that have the greatest impact on emissions.

BEST PRACTICE: DETERMINING THE EMBODIED ENERGY ASSOCIATED WITH A PRODUCT AND CALCULATING THE CARBON OFFSETS FOR C2C PLATINUM

Illustration of value chain

As outlined, the embodied energy includes the carbon footprint that occurs before the final manufacturing stage:



This includes all production steps that occur upstream of the final manufacturing site – in particular the cotton production and transportation. To calculate the carbon offsets required to cover **5%** of the embodied emissions, data is needed on the emissions for the production steps before the final manufacturing stage, as well as the total annual emissions from transportation of the product.

Embodied Emissions (in tCO2e) = (Total annual transport emissions (in tCO2e) + Total emission for pre-manufacturing production (in tCO2e)) x 5%

Example: Calculating the embodied emissions to be offset at Pratibha Syntex

Per 1,000 T-shirts, the data reveals that there are carbon emissions of 10.88 tCO2e for the annual transport and 38.86 tCO2e in the cotton production. Thus:

Embodied Emissions = [(10.88 tCO2e + 38.86 tCO2e)/1,000] x 5% = 0.00249 tCO2e to be offset per T-shirt

3. LEVELS OF ACHIEVEMENT

Overall, the C2C Certified criteria serve to differentiate textile producers according to their renewable-energy use and carbon emissions: by gradually sourcing more renewable energy and offsetting more emissions, C2C Certified applicants can graduate to the next level. Note that for BASIC to GOLD levels, the criteria refer only to the final manufacturing stage of the product, whereas the PLATINUM level considers the entire value chain – from Cradle to Gate – including emissions that occur at the sites of Tier-2 suppliers. The specific criteria for the different levels of achievement are as follows:

BASIC	Measurement of annual energy use and GHG emissions associated with the final manufacturing stage of the product
BRONZE	Development of renewable-energy use and carbon-management strategy
SILVER	5% of energy renewably sourced or offset with renewable-energy projects, and 5% of direct on-site GHG emissions offset for the final manufacturing stage
GOLD	50% of energy renewably sourced or offset, and 50% of direct on-site GHG emissions offset for the final manufacturing stage
PLATINUM	>100% of energy renewably sourced or offset, and >100% of direct on-site GHG emissions offset for the final manufacturing stage The embodied energy associated with the product from Cradle to Gate is characterised and quantified, and a strategy to optimise is developed. At reapplication, progress on the optimisation plan is demonstrated. ≥ 5% of the embodied energy associated with the product from Cradle to Gate is covered by offsets or otherwise addressed (e.g. through projects with suppliers, product re-design, or savings during the use phase).

Details of the requirements and instructions can be found in the C2C Certified Product Standard.

4. HOW TO OPTIMISE ELECTRICITY CONSUMPTION AND SOURCE RENEWABLE ENERGY

The ultimate goal of C2C Certified is a future in which factories make a positive impact on the ecosystem balance. Drawing on granular measurement of the current electricity and fuel consumption, this section discusses two aspects:

A. Optimising electricity and fuel consumption
B. Sourcing renewable energy

A. Optimising electricity and fuel consumption

Optimising electricity and fuel consumption means eliminating all unnecessary use of any energy source. In a typical garment factory, there are various opportunities for reducing electricity and fuel consumption while maintaining the output level.

- Meter the data, and analyse it to identify inefficiencies in the production process
- Devise a clear energy-management plan, perhaps with the help of a professional agency, to reduce or eliminate those inefficiencies
- Study the optimisation opportunities listed in this section, and pursue some or all of them

Optimising electricity consumption

There are a number of practical and cost-effective energy-efficiency improvements that require upfront investments and may be phased in over time. Further resources for optimising electricity consumption can be found online:

LINK TO FURTHER SOURCES

For further helpful information on optimising energy consumption, see the following:

Lawrence Berkeley National Laboratory's reference list
A comprehensive list of energy-saving opportunities – including items on realised savings, capital costs, and payback time – can be found in the article "Energy-Efficiency Improvement Opportunities for the Textile Industry"

NRDC – Clean by Design
A practical guide for responsible sourcing can be found in NRDC's 10 Best Practices for Textile Mills to Save Money and Reduce Pollution

SHOWCASE: COTTON BLOSSOM'S SEWING MACHINES

Replacement of sewing machines

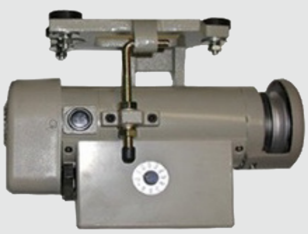
Cotton Blossom has been a pioneer in the movement to replace clutch-motor sewing machines with servo-motor sewing machines. Having confirmed, with the help of a specialised agency, that the energy-saving potential would be 60–80% per machine, the company duly replaced more than 2,500 sewing machines – about three-quarters of its total stock. The replacement proceeded slowly, phased over five years, to ensure a smooth transition and avoid disrupting production.

The *total investment of $2.3 million* lead to significant energy-savings, a productivity boost, and increased output.

The following manufacturers offer servo-motor machines: Siruba, Pegasus, Juki, Yamato

Clutch motor

- runs constantly
- higher electricity consumption



Servo motor

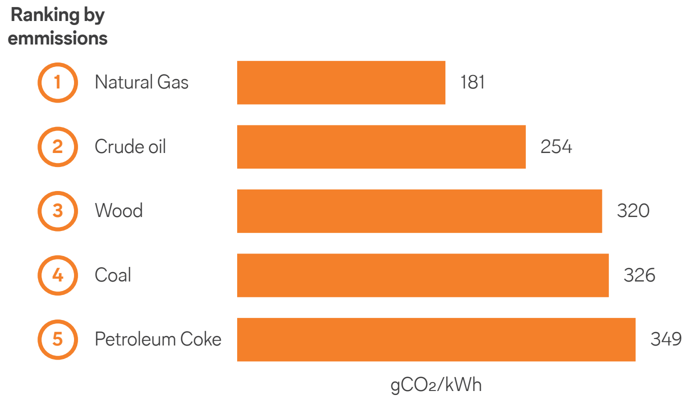
- runs when actually in use
- consumes just 20–40% of the energy used by a clutch motor
- more user-friendly
- generates almost no heat

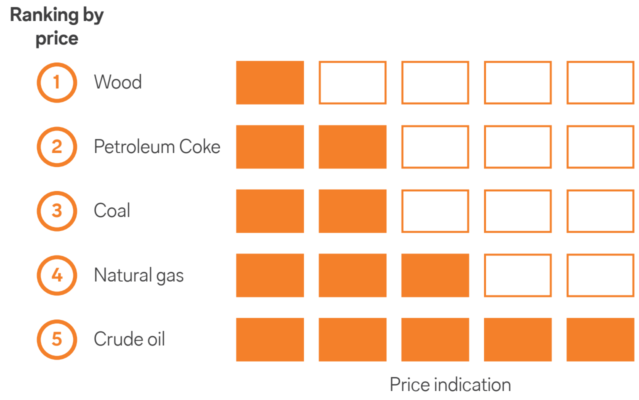
Optimising fuel consumption

The textile industry is characterised by a high demand for heat, particularly in the wet-processing divisions. This heat is often produced by on-site fossil-fuel combustion. The various conventional fuels differ widely in price and carbon emissions.

Ideally, heat requirements for production are met by renewable energy alone. Currently, the relevant innovative technologies are not commercially viable. In the interim, it is possible to select the most efficient conventional fuels in systems that capture and use all of the heat produced.

The graphs below provide an indicative comparison of the most common fuel types:





BEST PRACTICE: MAKING FUEL TYPES COMPARABLE

To compare the efficiency of different fuel types in terms of price and emissions is complex; it's important to compare how much of each fuel is needed for generating the same amount of energy. One helpful way of making the different fuels comparable is to set them in a specific scenario:

Suppose that you want to heat up 1 m^3 (= 1000 litres) of water by 1°C – that would require 1000 kcal of energy

The following table lists, for the five most common fuel types, the amount of CO_2 emitted, and the cost per unit of energy. Whereas CO_2 emissions can be clearly determined, prices are obviously volatile and may depend on external factors.

Fuel type	Emissions (in gCO_2/1000 kcal)	Price range (in USD/1000 kcal)
Natural gas	210 g	7.50 – 12.50 $
Crude oil	296 g	30.00 – 40.00 $
Wood	372 g	0.00 – 10.00 $
Coal	379 g	5.00 – 10.00 $
Petroleum	405 g	5.00 – 10.00 $

When committing to improving fuel efficiency, focus on a few of the factory's specifics, particularly in the wet-processing division, where the major proportion of thermal energy is required. Here is a list of relevant opportunities:

Cross-divisional

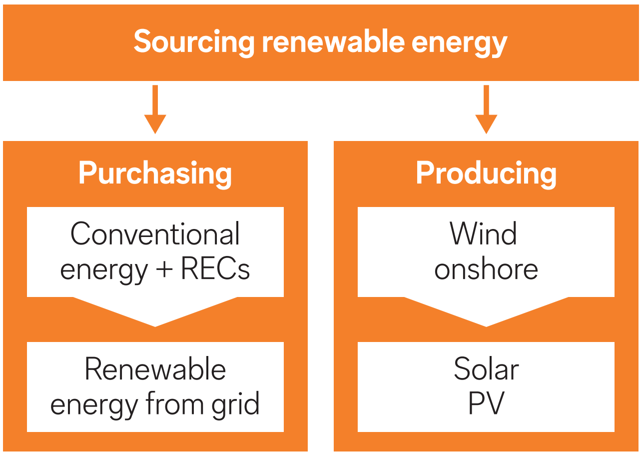
- Install or increase insulation
- Avoid heat-injected processes where possible
- Reduce the distance of transportation
- Recover heat

Wet processing

- Combine preparatory treatments
- Implement a bleach-bath recovery system
- Introduce point-of-use water heating in continuous washing machines
- Use counter-flow current for washing
- Install heat-recovery equipment in washing machines
- Install insulation for high-temperature dyeing machines
- Carry out cold-pad-batch pre-treatment
- Use innovative dyeing technologies
- Carefully control the temperature in atmospheric wet-batch machines
- Use discontinuous dyeing with airflow dyeing machines

B. Sourcing renewable energy

There are two distinct approaches to sourcing renewable energy:



Purchasing renewable energy

The most convenient way to source renewable energy is purchasing from a utility or broker, where this option is available. If these sources of bulk renewable energy are legitimate, they will provide documentation both to validate the renewable source of energy and to guarantee that the credits can be claimed. The most reputable sources are third-party verified; validation takes the form of Renewable Energy Certificates (RECs), which are globally accepted as certifying the authenticity of the renewable energy.

The market for renewable energy varies globally. In some locations, certificates may not be automatically transferred when the renewable energy is purchased from the grid. In some cases, the only verifiable way to claim that your energy is renewable is through direct purchase of RECs. Proceeds from the sale of RECs provide incentives for the expansion of renewable electricity generation. The RECs purchase process is simple, is adaptable to specific energy requirements and does not require upfront capital investment.

RECs can be viewed as guarantees or "green attributes" of renewable energy – serving as evidence that an electricity supplier has produced a certain amount of electricity from a renewable source. Often, electricity from multiple sources is fed into the electricity grid. By buying RECs equal to the energy required for a specific activity, a company can then claim renewable-energy use for that activity.

BEST PRACTICE: HOW TO ACQUIRE RECS IN INDIA

TIn India, RECs can be traded only on CERC-approved[1] power exchanges, notably IEX (www.iexindia.com) and PXIL (www.powerexindia.com):

- To be eligible for trading, you first have to register as a client
- Having determined the quantity of RECs that you want to purchase (1 REC corresponds to 1 MWh), you need to deposit funds equivalent to your bid into your member account
- You can now bid in REC trading sessions to purchase either solar RECs or non-solar RECs
- Solar RECs typically sell for Rs 3,500 ($52) each, non-solar RECs for Rs 1,500 ($22; as of December 2016)
- Non-solar RECs are equally acceptable for C2C Certified purposes

In addition to the Indian sources just mentioned, there are other websites trading in recognised RECs. One advantage of them is that they might not require you to create an account or to register as a member, and will simply allow you to make a purchase by credit card. In addition, their prices might be more competitive, thanks to the global market. Here are two such websites: TerraPass and GoodEnergy

Producing renewable energy

Direct use of renewable electricity can be achieved by on-site production – in particular, through wind on-shore or solar photovoltaic (solar PV) systems. These systems are currently the most feasible and cost-effective options, and are rapidly approaching par with conventional sources. The full range of options is shown in the chart below.

	Type	Costs[2]	Size (MW)
	**Wind on-shore**	1,300–1,600 $/kW 45–85 $/MWh	10–200
	Wind off-shore	3,200–4,800 $/kW 120–150 $/MWh	100–600
	**Solar PV**	950–1,600 $/kW 45–140 $/MWh	0.01–100
	Solar CSP	3,200–5,400+ $/kW 160–250 $/MWh	50–400
	Biomass/Biogas	2,100–3,800 $/kW 85–150 $/MWh	1–30
	Small Hydro	1,100–3,000 $/kW 20–200 $/MWh	1–10
	Geothermal	1,500–5,400 $/kW 40–85 $/MWh	2–100

Taking into account costs, project-size variability and financing requirements, small and medium-sized garment factories in India will currently find that the most feasible and cost-effective options for producing renewable energy are on-shore wind and solar PV.

[1] CERC = Central Electricity Regulatory Commission (of India)
[2] Cost for adding new capacity and levelised cost of energy | Source: IEA; BTM; Research firms: BCG; Bloomberg; United Nations

SHOWCASE: WHAT TO CONSIDER WHEN SETTING UP WIND-ENERGY PROJECTS IN INDIA

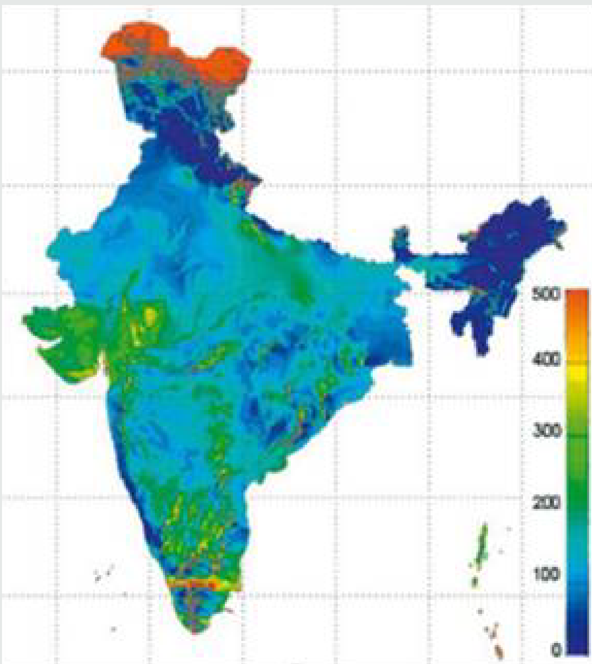
Wind energy has become one of the most prominent initiatives for renewable energy in India. Backed by strong policy support, the country's wind-power capacity is rapidly moving closer to the ambitious target of 60 GW by 2022. The main drivers are so-called Generation Based Incentives (GBIs) and Accelerated Depreciation (AD).

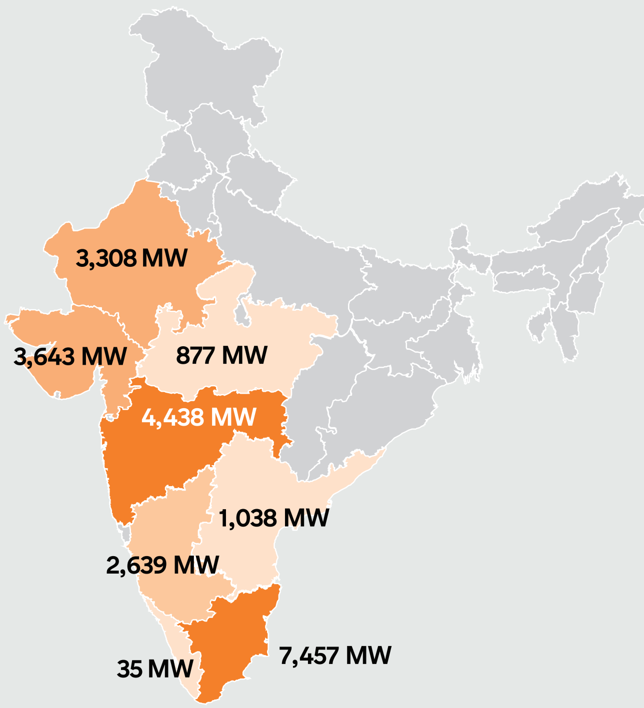
Policy support for wind energy

- *Generation Based Incentive (GBI)*
  The GBI scheme offers independent power producers additional revenue of slightly less than $0.01/kWh (up to maximum of about $150,000/MW over ten years) over and above the Power Purchasing Agreement (PPA) price
- *Accelerated Depreciation (AD)*
  The AD scheme offers 80% of the capital cost as depreciation in the first year of operation, thereby reducing the investment cost through tax savings (Note: the AD scheme phases out in 2017)

Preferred locations for wind energy

Wind conditions favour a few states in Southeast India as particularly conducive to wind energy. Tamil Nadu, Maharashtra, Gujarat, Rajasthan, and Karnataka are the most favourable regions, and the nation's current wind-energy capacity bears that out. Those five states produce more than 90% of India's overall wind energy (the total national output was about 24 GW in 2015).





Left: India wind density map 80 m from Report by WISE for the Ministry of New and Renewable Energy
Right: 2015 wind plant capacity in India from MNRE/analyst reports/Sigma insights

Besides the geographic conditions, there are several other factors that should influence the selection of sites across the country; notably:

Consistency of renewable-energy policies and tariff regimes

Consider how consistent the state government has been and might be in its energy policies, in particular towards wind energy. What are the implications if the state shifts to a tender model, as with solar energy? How does each of the main political parties regard wind energy, and how might state policy change after the next election? Do local regulations and processes make it easier or harder to gain the benefits of AD and GBI?

Transmission and distribution aspects

Consider grid connectivity and grid density. Without adequate connectivity, any project would be doomed to failure.

SHOWCASE: BUSINESS CASE FOR A TYPICAL APPAREL MANUFACTURER INVESTING INTO A WINDMILL

Description of windmill

As outlined above, a critical first step when investing in a windmill is the selection of the correct location, as wind speed is a main determinant in the effectiveness of a windmill.

Business case for windmill with capacity of 750 kWh

Upfront investment:

$537,000 In this example, the upfront investment cost is assumed to be fully self-financed.

In our example here, the Generation-based Incentive (GBI) support scheme is used. This support scheme offers wind-power generators a subsidy of slightly less than $0.01 per kWh of energy produced. The net profit of the windmill project can be calculated as follows:

Production profit & loss (per year):

Revenues

$68,100	Revenue from energy production (of 1.35 million kWh per year) & taking advantage of the GBI scheme
$5,400	Value of RECs received for renewable energy production
$73,500	**Total Revenue from renewable energy production with windmill**

Costs

$6,700	Maintenance cost per year
$21,500	Depreciation per year
$28,200	**Total Cost per year**

Gross profit

$45,300 Overall yearly gross profit from the windmill

Tax mitigation

$7,500 Tax mitigation (based on 35% corporate tax rate and linear depreciation of windmills for 25 years)

Net Profit

$52,800 Overall net profit for the manufacturer per year

Using the GBI scheme, the investment in the windmill has a nominal payback time of less than 11 years, even though the typical lifespan of a windmill is 25 years.

5. OFFSETTING EMISSIONS

The ultimate goal is to eliminate emissions from non-renewable sources, a scenario that requires a long-term perspective. In the meantime, textile companies can, or must, support the development of renewable fuels and GHG-reduction projects by offsetting their remaining emissions. After determining the carbon footprint of the factory – as explained above – the next step is to offset some or all of the emissions. A factory offsetting all its emissions is regarded as carbon-neutral, and, in that respect, as not polluting the environment. Note that offsetting might also be required for achieving a specific C2C certification level.

Like RECs, carbon offsets are verifiable claims linked to specific projects. Brokers issue a certificate confirming that a company has offset x tons of CO_2 equivalents. To be accepted by the C2C Products Innovation Institute, the offsets must show the name of the carbon offsetting project, the type of project, and the location. If that information is not shown on the certificate directly, the offsets should at least include a link or serial number tied to that information. There are several ways to acquire such certificates. Three options are discussed below, each with a list of potential sources:

A. acquiring offsetting certificates from the global/ conventional market
B. acquiring offsetting certificates from social projects
C. acquiring a certification licence for your own offsetting project

A. Acquiring offsetting certificates from the global/conventional market

There is a major global market in which offsetting certificates are bought and sold. The payments are channelled into large-scale projects, such as wind farms. Many of the certificate issuers have user-friendly websites, enabling prompt online purchase. This option usually represents the best value, with the lowest price per ton of CO_2-emission offsetting.

Among the numerous providers offering official certificates approved by the C2C Certified Products Program are the following:

- UN Climate Neutral Now, https://offset.climateneutralnow.org/ (all projects listed here are linked to a registry and thus provide detailed project information)
- TerraPass, www.terrapass.com
- Carbon Footprint, www.carbonfootprint.com

B. Acquiring offsetting certificates from social projects

As an alternative, credits may be purchased in order to specifically support social projects, typically smaller-scale and often locally based. These investments might be certified by organisations similar to Fairtrade, and are still subject to third-party verification through a registry. The price per ton of CO_2-emission offsetting tends to be slightly higher, but the advantage is that the proceeds go to worthy and accredited social or local projects.

Among the providers offering these certificates are the following:

- FairClimateFund, www.fairclimatefund.nl/en
- Climate Friendly, www.climatefriendly.com
- myclimate, www.myclimate.org

C. Acquiring a certification licence for your own offsetting project

A third option is to register your own emissions-offsetting project and to get a certification licence for it. Some agricultural or voluntary biogas projects may qualify for accreditation. Accreditation is long-term project, requiring measurement, validation and audits, and the engagement of an approved verification body.

Among the organisations that issue the licences are the following:

- Green-e, www.green-e.org
- The Gold Standard, www.goldstandard.org
- VCS, www.v-c-s.org
- Climate Action Reserve, www.climateactionreserve.org

6. GETTING STARTED

Given the energy-saving potential within the textile-manufacturing industry, many specialised agencies have emerged, offering tailor-made services to help clients tap their full energy-efficiency potential. For manufacturers, these agencies generally present a very positive business case. The savings derived from consulting them typically exceed the costs, and overall they tend to add considerable value to the companies that hire them.

BEST PRACTICE: EXTERNAL AGENCIES CAN CREATE VALUE FOR TEXTILE MANUFACTURERS

What does an external agency typically offer?

- The agency will conduct site visits and an energy audit, and then identify specific opportunities, the scope of savings, and potential roadblocks
- After presenting a final report, the agency will usually support the client during the implementation process and will often monitor progress as well
- Costs necessarily depend on the specific project; an indicative price is $12,000 in total
- Requirements often vary over time; remaining open to using new vendors is recommended.

Examples of agencies offering an energy audit

- Dexler Energy: http://www.dexlerenergy.com
- Schneider Electric India: http://www.schneider-electric.co.in/en/
- Siri Exergy & Carbon Advisory Services: http://siriexergy.com

FASHION FOR GOOD

C2C CERTIFIED™ "HOW-TO" GUIDE

Water Stewardship

WATER STEWARDSHIP

1. INTRODUCTION TO WATER STEWARDSHIP

In general the apparel industry has serious negative effects on watershed health. The dyeing process in particular consumes a great deal of water and creates effluents that can contaminate local water sources. End customers are becoming more aware of negative press associated with apparel brands and their manufacturers – in particular stories and images of toxic discharges to waterways and the consequent damage to the surrounding ecosystems and communities.

The Cradle to Cradle (C2C) Certified™ Products Program[1] can address these concerns, and can make a direct positive impact on watershed health. It does so by promoting the right choice of materials, the right processes and a commitment to continuous improvement.

ASPIRATION OF CRADLE TO CRADLE

Manufacturing processes are designed in the awareness that water is a precious resource for all living things; and at each level, progress is made towards the ultimate goal – namely, with the right design, all effluent can be made clean enough to drink.

APPAREL CONTEXT

The major water issues arising in the textiles industry are as follows:

- Various processes demand an extremely large volume of water
- Dyebath effluent often contains toxic chemicals, which may enter the biosphere if the effluent remains untreated; the pollutants include:
    - halogenated organic species (persistent, bioaccumulative)
    - metals (cadmium, chromium, cobalt, tin)
    - surfactants with very high aquatic toxicity

DEMAND FOR CLEAN WATER

To systematically address the water issues associated with apparel production, many major brands have signed up to various multi-stakeholder initiatives.

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

Table 7: List of water-focused initiatives

Initiative	Emphasis	Major Brands Involved
ZDHC	Based on a Manufacturing Restricted Substances List to eliminate ingredients of concern, particularly from wastewater, and a set of wastewater-management guidelines to increase effectiveness and improve overall quality	Nike, Adidas, Gap, Inditex, Kering, Levi Strauss, Marks & Spencer, Nike, Puma, C&A, Esprit, H&M, G-Star Raw, PVH, Primark, and others
Detox Campaign	A Greenpeace initiative to get brands to adopt a Manufacturing Restricted Substances List and eliminate those substances from their operations by 2020 (with corresponding transparency and management plans); also, to achieve a global ban on PFCs	Inditex, Benetton, H&M, C&A, Fast Retailing, G-Star Raw, Adidas, Levi Strauss, Primark, Puma, Marks & Spenser, Nike, Esprit, Li-Ning, and others
The Sustainability Consortium	Focused on optimising chemistry to reduce water pollution, as well as on reducing water and energy consumption	Wal-mart, Hanes, Marks & Spencer, Wrangler, and others

The C2C Certified Products Program aligns with the goals of these initiatives in promoting Water Stewardship, and integrates the aspiration for clean water into the product chemistry itself.

BENEFITS TO MANUFACTURERS

When manufacturers improve their Water Stewardship through the C2C Certified Products Program, they benefit in several of the following ways:

- *Cost savings.* By optimising water use and using C2C Certified materials, manufacturers can reduce costs through lower energy and water demands (less steam required, lower overall water volume, lower volume of water to be treated, lower treatment demand owing to better chemistry in effluent). In addition, by recycling water, factories can maintain a consistent water supply during periods of water scarcity, and thereby facilitate continuous, uninterrupted production.
- *Better relationships with workers and local communities.* If water is recycled or only clean water is released, the burden on local water supplies and waterways is reduced.
- *Better relationships with brands.* Customers are demanding better environmental performance from brands, and brands are increasingly looking for manufacturers that have clean manufacturing processes.

2. C2C CERTIFIED CRITERIA FOR WATER STEWARDSHIP

The six components of the C2C Certified criteria for Water Stewardship are as follows:

A. Demonstrating compliance
B. Conducting an audit of local water issues
C. Developing a statement of water-stewardship intentions
D. Conducting a factory-wide water audit
E. Assessing and optimising product-related process chemistry
F. Releasing only drinking-quality water

All levels of certification require the first four items. SILVER and above require the assessment of process chemistry; GOLD and above require optimised process chemistry; and PLATINUM requires that factories should release only drinking-quality water. For details on the submission criteria, and supporting resources, visit the C2C Certified Product Standard.

A. Demonstrating compliance

For all levels of C2C certification, factories need to show that they are in compliance with well-developed and well-enforced local regulations.

B. Conducting an audit of local water issues

The more clearly manufacturers understand the ecosystem in which their factories operate, the better they can understand their own role within it and identify ways to contribute positively to overall watershed health. Compiling this information is simple, and can easily be done by internal personnel.

SHOWCASE: LOCAL WATER ISSUES AUDIT FOR PRATIBHA SYNTEX

As part of the certification process, Pratibha Syntex prepared the following audit of local water issues:

Location	Pithampur, District Dhar, Madhya Pradesh (India)
Watershed or Catchment Name	Sanjay Jalashaya (rainwater-harvesting water body)
Major Water Sources within Catchment	Rainwater only (WBCSD Global Water Tool and/or Aqueduct Water Risk Atlas, India Census)
Major Demand on Sources	Municipal and industrial supply (WBCSD Global Water Tool and/or Aqueduct Water Risk Atlas, India Census)
Scarcity/Stress Level	Medium-High (WBCSD Global Water Tool and/or Aqueduct Water Risk Atlas, India Census)
Access to improved water (% of population)	61.5% (WBCSD Global Water Tool and/or Aqueduct Water Risk Atlas, India Census)
Access to improved sanitation (% of population)	24% (WBCSD Global Water Tool and/or Aqueduct Water Risk Atlas, India Census)
Impaired waterways, endangered wetland, or water bodies affected by eutrophication	None
Other issues	None

C. Developing a statement of water-stewardship intentions

For each issue identified in the audit of local water issues, manufacturers need to develop an approach to addressing them in the present and future.

SHOWCASE: WATER-STEWARDSHIP STATEMENT FROM PRATIBHA SYNTEX

Pratibha Syntex does not contribute to the stress on its local watershed, as the company has an on-site effluent-treatment plant that effectively cleans the water via mechanical and biological processes. The process water is continuously cleaned and reutilised on-site.

The only water imported from the local watershed is for drinking and utility purposes, as well as to compensate for process losses.

D. Conducting a factory-wide water audit

Manufacturers will need to conduct a factory-wide water audit that includes how much water is used annually (and details on its use), where it comes from, how it might be recycled and the quality and amount of effluent discharge.

SHOWCASE: PRATIBHA SYNTEX WATER AUDIT

As part of the certification process, Pratibha Syntex prepared the following water audit:

I. Sources	
Municipal Supply	98,550 m^3
Recycled/Reclaimed	597,505 m^3
% of total reclaimed	85.84%
Total All Sources	**696,055 m^3**
II. Storage	Not applicable
III. Discharge	Not applicable
IV. Consumption/Loss	
Total Water Input	696,055 m^3
Total Water Discharge/Loss	84,597 m^3 (evaporation, leaks)
Total Water Consumption	**611,458 m3**
V. Use	
Embodied in Products	
Process & Equipment Use	402,741 m^3
Cooling & Heating	111,139 m^3
Other Facility Support	
Personnel	
Sanitary & Domestic	75,190 m^3
Outdoor Uses	21,900 m^3
Total Use Estimate	**610,970 m3**

E. Assessing and optimising product-related process chemistry

Ideally, the manufacturer will be able to demonstrate that the wastewater-treatment system is a closed-loop water-recycling system and that there is no effluent leaving the factory (and that the effluent would ordinarily be discharged into water systems). If so, no further assessment or optimisation of process chemistry is required.

If the wastewater-treatment system is not closed-loop, then process chemistry will need to be assessed for SILVER; and, in the case of GOLD and above, the process chemistry will need to be optimised against the Material Health criteria. Please see the Material Health chapter for more information on the criteria.

F. Releasing only drinking-quality water

This requirement applies only to PLATINUM-level certification. To achieve that level, it is necessary not only to optimise the process chemistry but also to test the effluent and show that it meets or exceeds local regulations for drinking water.

3. LEVELS OF ACHIEVEMENT IN WATER STEWARDSHIP

There are five potential levels of achievement; each level builds on the requirements of the previous level. Note that from SILVER level upwards, process chemistry becomes a factor in the assessment.

BASIC	No discharge permit violations within the last two years Local & business-specific water issues characterised Submission of a statement of intentions & actions to mitigate identified problems
BRONZE	A factory-wide water audit completed
SILVER	Product-related process chemicals in effluent characterised and assessed or Supply-chain-relevant water issues characterised for at least 20% of Tier-1 suppliers, and a positive-impact strategy developed
GOLD	Product-related process chemicals in effluent optimised or Demonstrated progress on the strategy for the Silver-level requirements
PLATINUM	All water leaving the factory meets drinking-water quality standards

For detailed information on the requirements and instructions, refer to the C2C Certified Product Standard. The catalogue can be found online: Cradle to Cradle Certified Product Standard (pdf file).

4. OPTIMISING WATER USE AND PROTECTING WATER QUALITY

If manufacturers choose optimised in chemicals and adopt best practices in water efficiency, they can reduce the amount and intensity of water treatment required. That reduction will mean benefits for the economy, human health and the environment; it will also make it easier to achieve higher C2C certification levels.

A variety of actions can contribute to reducing water consumption and enhancing wastewater quality:

At the specification level:

- ***Choose the right fibres.*** Fibre choices often determine the amount of water needed over a garment's entire production cycle. Linen, PET, nylon, hemp, cotton and tencel have lower overall water requirements than acrylic, wool, silk and viscose. Cotton and nylon have high water demands during raw-material production, but lower water requirements during the phases involving fibre production, fabric production and dyeing/finishing. Choosing undyed or chlorine-free fibres will mean avoiding dioxins, which could show up in wastewater. For comparisons on the different energy, water, waste, and GHG emissions associated with fibres, consult the following sources of information:
  - HIGG Material Sustainability Index
  - Made-By's Environmental Benchmark for Fibres
  - Nike's Making App
  - Centre for Technical Textiles, University of Leeds, The role and business case for existing and emerging fibres in sustainable clothing (April 2010)

- ***Use C2C Certified dyes, finishes and process chemicals.*** All C2C Certified products have been assessed for effects on human and ecological health, and those that achieve GOLD or higher have been optimised. This certification means cleaner water and safer discharges.

At the process level:

- ***Prefer low-water pre-treatment*** if pre-treatment is needed. Avoid enzyme scouring, and avoid both hydrogen-peroxide bleaching and chlorine bleaching; instead, opt for mercerising and EOO bleaching.
- ***Prefer low-water dyeing processes.*** Cold-pad-batch dyeing and continuous-line dyeing are more water-efficient than other processes.
- ***Prefer low-water garment finishes and printing approaches.*** Water jet fading and Ice CO2 Blast have low water requirements relative to processes like stone washing and enzymatic shading. Similarly, digital ink printing requires far less water than bio discharge painting.
- ***Implement best-practice leak detection, preventative maintenance, and improved cleaning***

A good resource for comparing the relative environmental performance of each technique is The Wet Processing Benchmark from Made-By and Systainable Solutions.

At the factory level:

- ***Install metering on each piece of equipment.*** Monitoring each item of equipment allows for faster detection of malfunctions and provides opportunities for incremental efficiency improvements. Precise information on water usage can help in determining whether and when specific machines or systems should be replaced by more water-efficient counterparts.
- ***Recapture water.*** Recaptured and condensed steam, together with recaptured condensate and non-contact cooling water, can provide a steady supply of water that would otherwise evaporate.
- ***Reuse process water.*** By reusing process water, factories can move towards a closed-loop manufacturing process, which enables a more reliable water supply. That is particularly valuable in drought-prone locations, and reduces stress on the surrounding watershed. It is worth considering the reuse of contact cooling water from singeing, preshrink systems and circulating pumps.

For more details on water-saving strategies at the factory level, refer to NRDC's 10 Best Practices for Textile Mills to Save Money and Reduce Pollution.

SHOWCASE: PRATIBHA SYNTEX COLD-PAD-BATCH DYEING SYSTEM

In 2007, Pratibha Syntex was looking for ways to optimise water use in order to reduce water demand from the municipality and to reduce the wastewater-treatment load. At ITMA (the premier textile machinery exhibition), Pratibha Syntex found a cold-pad-batch dyeing technology by Erbatech that suited its aims. The technology could provide water savings and also provide superior dyeing and finishing for cellulosics.

Implementation of the technology was not without its challenges. It took Pratibha Syntex six years to stabilise the quality. The challenges included:

- limited technical support
- the considerable capital cost
- the need for skills development and for regular fine-tuning of equipment, according to different materials
- scaling up from lab to bulk use

The first set of machines was installed in 2008 and the second set of machines in 2016. Further investments in the technology have improved performance and increased capacity.

Pratibha Syntex lists the following benefits of the system:

- significant reduction in solid waste, relative to other conventional dyeing processes (mainly through the elimination of salt and special chemicals)
- improved fabric quality
- greater water and energy efficiency (30–40% savings compared with conventional dyeing)
- smoother fabrics: no need for biopolish
- the opportunity to conduct pre-dye checks and improve the chances of getting things right first time
- uniform dye quality with even colour absorbency and colour fastness
- reduced labour costs
- a better working environment

5. CLEANSING WATER

Given the apparel industry's poor environmental record in relation to water, the C2C Certified Products Program assigns a high value to the cleansing of water. Such cleansing will benefit a manufacturer in various ways: it helps in reducing future liabilities, in complying with or anticipating regulations and (if the water is also recycled) in providing a steady and reliable source of process water.

Ideal treatment process

From a C2C Certified perspective, the ideal wastewater-treatment system is one that completely metabolises organics into nutrients and completely chelates all metals from process effluents. The treatment system can be simplified if properly integrated with process-chemistry optimisation; all salt compounds from wastewater can qualify as biological nutrients, and the water leaving the system is clean enough to drink. The impact on the watershed is net positive (i.e. the factory creates water that is cleaner than the water it received).

Implementing a water-treatment system

Water-treatment experts at Pratibha Syntex offered the following advice on implementing or upgrading an on-site wastewater-treatment system:

- *Visit other manufacturers.* Ask questions about their systems – how the systems perform, how they were implemented, what the capital and operational costs are, how they are staffed and how that staff is trained and what the companies would have done differently.
- *Do research* on the various systems recommended and list the pros and cons of each. Reach out to industry groups for the latest thinking on wastewater-treatment.
- *Consider a physio-biological system*, which combines biological treatment with mechanical aeration and processing.
- *Hire a consultant* to design/build the system, but train internal staff to run it. The smooth and proper functioning of the wastewater-treatment system affects the entire production line, so it is worth embedding the expertise in-house.

Operating an on-site treatment system

The balance between wastewater-treatment capacity and load is a critical one. Pratibha Syntex offered the following practical advice regarding operations:

- *Balance water treatment with the dyeing schedule.* The way to avoid overloading the system is to sequence jobs carefully, so that the processing load is levelled out; for instance, schedule light-treatment jobs immediately after high-treatment jobs.
- *Ensure good daily coordination between the water-treatment team and the dyeing teams.* Without coordination, the wastewater-treatment system could get out of balance and slow down production.

SHOWCASE: PRATIBHA SYNTEX WATER-TREATMENT SYSTEM

In 2005, Pratibha Syntex, in keeping with its commitment to sustainability, implemented a "closed loop" water-treatment system. Operating such a system is now a legal requirement for apparel manufacturers in the region.

Pratibha Syntex's water-treatment system has a capacity of 2,000 kilolitres of water a day and has a water recovery efficiency of 93%. This means that 93% of the water treated is fed back to operations as clean water. The most water intensive process in a garment factory is dyeing. At Pratibha Syntex, the effluent from dyeing is segregated into two streams, based on their concentration of colorants and salt. The stream with high concentrations of colorants and salt comes from the actual dye bath effluent, whereas the stream with low concentrations mainly comes from the water used in the post-dyeing washing process.

The low concentration effluent requires only moderate treatment and goes through a physiochemical treatment which removes any colorant residuals, and a reverse osmosis filtration process before it can be used again. The high concentration effluent requires a more sophisticated treatment. In a first process step, this effluent is treated to normalize parameters such as the pH-value. Then it is fed into a multi-effect evaporator (MEE). In the MEE, the effluent is converted into sludge and the remaining water is evaporated, before the cleaned water is fed back to operations.

The system requires a steady flow of water to function properly. It can be shut down for short periods of time for maintenance.

6. GETTING STARTED

Manufacturers can achieve high achievement levels in Water Stewardship by adopting practices and activities conducive to optimisation. Some activities are fairly simple and can begin right away; others will require more time and investment.

In the short term

- Assess the baseline:
  - Conduct a water audit to understand how much water you use, where it is used, and the quality of the water at each stage
  - Conduct an audit of the local water issues in your area

In the medium term

- Optimise:
  - Develop a statement of water-stewardship intentions
  - Develop a water-optimisation plan
  - Research potential closed-loop water-treatment technologies
  - Talk to other manufacturers about how they have dealt with water treatment

FASHION FOR GOOD

C2C CERTIFIED™ "HOW-TO" GUIDE

Social Fairness

SOCIAL FAIRNESS

1. INTRODUCTION

A key principle of the Cradle to Cradle (C2C) Certified™ Products Program[1] is that products or services should be designed in a way that “does good”, leaving a “beneficial footprint for human society and the environment”. Manufacturers are encouraged to be good “corporate citizens” in general, going beyond their corporate borders and caring for the local community, to be environmentally responsible, and to reinvest in natural capital.

ASPIRATION OF CRADLE TO CRADLE

C2C Certified is striving to guide businesses towards “operations that protect the value chain and contribute to all stakeholder interests, including employees, customers, community members, and the environment”.

APPAREL CONTEXT

Apparel manufacturing is a labour-intensive industry, employing millions of workers worldwide. Working conditions are often challenging, and tragedies such as the Rana Plaza collapse in 2013 have highlighted the issue starkly and provoked global criticism of the industry. Social Fairness is therefore a top priority for the industry, with ever-higher expectations from governments, NGOs, brands, and end customers.

Social Fairness in the textile industry is a complex topic. Many factories clearly have much scope for improvement in this area. C2C Certified and other certification standards acknowledge the difficulty of achieving change, but the ambition remains: to make a positive impact on communities and ecosystems by encouraging and working with suppliers to make relevant adjustments and thereby continuously improve working conditions and business practices.

BENEFITS TO MANUFACTURERS

Manufacturers have a variety of benefits associated with improving Social Fairness, including the following:

- **Improved relationships with workers and communities**. By paying fair wages and investing in the personal and professional development of employees, companies are not only reinforcing staff loyalty but also helping to raise the standard of living in the entire local community.

- **Less workforce turnover**. By providing working conditions that are perceptibly better than those of other factories, companies can boost employee retention.

- **Better relationships with brands**. The apparel industry has a poor public image in respect of Social Fairness. In response, many brands have strict requirements on transparency and Social Fairness when choosing suppliers. Manufacturers that evidence fair treatment of their workers are therefore increasingly gaining a competitive advantage.

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

SOCIAL FAIRNESS

DEFINITION OF SOCIAL FAIRNESS

Many apparel brands and manufacturers focus their Social Fairness efforts on ensuring that their suppliers comply with a specified "code of conduct". The code typically includes basic rights for workers – minimum wages, maximum working hours, provisions against child labour– as well as adherence to local laws.

That focus is the first step in the journey towards PLATINUM level for Social Fairness. Social Fairness is more than insistence on basic compliance. For the C2C Certified Products Program, a key motivation is to make a positive impact on the economy, the environment, and society. So, the definition of Social Fairness in the Product Standard is broad:

C2C CERTIFIED DEFINITION OF SOCIAL FAIRNESS

Social Fairness ensures that progress is made towards sustaining business operations that protect the value chain and contribute to all stakeholder interests, including employees, customers, community members, and the environment. It is important for business ethics to go beyond the confines of the corporate office and permeate the supply chain, engaging it in responsible manufacturing, enforcing fair treatment of workers, and reinvesting in natural capital.

2. C2C CERTIFIED CRITERIA FOR SOCIAL FAIRNESS

The six criteria for Social Fairness under the C2C Certified Products Program are as follows:

1) conducting a self-audit on fundamental human rights and developing an implementation plan including ingredients with material-specific certification
2) conducting a social-responsibility self-audit and developing an impact strategy
3) assessing the information required for material-specific certification
4) investigating social issues in the supply chain
5) realising an innovative social project
6) undergoing a third-party social-responsibility audit

Overall, the Social Fairness criteria for C2C certification aim to provide a differentiated evaluation of the textile manufacturer's current Social Fairness status and its activities to improve on relevant social matters. BASIC to GOLD levels can be achieved by conducting self-assessments and performing certain management actions. PLATINUM level requires an audit by a recognised third-party certification body to confirm the manufacturer's social responsibility and high social standards. The C2C Products Innovation Institute is currently in the process of updating the Product Standard, and the requirements will very likely become more stringent in the next version.

The rest of this chapter concentrates on ways of realising an innovative social project (criterion 5) and on undergoing a third-party social responsibility audit (criterion 6).

REALISING AN INNOVATIVE SOCIAL PROJECT

The C2C Certified Product Standard requires that the company to be certified "actively conducts an innovative social project that positively impacts employees' lives, the local community, the global community and social aspects of the product's supply chain or recycling/reuse". The social project should have a positive effect on social issues, and ideally should relate to *Cradle to Cradle's* principles – eliminate the concept of waste, use renewable energy, and celebrate diversity. The Social Fairness requirements are deliberately defined very broadly, in recognition of the different value systems and opportunities in different parts of the world.

SHOWCASE: COTTON BLOSSOM'S FREE MEDICAL CAMP

DESCRIPTION
Once a year, Cotton Blossom organises a free medical camp for its employees, their family members, and people from the community. At the medical camp, people can consult doctors, undergo check-ups, and receive basic and prescription drugs at no cost. In cases of serious illnesses, patients can even be hospitalised at no cost to themselves.

RESULT
More than 90% of factory employees have a check-up whenever a medical camp is organised. In addition, employees' family members and other local residents receive treatment as appropriate, and the overall health status of the local community is raised accordingly.

UNDERGOING A THIRD-PARTY SOCIAL-RESPONSIBILITY AUDIT

To achieve PLATINUM level, the manufacturer must have recently passed a third-party social-responsibility audit conducted by an internationally recognised certification body. There are several audits/certificates that are pre-approved for the C2C Certified Products Program:

- B Corp certification with third-party audit
- Business Social Compliance Initiative (BSCI) audit
- Global Social Compliance Programme (GSCP) audit
- Social Accountability International SA8000 certified
- Worldwide Responsible Apparel Production (WRAP)

Other third-party certifications might be valid too. At a minimum, the certifying organisation should be internationally recognised, and should address issues of child labour, forced labour, health and safety, freedom of association and collective bargaining, discipline/harassment, working hours and compensation.

Given that the C2C Products Innovation Institute is likely to tighten the Social Fairness requirements following its review, manufacturers commissioning a third-party audit are advised to opt for one of the more rigorous ones – such as B Corp, SA800, or the Fairtrade Textile Standard – to ensure that it will fulfil requirements in the future too.

3. LEVELS OF ACHIEVEMENT

To achieve a given certification level, you have to fulfil all the requirements of lower levels, as well as some specific new requirement(s). For higher-level certification in the Social Fairness category, the manufacturer must not only address any issues identified but also initiate innovative social projects that benefit employees, the wider community, and/or the environment.

BASIC	Streamlined self-audit on fundamental human rights Management procedures to address identified issues
BRONZE	Social-responsibility self-audit (e.g. UN Global Compact, B-Corp)
SILVER	Material-specific or issue-specific certification on at least 25% of the product material by weight (e.g. FSC) or Investigation of social issues in the supply chain, and development of a strategy or Innovative social projects that positively impact the employees or community
GOLD	Two of the three SILVER level requirements
PLATINUM	All three of the SILVER level requirements Third-party audit by an international social-responsibility programme (e.g. SA8000, B Corp, or Fairtrade Textile Standard)

Detailed information on the requirements and instructions can be found in the C2C Certified Product Standard (pdf file).

4. GETTING A THIRD-PARTY SOCIAL-RESPONSIBILITY AUDIT – A DETAILED EXAMPLE

The C2C Certified Program accepts a range of third party social-responsibility audits such as SA8000, B Corp, or the Fairtrade Textile Standard. Among them, the Fairtrade Textile Standard is recognised as one of the more stringent certifications. It covers many aspects of social responsibility, notably:

A. Wages and social security benefits
B. Working hours
C. Empowerment of workers
D. Training and capacity-building, including youth employment programmes
E. Women's empowerment

SHOWCASE: FAIRTRADE TEXTILE STANDARD

PURPOSE
The purpose of the Fairtrade Textile Standard is to guarantee workers along the entire textile supply chain a decent standard of living, and empower them to combat poverty, strengthen their bargaining position and take more control of their lives.

ABOUT FAIRTRADE
Fairtrade International is a global non-profit organisation that works with farmers and workers to improve lives through more equitable trade. Its vision is a world in which small producers and workers enjoy secure and sustainable livelihoods, fulfil their potential and direct their own future. Fairtrade International owns the sustainability trademark FAIRTRADE, which is used by products around the world.

HOW IT WORKS
The Standard requires that employers pay living wages, guarantee workers the right to join unions, and ensure that health, safety and environmental principles are adhered to.

WHY APPAREL MANUFACTURERS SHOULD GET THE CERTIFICATION

- Fairtrade is an internationally recognised sustainability certificate
- Getting a Fairtrade certification shows a strong commitment to Social Fairness
- The certification is based on a clearly defined methodology; e.g. on how to calculate a living wage or set correct living wages
- Fairtrade offers support, using local staff, to factories to help them implement the Standard correctly

A. Wages and social security benefits

Manufacturers should pay a living wage to all workers. A living wage is defined as “remuneration received for a standard work week by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transport, clothing, and other essential needs, including provision for unexpected events[2].” Note that a living wage can be higher than the legal minimum wage in a given location. When setting the correct living wage, the manufacturer should consider the following factors:

- legal or sectoral regulations (if applicable)
- regional average salaries
- official minimum wages

The living-wage benchmarks are calculated by Fairtrade International using the Anker methodology, and are regularly updated.

[2]See https://www.fairtrade.net/fileadmin/user_upload/content/2009/standards/documents/generic-standards/GLWC_Anker_Methodology.pdf, p.2

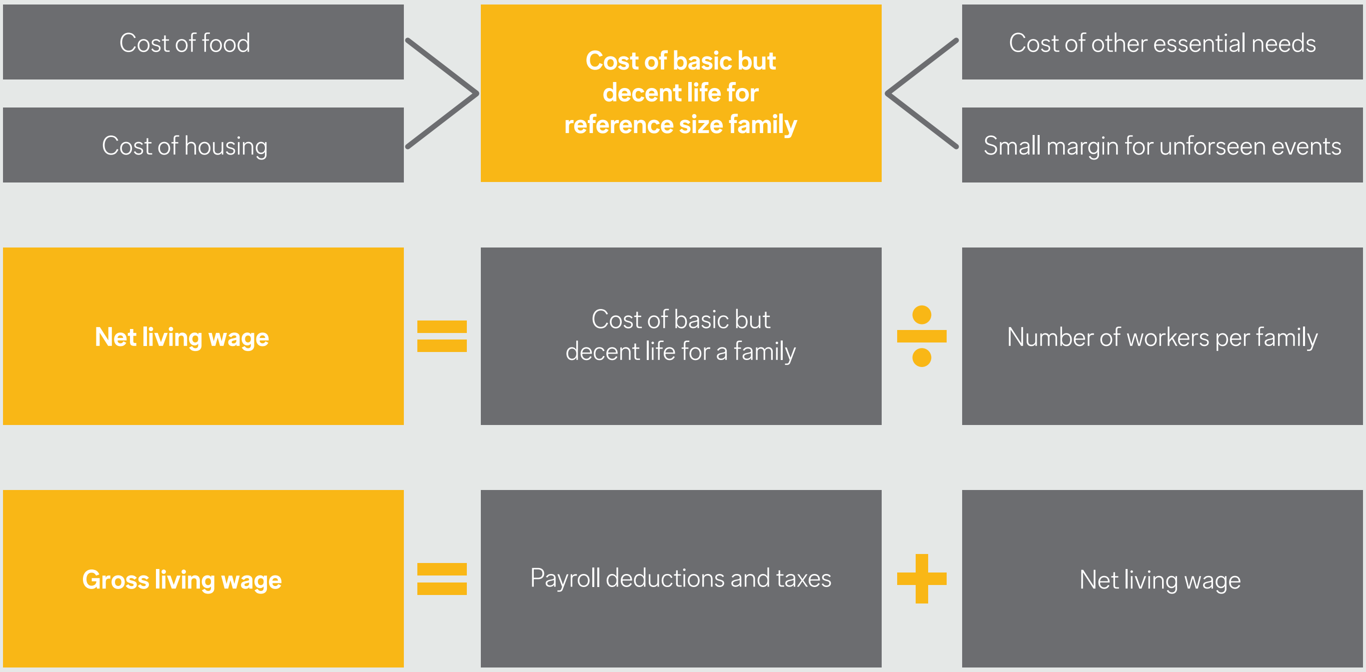
BEST PRACTICE: ANKER METHODOLOGY TO CALCULATE LIVING WAGES

ABOUT THE METHODOLOGY

Fairtrade International, GoodWeave, and three other sustainability NGOs have agreed to use one consistent methodology to calculate living wages: the Anker methodology. Fairtrade uses this methodology to calculate living-wage benchmarks, against which actual wages paid by Fairtrade-certified manufacturers are compared. Doing so ensures the payment of living wages at manufacturers in different locations.

HOW IT WORKS

The methodology estimates the cost of a basic but decent lifestyle for a worker and his/her family in a particular place. Local data collection, together with secondary data, is used to make the methodology practical and credible. Local food prices, housing costs, cost of education, health care and transport are measured separately to calculate the living wage for a given area.



Source: isealalliance.org

WHY IT MAKES SENSE TO USE THIS METHODOLOGY

- The methodology considers important input factors individually, without being too complex
- Local data is included in the calculation of costs, thereby providing a realistic picture

B. Working hours

The Fairtrade Textile Standard mandates that manufacturers respect local laws and working hours as agreed with representatives of the workers, such as trade unions. At a maximum, workers' regular working hours should not exceed eight hours per day and 48 hours per week. For every six consecutive days of work, workers must get one day of rest. Overtime should not be required in order to sustain normal business operations, but should be limited to exceptional circumstances such as peak production times.

Furthermore, workers should be educated about local laws regarding working hours and the need to avoid excessive overtime work. The manufacturer should clearly communicate to workers that it is in the workers' and manufacturer's best interest to stay within the law regarding working hours. Excessive overtime exposes workers to health and safety risks. For manufacturers, excessive overtime might result in quality issues and risk of legal action due to violations of employment laws.

BEST PRACTICE: PRATIBHA SYNTEX OVERTIME POLICY

DESCRIPTION
Some manufacturers argue that they need to operate with regular overtime in order to attract enough workers, since workers want to maximise their income and would otherwise look elsewhere for work. Pratibha Syntex, however, has a clear stance against regular overtime, and openly communicates that policy.

HOW IT WORKS
Pratibha Syntex makes it clear to its workers and job applicants that it does not allow regular overtime work. Workers are informed that excessive overtime is against the law and could put both Pratibha Syntex and the workers at operational and legal risk.

IMPACT ON BUSINESS OPERATIONS
Since Pratibha Syntex is very clear and open about its policy, job applicants who accept an employment offer do so in full awareness that they cannot expect and will not be permitted to do regular overtime work.

C. Empowerment of workers

The empowerment of workers, specifically the right of workers to form or join a trade union, is a key element of the Fairtrade Textile Standard. Under the terms of the Standard, companies must not in any way discourage or hinder workers from forming or joining a union. Instead, companies should make workers aware of their right to form or join a union, by publicly displaying information in relevant languages and ensuring that illiterate workers understand it too. Fairtrade-certified companies are required to sign the Fairtrade "Freedom of association protocol", which lists all rights and obligations of workers and employers regarding freedom of association and collective bargaining.

D. Training and capacity-building

According to Fairtrade, training is an essential element in improving the situation of workers[3]. The relevant training is of two different types:

- raising workers' awareness of labour rights and Fairtrade
- professional skills development

To raise workers' awareness of their labour rights and their rights under the Fairtrade Textile Standard, manufacturers should actively communicate these rights to workers. They can do so, for example, by publicly displaying the labour rights or by educating workers in meetings. Trade union representatives or elected worker representatives should receive dedicated training on labour rights and negotiation skills to empower them in their role.

In addition, manufacturers should offer regular training opportunities to their workers for personal and professional development.

SHOWCASE: COTTON BLOSSOM'S SKILLS-DEVELOPMENT TRAINING

PURPOSE OF THE TRAINING

To help new employees become skilled workers by giving them professional training

CONTENT & FORMAT OF THE TRAINING

100% of new employees are taught operational skills – such as sewing, pressing, and packing – by professionals from implementation agencies such as Technopak and NIFT-TEA (College of Knitwear Fashion). Training takes place over a period of 35 days.

BENEFITS OF THE TRAINING

- helping new employees become proficient in their jobs more quickly
- helping to increase the workers' personal capital
- ensuring consistent quality of work
- improving health and safety in factory operations

[3]See http://www.fairtrade.net/standards/our-standards/textile-standard.html

E. Women's empowerment

Women in garment factories often face discriminatory policies and practices based on gender stereotypes that deny them equal wages, access to job opportunities, training and capacity management, and promotions. Sexual harassment has also been widely documented.

Sexual harassment is a form of gender-based violence, and a violation of human rights. Some countries, such as India, have specific laws against sexual harassment at the workplace. According to the Anti-Sexual Harassment Act, companies operating in India with more than ten employees need to have an Internal Complaints Committee. Legal compliance is a basic expectation of the C2C Certified Products Program and the Fairtrade Textile Standard, so garment manufacturers wanting to be certified need to ensure their compliance.

Due to the challenges that women encounter in the workplace, the Fairtrade Textile Standard requires companies to implement policies and practices to ensure equity in employment and promotion of women. The Standard also mandates training and capacity-building specifically targeted at women. Other requirements to support women's empowerment are the right of maternity leave, no termination of employment on grounds of pregnancy, safe work for pregnant and nursing women and the right to take nursing breaks.

Gender equality has become an important topic for businesses around the world. Thousands of companies have committed to promote equality by empowering women in the workplace, marketplace and communities in alignment with the Women's Empowerment Principles (WEPs), a part of the UN Global Compact. Apparel companies, including Levi Strauss & Co. and Gap Inc., are implementing the WEPs, and others in the industry are planning to follow suit. It is only a matter of time before apparel brands will expect their suppliers to commit to these principles too[4].

[4]See http://weprinciples.org/Site/CompaniesLeadingTheWay/

SHOWCASE: ETHICAL TRADING INITIATIVE (ETI) TAMIL NADU MULTI-STAKEHOLDER NALAM PEER EDUCATION PROGRAMME

PURPOSE OF THE TRAINING

Strengthen the ability of young women workers and local employees to address issues together

CONTENT & FORMAT OF THE TRAINING

The programme provides training on workers' rights and women's health issues, currently reaching 13,489 women workers in 25 textile mills and garment factories, through intensive training by more than 550 "peer educators". These peer educators train co-workers at scheduled times.

In ten of these workplaces, the programme is currently funded through the Freedom Fund/C&A Foundation, and another 15 are funded through ETI member businesses. Many of the mills have been encouraged to participate by brands and retailers who belong to ETI. Locally, the programme is known as the "nalam" project – the Tamil word for well-being. The project helps to open up communication so that mills and factories can address key problems affecting the mostly female workforce – problems such as excessive working hours, poor living conditions in hostels, illnesses caused by exposure to cotton dust, and lack of access to grievance mechanisms in cases of discrimination or harassment. The project measures progress at each workplace towards decent work conditions.

Training topics include worker rights and responsibilities, as well as financial management, nutrition and health and safety issues. Supervisors are also trained in ways of improving their communication with workers.

BENEFITS OF THE TRAINING

- It empowers women workers by making them aware of their rights, and showing them how to communicate about issues within the workplace.
- It improves their health and well-being by increasing their knowledge of nutrition, health, savings and decision-making.
- Participating mills also report better relationships with workers, reduced worker turnover and fewer days lost through illness.

5. MEASURING THE IMPACT OF SOCIAL FAIRNESS ACTIVITIES

It can be difficult to measure the benefits of Social Fairness activities accurately in a meaningful way.

When you set out to achieve any Social Fairness effect, “begin with the end in mind”. That means define the impact you would like to achieve before choosing the specific activities to engage in. Consider the chart below:

Input	Output	Outcomes	Impact
e.g. time and ressources invested for free medical treatment	e.g. number of people that went through free medical treatment	e.g. fewer cases of serious disease in the community	e.g. increased average life expectancy in the community

Step one is to concentrate on the desired impact, e.g. “increased average life expectancy in the community”. Step two (moving backwards through the chart) is to define the outcomes that lead to achieving this impact. In the above example, one such outcome is a reduction in cases of serious disease in the community.

One way to reduce serious disease in the community is to identify and treat illnesses early, and one way of achieving that is by maximising the number of people receiving free medical treatment. To enable that output, finally, the requisite inputs include organisation time, engaging of doctors and nurses, a supply of medicines, and so on.

As this simple example shows, analysing things in reverse order is a valuable strategy here. By defining the intended impact, the optimal set of Social Fairness activities and key performance indicators can be designed.

6. GETTING STARTED

Conducting a self-audit is the first step in Social Fairness. This assessment will give you a first impression of how your company rates on various Social Fairness criteria. There are several self-audit frameworks available, such as:

- the UN Global Compact Self-Assessment Tool, http://www.globalcompactselfassessment.org/
- the B-Lab Self-Assessment, http://www.bimpactassessment.net/.

BEST PRACTICE: B-LAB IMPACT SELF-ASSESSMENT

PURPOSE

The B-Lab Impact Assessment is a free, confidential online tool that companies can use to measure their social and environmental impact. The results are compared with those of other companies, and include suggestions for improving your impact over time. By conducting this self-audit, a company fulfils the requirements for C2C BRONZE level in the Social Fairness category.

ABOUT B-LAB

B-Lab is a nonprofit organisation. Its vision is that “companies will compete not only to be the best in the world, but the Best for the World”.

HOW IT WORKS

The self-assessment comprises three steps:

1. Assess: you answer a series of questions regarding your company’s social and environmental practices
2. Compare: you compare your answers with those of other businesses
3. Improve: you generate an improvement plan and use free best-practice guides for specific areas of improvement

EXAMPLE QUESTIONS

- What is the minimum number of vacation days offered annually to workers?
- Has the company worked within its industry to develop social and environmental standards for the industry?
- What percentage of energy (relative to company revenues) was saved in the last year?

WHY COMPANIES CONDUCT THE SELF-ASSESSMENT

- To see where they stand relative to other companies
- To discover which aspects need improvement, and to get suggestions on how to improve
- To prepare for a full B-Corp certificate – an internationally recognised certification of corporate social responsibility

C2C CERTIFIED™ "HOW-TO" GUIDE

Further Resources

Business Case

BUSINESS CASE

1. INTRODUCTION

In general, a Cradle to Cradle (C2C) Certified ™[1] garment has a cost structure similar to any comparable garment. There are some specific requirements, however, that involve either upfront investments or higher product costs. This chapter discusses both aspects in detail.

2. UPFRONT INVESTMENTS

Upfront investments relate to different groups of costs:

- *Preparing the assessment package* and submitting it to the C2C Products Innovation Institute. Those costs will occur for every new Bill of Materials (BoM).
- *The targeted level of C2C certification.* For example, meeting the criteria of PLATINUM level will require greater investment than meeting the criteria of SILVER level.
- *The status quo of the production process.* For example, if a factory currently applies no water-treatment procedures at all, the investment needed for achieving C2C Certified GOLD or PLATINUM level might well be quite significant. In contrast, if a factory already has a zero-discharge system in place, the additional investment required is zero.

A. General project & certification cost

Below are the estimated general project costs, covering the assessment and the certification:

- $40,000 for the C2C assessor to prepare the assessment report and give optimisation recommendations
- $5,000 for submission of the application to, and its processing by, the C2C Products Innovation Institute

A C2C certification project will require an internal champion and time from internal team members. These costs should also be considered.

B. Material Health

The investments for Material Health are related mainly to the optimisation of the Bill of Materials (BoM). No major investment is involved. However, if the aim is to secure C2C certification at GOLD or PLATINUM level, testing for volatile organic compounds (VOCs) is required, which involves a modest one-time layout.

- $1,600 for VOC testing (required for GOLD and PLATINUM levels)

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

C. Material Reutilisation

Material Reutilisation implies no major upfront investments, unless composting is the preferred route for reutilisation. In this case, a composting test is necessary.

- $5,000 for composting testing (required only if composting is the chosen method of reutilisation)

D. Renewable Energy and Carbon Management

For Renewable Energy and Carbon Management, the upfront investment should be minimal. The only likely investment would be to enable the measuring of energy consumption by installing energy meters in the factory. Such an investment should achieve prompt payback, because of the energy optimisation that would result. A longer-term investment would be to install on-site renewable energy. For further details, refer to the chapter on Renewable Energy and Carbon Management.

All other C2C Certified criteria can be met by purchasing the appropriate certificates (renewable energy and carbon offsetting certificates). Since these costs are variable in nature, they can be classified as product costs (see the section on Product Cost below).

E. Water Stewardship

To reach higher certification levels in Water Stewardship, additional investment may or may not be needed depending on the company's existing water-treatment infrastructure. If the factory already has a well-functioning zero-discharge system, no additional investments are required. At the opposite extreme, if it has no system of water treatment, the investment cost will be considerable. Given the wide range of scenarios, relevant cost estimates cannot be provided.

F. Social Fairness

For Social Fairness, any investment costs will depend on the company's existing practices and on the targeted C2C certification level. If the target is PLATINUM level, a third-party Social Fairness audit and certification (e.g., SA8000) is required.

- $5,000 for application for and acquisition of the SA8000 certificate

3. CHANGES IN PRODUCT COSTS

In addition to the investments outlined above, there will be changes in product costs (or variable costs), namely labour, product materials and process materials.

A. Material Health

To reach higher levels of Material Health certification, a number of raw materials may have to change. Common material changes are substituting better cotton to organic cotton and using C2C Certified dyes, as shown in the showcase example below.

SHOWCASE: COST IMPACT FOR GARMENTS AT PRATIBHA SYNTEX

Pratibha Syntex
For Pratibha Syntex, the main additional product costs in Material Health came from a switch from Better Cotton Initiative (BCI) cotton to C2C approved organic cotton, from standard dyes to C2C approved dyes, and from conventional cotton thread to C2C Certified Tencel thread:

Impact on cost ...	due to change from ...	to ...
+ $0.04 per garment	Better Cotton Initiative (BCI) cotton	Certified organic cotton
+ $0.15 per garment	Standard dyes	C2C Certified dyes
+ $0.07 per garment	Conventional cotton thread	C2C Certified Tencel thread
+ $0.26 per garment	Total	

B. Material Reutilisation

For Material Reutilisation, there are no expected additional product costs for the manufacturer. The only product costs that might arise are related to take-back systems for the garments. These costs would be borne by the retailer of the C2C Certified garments.

C. Renewable Energy and Carbon Management

In regards to Renewable Energy and Carbon Management, the cost impact will depend on three variables:

- the amount of energy already being derived from renewable sources
- the level of on-site emissions
- the desired certification level

For instance, for a PLATINUM level of C2C certification, 100% of the direct on-site energy must come from renewable sources and 100% of the direct on-site emissions must be renewable or offset. In addition, 5% of the "embodied" emissions – those related to earlier stages in the supply chain – are calculated and must be offset. For C2C Certified GOLD level, the requirement is 50% in each case.

These additional costs will most likely be reflected in the garment's cost breakdown, and would be passed on to the retailer and hence the end customer. The examples below illustrate the cost impact when our two showcase manufacturers, in pursuit of C2C Certified at the GOLD level, purchase additional RECs and carbon offsets.

SHOWCASE: COST IMPACT OF ENERGY REQUIREMENTS FOR GARMENTS FROM COTTON BLOSSOM AND PRATIBHA SYNTEX

For both manufacturers, the aim was to achieve GOLD level in Renewable Energy. That meant ensuring at least 50% renewable energy and offsetting at least 50% of the emissions. Note that the numbers here depend on the actual energy consumption per garment, and thus differ from factory to factory (and from garment to garment):

Cotton Blossom

+ $0.0195 per garment	Purchase of additional RECs
+ $0.0013 per garment	Purchase of additional carbon-offsetting certificates
+ $0.0208 per garment	Total

Pratibha Syntex

+ $0.0035 per garment	Purchase of additional RECs
+ $0.0001 per garment	Purchase of additional carbon-offsetting certificates
+ $0.0036 per garment	Total

D. Water Stewardship

As mentioned above, Water Stewardship depends on the factory's existing water-treatment infrastructure. If a manufacturer has already established a zero-discharge water system, there are no further adjustments or improvements required.

E. Social Fairness

For Social Fairness, the main impact would come from a change to the wages structure to meet living wage. However, assuming that the current wage rate is satisfactory, there would be no impact on the direct labour aspect of the garment's product cost.

SHOWCASE: BUSINESS CASE FOR A TYPICAL APPAREL MANUFACTURER UPGRADING TO C2C CERTIFIED GOLD

Set-up of the business case

This business case is written from the perspective of a hypothetical garment manufacturer that is approached by a brand to produce C2C Certified T-shirts. Specifically, the brand wants to know if the garment manufacturer is able to produce C2C Certified GOLD T-shirts. The hypothetical garment manufacturer has not produced any C2C Certified garments before and thus needs to evaluate if producing C2C Certified GOLD T-shirts would be profitable or not.

Starting to produce C2C Certified GOLD T-shirts requires certain upfront investments – depending on the specific situation of the apparel manufacturer – and leads to increased product costs compared to producing conventional T-shirts. For the increased product costs, we assume that they can be passed on to the brand by increasing the "Free on Board" (FOB) price accordingly.

Upfront investments (one-time costs, independent of production quantity):

A. General project & certification cost

- $40,000 for C2C assessor
- $5,000 for C2C certification

$45,000 Total

B. Material Health

- $1,600 for VOC testing

$1,600 Total

In this case, we assume no upfront investments are required for Material Reutilisation, Renewable Energy, Water Stewardship, or Social Fairness. Therefore:

Total upfront investment:

$46,600 Total

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Product costs (costs per unit of production)

The product costs are composed of material costs, labor and overhead costs, as well as additional costs that arise to fulfill the C2C Certified GOLD requirements (e.g., purchasing RECs and carbon offsets).

These product costs are likely higher than they are for a conventional T-shirt. This can be illustrated with the changes in material costs and the additional costs for purchasing RECs and carbon offsets for a C2C Certified GOLD T-shirt compared to a "conventional" T-shirt:

Material Health (based on Pratibha Syntex's switch to C2C GOLD garment)

• $0.04 per garment	from BCI* cotton to C2C Certified organic cotton
• $0.15 per garment	from standard dyes to C2C Certified dyes
• $0.07 per garment	from conventional cotton thread to C2C Certified Tencel
$0.26 per garment	**Total**

Renewable Energy (based on Pratibha Syntex's purchase of RECs and carbon-offsets)

• $0.0035 per garment	for purchase of additional RECs
• $0.0001 per garment	for purchase of additional carbon-offsetting certificates
$0.0036 per garment	**Total**

It is important to note the ultimate product costs of a C2C Certified GOLD T-shirt depend entirely on the specific situation of the garment manufacturer.

For the remainder of the business case, we assume the following figures for the C2C Certified GOLD T-shirt:

- product costs of $4.09 per garment
- a FOB of $4.50 per garment (based on a margin of 10 percent (or $0.41) on the product costs)

Based on these figures, one can calculate how many C2C Certified GOLD T-shirts the manufacturer must sell to amortise the upfront investment of $46,600 and break-even with a margin of $0.41 per T-shirt:

Required T-shirts to be sold to break even = $46,600/$0.41 = **113,700 T-shirts**

* BCI: Better Cotton Initiative

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This is not an unlikely scenario: 1) As outlined in the previous chapters, more brands want to offer products with credible sustainability certifications, such as that provided by the C2C Certified Products Program; and 2) Few apparel manufacturers are currently offering C2C Certified products. Therefore, those that do so are likely to face higher demand for their products.

Moreover, brands interested in C2C Certified products are likely to share in the upfront investments, at least in the early stages. One way this could work is through amortisation up-charges on the FOB. This would help the manufacturer break-even more quickly as shown in below matrix.

The matrix outlines the profits for producing different volumes of the C2C Certified GOLD T-shirt at different levels of amortisation up-charge (in % on the initial $4.50 FOB):

Revenue = Number of C2C Certified T-shirts sold x (FOB x (1 + Amortisation up-charge (in %))

Cost = (Number of C2C Certified T-shirts sold x Product costs) + Upfront investment

Profit = Revenue – Costs

Profit by number of C2C Certified T-shirts sold and amortisation up-charge

Amortisation up-charge on FOB (in %)

Number of C2C Certified T-shirts sold

	0%	1%	2%	3%	4%
20,000	$-38,400	$-37,500	$-36,600	$-35,700	$-34,800
40,000	$-30,200	$-28,400	$-26,000	$-24,800	$-23,000
60,000	$-22,000	$-19,300	$-16,600	$-13,900	$-11,200
80,000	$-13,800	$-10,200	$-6,600	$-3,000	$600
100,000	$-5,600	$-1,100	**$3,400**	$7,900	$12,400
120,000	$2,600	$8,000	$13,400	$18,800	$24,200
140,000	$10,800	$17,100	$23,400	$29,700	$36,000

Example: Assume that the brand agrees to an amortisation up-charge of two percent to support the initial investment cost, resulting in an FOB of $4.59 instead of $4.50. In that case, the garment manufacturer would make a profit of $3,400 by selling 100,000 units of C2C GOLD Certified T-shirts.

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C2C CERTIFIED™ "HOW-TO" GUIDE

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Project Plan

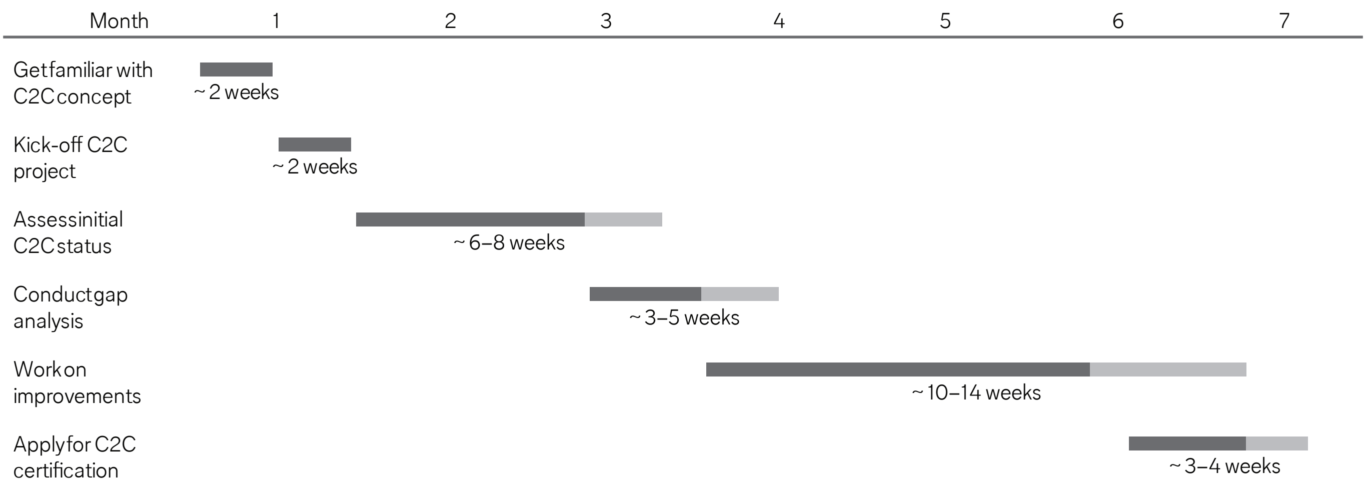
PROJECT PLAN

OVERVIEW

This chapter provides a sample project plan for getting a garment C2C Certified under the Cradle to Cradle (C2C) Certified™ Products Program[1]. The plan consists of several key steps:

- Step 0: Get familiar with the C2C Certified concepts
- Step 1: Introduce C2C Certified and launch the project
- Step 2: Assess the initial C2C Certified status
- Step 3: Conduct a gap analysis
- Step 4: Work on improvements
- Step 5: Apply for C2C Certified

The process should take approximately seven months, but may take longer in the case of major improvement plans. Here is an indicative timeline:



STEP 0: GET FAMILIAR WITH THE C2C CERTIFIED CONCEPTS

Before beginning the process of getting a product C2C Certified, key personnel should familiarise themselves with the Program's concepts. Only by thoroughly understanding the five criteria categories – Material Health, Material Reutilisation, Water Stewardship, Renewable Energy and Carbon Management, and Social Fairness – will they be able to plan and conduct the project efficiently.

To that end, companies should take the following steps:

- Appoint an internal project lead
- Identify and engage all relevant stakeholders (see the Best Practice box below)
- Reach out to an Accredited Assessor (see the relevant textbox below)
- Liaise with potential brand partners and select a brand
- Develop the project timeline and decide on the launch date
- Organise a launch workshop involving all stakeholders

[1] Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

BEST PRACTICE: GETTING ALL RELEVANT STAKEHOLDERS ENGAGED

Steering such a project requires considerable organisation. It is helpful to have experts and stakeholders on board for the different aspects of the C2C certification process. Ideally, the following stakeholders will be represented in the project team:

Project lead
A factory appointee who directs the project, coordinates the other stakeholders, and drives progress

Brand contact
A representative from the contracted brand who can authorise the product design & development

Designer/developer
An employee of the manufacturer who has experience in developing products and is able to suggest alternative specifications that would meet the requirements for C2C Certified

Materials/Chemicals expert
A factory employee and key point of contact who is familiar with all the materials and ingredients used in the production process

Reutilisation expert
An appointee who can lead the strategy for reutilising materials (in view of the re-collection requirement, the expert would ideally be an employee of the brand)

Energy expert
A factory employee or consultant familiar with product-specific energy sources and consumption

Water expert
A factory employee or consultant familiar with the water-treatment processes

Social Fairness expert
Usually a member of the manufacturer's Human Resources team who deals with activities involving corporate social responsibility or with related certification/accreditations (e.g. SA 8000)

Accredited Assessor
A project manager from an assessment body, who will conduct and facilitate the C2C Certified assessment and is familiar with all the details of the certification

BEST PRACTICE: SUPPORT IN THE ASSESSMENT AND CERTIFICATION PROCESS

Finding an Accredited Assessor
A number of agencies and institutes are qualified and equipped to help companies get their products C2C Certified.

What does an assessor offer?
An Accredited Assessor supports the company through the entire process – from explaining the Program's concepts in the initial project phase, to identifying potential obstacles, to evaluating materials, to helping with the final formalities of securing the certification.

Selected Accredited Assessors include:
- SGS, http://www.sgsgroup.us.com/en/Sustainability.aspx
- MBDC, http://www.mbdc.com
- EPEA, http://www.epea.com
- ARCHE Consulting, http://www.arche-consulting.be/en/

A more comprehensive list can be found here.

STEP 1: INTRODUCE C2C CERTIFIED AND LAUNCH THE PROJECT

Once this general orientation has taken place, the individual stakeholders delve into their specific areas and start collecting data to facilitate the subsequent steps. To keep the project on track, set timelines for this data collection and provide resources for additional support.

BEST PRACTICE: EXAMPLE OF A LAUNCH WORKSHOP

The following sessions can be facilitated by the Accredited Assessor using this "How-To" Guide, videos and other sources from http://www.fashionforgood.com/:

Session 1: General introduction to the C2C Certified Products Program (2–3 hours)
Explain the C2C Certified Products Program and familiarise the stakeholders with the overall concepts and benefits

Session 2: Certification process (2 hours)
Review the certification process and the logic of the achievement levels of the C2C Certified Products Program

Session 3: Material Health (1 hour)
Review the Material Health criteria at a high level

Session 4: Material Reutilisation (1 hour)
Review the Material Reutilisation criteria at a high level

Session 5: Renewable Energy and Carbon Management (1 hour)
Review the Renewable Energy and Carbon Management criteria at a high level

Session 6: Water Stewardship (1 hour)
Explain the Water Stewardship criteria at a high level

Session 7: Social Fairness (1 hour)
Explain the Social Fairness criteria at a high level

Session 8: Project Plan & Business Case (2 hours)
Explain the Project Plan and discuss the sample Business Case at a high level

Once this general orientation has taken place, the individual stakeholders delve into their specific areas and start collecting data to facilitate the subsequent steps. To keep the project on track, set timelines for this data collection and provide resources for additional support.

STEP 2: ASSESS THE INITIAL C2C CERTIFIED STATUS

The purpose of this step is to establish the product's initial C2C Certified achievement level along the five criteria. The following matrix illustrates a hypothetical outcome:

C2C Criteria	BASIC	BRONZE	SILVER (Current Status)	GOLD	PLATINUM
Material Health	✓	✓	✓	✗	✗
Material Reutilization	✓	✓	✓	✗	✗
Renewable Energy	✓	✓	✓	✗	✗
Water Stewardship	✓	✓	✓	✓	✓
Social Fairness	✓	✓	✓	✓	✗
Overall			✓		

To create this initial assessment the Accredited Assessor must have access to the requisite data, which is provided by the other stakeholders. For example, the water expert on the project team would need to show the assessor the factory's water-treatment system, identify the sources of the water, explain the treatment processes and provide relevant bills and any test reports. This step combines on-site activities (e.g. assessing the water facilities) and remote activities (e.g. emailing the Bill of Materials (BoM)).

This step could take up to six weeks or even more, especially if the relevant data is not readily accessible. The most time-consuming part of this step will be gathering information on materials from the supply chain since it often requires executing non-disclosure agreements (NDAs) between Tier 2 suppliers and the Accredited Assessor.

STEP 3: CONDUCT A GAP ANALYSIS

The purpose of this step is to outline what improvements need to be implemented to achieve the desired level of C2C Certified achievement – a decision that should be based on discussions between manufacturer representatives, brand representatives and the Accredited Assessor. These discussions will consider various trade-offs between the product's features, cost and launch date. A higher certification level might require new design features, extra spending or more prolonged research.

The gap analysis helps the stakeholders to reach agreement not just on the overall certification level to aim for, but also on the improvements needed to achieve it and on an action plan for implementing improvements. The sample improvement plan below lists the specific actions that would be needed to upgrade from SILVER level to GOLD level.

PROJECT PLAN

C2C Criteria	Current Status: SILVER	Current Status: GOLD	Actions Required to achieve GOLD
Material Health	✓	✗	Assess all materials to ensure the product has no more properties classified as "highly problematic" (ABC-X ratings)
Material Reutilization	✓	✗	Increase recyclable or compostable content of product and complete a "nutrient management" strategy
Renewable Energy	✓	✗	Purchase additional RECs and Carbon Offsets to meet target criteria
Water Stewardship	✓	✓	
Social Fairness	✓	✓	
Overall	✓	✗	

STEP 4: WORK ON IMPROVEMENTS

The purpose of this step is to implement the defined improvement plan in order to achieve the targeted level of C2C Certified. Ingredients might need to be replaced or eliminated, and that might involve an iterative process with the Accredited Assessor and the brand representative. The Assessor's expertise would help in suggesting alternative ingredients, and the brand representative might urge changes to some of the product features; e.g. a new colour palette if the current dyes need to be replaced.

During this improvement phase, this "How-To" Guide should be very helpful. It provides specific information for the different C2C Certified criteria categories. Further details can be found in the C2C Certified Product Standard here.

STEP 5: APPLY FOR C2C CERTIFIED

The purpose of this step is to finalise the application and submit it to the Cradle to Cradle Products Innovation Institute. Once all the requirements for all the criteria at the desired level have been fulfilled, the assessor assembles the assessment report and documentation, completes the application and submits it to the C2C Products Innovation Institute.

The project team's initial work is now over. The Institute will review the application and its accompanying documents, and – if all is correct – grants the certification. That process will take three to five weeks, depending on the complexity of the products and the completeness of the application.

SHOWCASE: C2C CERTIFIED PROJECT OF COTTON BLOSSOM AND PRATIBHA SYNTEX

The two apparel manufacturers Cotton Blossom and Pratibha Syntex agreed to a joint pilot project with Fashion for Good during the summer of 2016.

Steps 1 & 2: Introduce C2C Certified and launch the project; assess the initial C2C Certified status

- During the initial factory visits at Cotton Blossom and Pratibha Syntex in August 2016, MBDC, an Accredited Assessor, explained the certification system to all relevant stakeholders. During these visits, the initial assessments were launched in order to understand the production processes and begin the collection of data.
- Thereafter, the assessment processes were conducted remotely through shared data on aspects of production and other topics relevant for C2C Certified.
- The initial assessment revealed that the factories were already able to produce the two intended products at C2C Certified SILVER level.

Step 3: Conduct a gap analysis

- The leadership team of the project decided that the target level for both products should be GOLD – both for commercial reasons and because it was a realistic target.
- The gap analysis, completed in September 2016, identified the improvements that the products would need in order to rise from SILVER to GOLD certification.

Step 4: Work on improvements

- The improvement phase was duly launched to implement the changes needed for achieving GOLD level. In particular, the factory teams engaged in finding suitable substitutes for a few of the ingredients. The work also involved developing new dyeing recipes and a new colour palette, as well as testing the quality of the optimised products.
- A second round of factory visits by the project team and the Assessor took place in October 2016 to review the improvements and identify the gaps that still remained.
- The fashion retailer involved in the project then reviewed and approved the improvements, in order to finalise the style and place the orders; e.g. selecting the colours from the colour palette, and designing a care-instructions label.

Step 5: Apply for C2C certification

- In February 2017, once the product specifications and the (BoM) were finalised and all other documents completed, the application was submitted to the C2C Products Innovation Institute. The C2C Certified GOLD certification was granted three weeks later.
- The processing of the application was relatively quick, thanks in part to the conscientious involvement of the Accredited Assessor during the whole process. Not all certifications proceed so smoothly, so companies should plan for a buffer when submitting an application.

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Supplier Optimised Bills of Materials (BoM)

SUPPLIER OPTIMISED BoM

1. INTRODUCTION

Cotton Blossom and Pratibha Syntex, manufacturers of garments for international fashion retailers, worked with accredited assessor MBDC to optimise their Bills of Material (BoM) in order to fulfil the requirements of C2C Certified GOLD. In the optimisation process, chemicals in the BoM are assessed for their risk to human health using the C2C Certified ABC-X assessment methodology, and all potentially harmful chemicals are either replaced with better chemicals or removed altogether.

The first step in the process was for each company to submit an initial BoM to MBDC for assessment. For both companies, many dye and process chemicals were initially assessed GREY, owing to incomplete formulation. In addition, a few X-assessed materials and X-assessed ingredients were identified.

MBDC followed up with the suppliers from earlier stages of the supply chain (Tier-2 suppliers) for more information for the GREY-assessed materials, and in many instances received complete formulations from the initial inquiry. Where the Tier-2 suppliers would not or could not provide complete formulations for their products, MBDC suggested replacement suppliers – suppliers willing to share their formulations and that already had suitable materials assessed as A, B or C. In this way, all GREY-assessed materials were eliminated from both BoMs. Since A, B, and C materials are considered optimised from a C2C Certified perspective, only the X-assessed materials remained for phase-out and substitution.

This section reproduces the optimised BoM from each supplier. Each BoM includes the product name, manufacturer, function, and the assessment from MBDC.

Table 8: Optimised Bill of Materials: Pratibha Syntex

	Product	Function	Manufacturer	Assessment
1	IMACOL CN	Pretreatment	CLARIENT	C
2	ULTRAVON EL	Pretreatment	HUNTSMAN	C
3	INVATEX SA	Pretreatment	HUNTSMAN	C
4	ALBAFLOW FFC	Pretreatment	HUNTSMAN	C
5	CAUSTIC FLAKES	Pretreatment	BASIC CHEMICAL	C
6	HYDROGEN PEROXIDE	Pretreatment	BASIC CHEMICAL	C
7	MATEXIL NZPN	Pretreatment	CRODA	C
8	LANAPEX SEQUEST	Pretreatment	CRODA	C
9	ACETIC ACID	Pretreatment	BASIC CHEMICAL	B
10	IMACOL CN	Dyebath Chemicals	CLARIENT	C
11	INVATEX SA	Dyebath Chemicals	HUNTSMAN	C
12	ALBATEX CO	Dyebath Chemicals	HUNTSMAN	C
13	ALBAFLOW E3DCC	Dyebath Chemicals	HUNTSMAN	C
14	ALBATEX AB 55	Dyebath Chemicals	HUNTSMAN	C
15	GULABER SALT	Dyebath Chemicals	BASIC CHEMICAL	B
16	SODA ASH	Dyebath Chemicals	BASIC CHEMICAL	B
17	CAUSTIC FLAKES	Dyebath Chemicals	BASIC CHEMICAL	C

Table 8 (continued): Optimised Bill of Materials: Pratibha Syntex

	Product	Function	Manufacturer	Assessment
18	ERIPON R	Washoff Chemicals	HUNTSMAN	C
19	SIRIX N	Washoff Chemicals	CLARIENT	C
20	ACETIC ACID	Washoff Chemicals	BASIC CHEMICAL	B
21	IMACOL CN	(White)	CLARIENT	C
22	ULTRAVON CPR	PTR CPB	HUNTSMAN	C
23	INVATEX ED	PTR CPB	HUNTSMAN	C
24	CAUSTIC FLAKES	(White)	BASIC CHEMICAL	C
25	HYDROGEN PEROXIDE	(White)	BASIC CHEMICAL	C
26	ACETIC ACID	(White)	BASIC CHEMICAL	B
27	SAPAMINE EHPE	Finishing Chemicals	HUNTSMAN	C
28	ACETIC ACID	Finishing Chemicals	BASIC CHEMICAL	B
29	VEROLAN NBO	Dyebath Chemicals	RUDOLF	C
30	Remazol Yellow GN	Reactive Dye	Dyestar	C
31	Remazol Yellow GR 133%	Reactive Dye	Dyestar	C
32	Remazol Brilliant Yellow GL	Reactive Dye	Dyestar	C
33	Remazol Ultra Orange RGBN	Reactive Dye	Dyestar	C
34	Remazol Ultra Carmine RGB	Reactive Dye	Dyestar	C
35	Remazol Brilliant RedF3B	Reactive Dye	Dyestar	C
36	Remazol Brilliant Blue RN	Reactive Dye	Dyestar	C
37	LEVAFIX FOREST ECO	Reactive Dye	Dyestar	C
38	REMAZOL BLACK ECO	Reactive Dye	Dyestar	C
39	REMAZOL RED F3B	Reactive Dye	Dyestar	C
40	Natura Sewing Yarn (Johann Mueller)	Sewing Yarn	Johann Mueller	C
41	HOSTAPAL MRZ	Clarient	CLARIENT	C
42	RUKOFIN SIQ	Finishing Chemicals	Rudolf	C
43	CAUSTIC LYE	Dyebath Chemicals	Basic Chemical	C
44	Neck Ink Pigment (Black)	Colorant	INK CUPS	C
45	Neck Ink Pigment (White)	Colorant	INK CUPS	C

Table 9: Optimised Bill of Materials: Cotton Blossom

	Product	Function	Manufacturer	Assessment
1	Ultravon RLF	Wetting agent	Huntsman Textile Effects	C
2	Albafluid EL3DM	Anti creasing agent/ Lubricant	Huntsman Textile Effects	C
3	Caustic	Alkali for pretreatment	TCC Ltd.	C
4	Hydrogen Peroxide	Bleaching chemical	Hindustan Organic	C
5	Clarite CBB	Peroxide stabilizer	Huntsman Textile Effects	C
6	Glacial Acetic Acid	Neutralising Acid	IOL Chemicals	C
7	Invatex AC	Core PH neutralizer	Huntsman Textile Effects	C
8	Felosan RGN	Wetting agent	CHT BEZEMA	C
9	Kleerix PER	De Mineralising chemical	Rossari Biotech	C
10	Neutracid NCS	Core PH neutralizer	CHT BEZEMA	C
11	Sodium Sulphate (Gl Salt)	Dyes Exhaustion	Grasim Industries	B
12	Soda Ash	Dye fixation	TATA Chemicals	B
13	Sodium Hydrosulphite	Reduction agent/ Cleaning agent	Transpek Aslali	C
14	Lavagal RL	Dye levelling agent	Tanatex Chemicals B.V.	C
15	Persoftal LX	Dye lubricant	Tanatex Chemicals B.V.	B
16	Ladiquest 1097	Soaping agent	ARCHROMA	C
17	Cellcat Combi	Bio Polishing chemical	Zytex Corporation	C
18	Wetsoft 334	Softening chemical	Wacker silicones	C
19	Resil BT 1020	Softening chemical	Resil Chemicals	C
20	Resil Ultrafab CAM	Softening chemical	Resil Chemicals	C
21	Uvitex BHA Liq.	Optical Brightners	Huntsman Textile Effects	B
22	Uvitex BMU-V - Liq.	Optical Brightners	Huntsman Textile Effects	C
23	diluant M-02	Screen Printing thinner	Spinks world	B
24	FT-0003	Screen Printing Ink	Spinks world	C
25	Albafix ECO	Dye fixer	Huntsman Textile Effects	C
26	Neck Ink Pigment (Black)	Colorant		C
27	Neck Ink Pigment (White)	Colorant		C
28	Rem. Br. Yellow GL150%	Reactive Dye	Dyestar	C
29	Rem. Yellow GR	Reactive Dye	Dyestar	C
30	Rem. Br. Red F3B	Reactive Dye	Dyestar	C
31	Rem. Br. Blue RN	Reactive Dye	Dyestar	C
32	Leva fix Eco Black(very New)	Reactive Dye	Dyestar	C
33	Drimaren yellow HF-3GL	Reactive dyes	ARCHROMA	C

Table 9 (continued): Optimised Bill of Materials: Cotton Blossom

	Product	Function	Manufacturer	Assessment
34	Drimaren Red CL-5B gr	Reactive dyes	ARCHROMA	C
35	Drimaren Red CL-5B p	Reactive dyes	ARCHROMA	C
36	Drimaren Red HF-3B gr	Reactive dyes	ARCHROMA	C
37	Drimaren Red HF-6BL cdg	Reactive dyes	ARCHROMA	C
38	Drimaren Red HF-CD cdg	Reactive dyes	ARCHROMA	C
39	Drimaren Scarlet HF-3G cdg	Reactive dyes	ARCHROMA	C
40	Drimaren Navy HF-GN gr	Reactive dyes	ARCHROMA	C
42	Invatex AC	Core PH neutralizer	Huntsman Textile Effects	C
43	Sodium Hydrosulphite	Reduction agent/ Cleaning agent	Transpek Aslali	C
44	Resil BT 1020	Softening chemical	Resil Chemicals	C
45	Uvitex BHA Liq.	Optical Brightners	Huntsman Textile Effects	B
46	Uvitex BMU-V - Liq.	Optical Brightners	Huntsman Textile Effects	C
47	Natura Sewing Yarn (Johann Mueller)	Sewing Yarn	Johann Mueller	C

SUPPLIER OPTIMISED BoM

C2C CERTIFIED™ "HOW-TO" GUIDE

Further Resources

C2C Certified Considerations for Common Apparel Materials

C2C CONSIDERATIONS

1. INTRODUCTION

This chapter includes a summary of the Material Health and Material Reutilisation considerations for various materials that may be used in the manufacture of apparel, including:

- fibres
- dyes, performance additives, finishes & process chemicals
- printings, findings, and tags

Much of this information is taken (and updated) from the larger Textiles Opportunities report prepared by MBDC for Fashion Positive/Cradle to Cradle (C2C) Products Innovation Institute.

2. C2C CERTIFIED ™ PRODUCTS PROGRAM[1] CONSIDERATIONS FOR FIBRE SELECTION

The right fibre choices can reduce garment complexity, increase compostability/recyclability, and provide additional social and environmental benefits.

LINK TO CRADLE TO CRADLE

Fibre choices directly affect level of achievement in the areas of Material Health and Material Reutilisation.

C2C Certified ™ brings two major considerations to the selection of fibres:

- The garment should be able to serve as either a biological nutrient (compostable) or a technical nutrient (recyclable). The idea here is to choose one end-of-use strategy and to stay with it; so if a garment is to be composted, that means avoiding technical/bio blends (e.g. cotton/elastane) or other fibres that don't support a compostable strategy.
- Material Health criteria should be integrated into the selection of fibres. The idea here is to select fibres that have been grown/developed and processed in ways that support human and ecological health

This section includes the following subsections:

- considerations for preferred biological-nutrient fibres – Cotton, Viscose, Acetate, PLA, Wool, Linen (Flax, Bamboo/Bast process), Biological/Biological Blends
- considerations for preferred technical-nutrient fibres – Polyester, Nylon 6, Nylon 6,6, Polypropylene, Polyethylene
- considerations for fibres and blends that are NOT preferred from a C2C Certified perspective – Silk, Elastane, Biological/Technical Blends, Technical/Technical Blends

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

C2C CONSIDERATIONS

The charts below list the nutrient potential (on a scale of Excellent-Good-Poor), the concerns from a C2C Certified perspective, and the factors to look for when seeking better alternatives.

Table 10: Preferred Biological-Nutrient Fibres

Fibre	Nutrient Potential	Concerns	Factors to look for
Cotton	Excellent bio nutrient	• Residual pesticides & herbicides • Chlorine bleaching (dioxins)	Certified organic sources harvested with fair labour practices: • GOTS + Fair Trade USA Certified • GOTS only • Better Cotton Initiative BCI
Viscose (Rayon, Tencel, Modal, Bamboo)	Excellent bio nutrient	• Chlorine bleaching (dioxins, particularly concerning in elemental chlorine bleaching) • Deforestation	• Unbleached or chlorine-free bleached wood pulp from FSC certified sources, and recurrent testing for chlorinated organic compounds to ensure no dioxins • Lyocell process, which utilises benign process chemicals, has a high solvent-reutilisation rate, and non-toxic effluent
Acetate	Good bio nutrient	• Chlorine bleaching (dioxins, particularly concerning in elemental chlorine bleaching) • Contributions to deforestation	• Unbleached or chlorine-free bleached wood pulp from FSC certified sources, and recurrent testing for chlorinated organic compounds to ensure no dioxins
PLA	Good as both bio and technical nutrient. Bio cycle: industrial composting only. Tech cycle: can be recycled mechanically & chemically	• Can be made with problematic organotin catalysts (suspected endocrine disruptors) • Typically manufactured from genetically modified (GMO) corn	• Optimised catalyst (such as Natureworks Ingeo®) • Non-GMO sources
Wool	Excellent bio nutrient	• Pesticide residue on wool fibres • Chlorine-based anti-shrink treatments • Dangers to animal welfare	• Pesticide-free sources • Chlorine-free/ organohalogen-free wool treatments • GOTS certified • Responsible Wool Standard (RWS)
Linen (Flax)	Excellent bio nutrient	• Pesticide residues	• Pesticide-free/organic sources
Linen (Bamboo) – Bast Processed	Excellent bio nutrient	• Process chemicals involved in bleaching and fibre processing	• Optimised process chemistry
Hemp	Excellent bio nutrient	• Process chemicals involved in bleaching and fibre processing	• Optimised process chemistry
Ramie	Excellent bio nutrient	• Process chemicals involved in bleaching and fibre processing	• Optimised process chemistry
Bio/Bio blends (cotton/wool, rayon/wool, acetate/rayon)	Good bio nutrient	• Residual pesticides/herbicides • Chlorine-based bleaching agents	• Organic sources • Pesticide-free sources • Chlorine-free/ organohalogen-free wool treatments

Table 11: Preferred Technical-Nutrient Fibres

Fibre	Nutrient Potential	Concerns	Factors to look for
Polyester (PET)	Excellent technical nutrient; widely recycled with established infrastructure	• Conventional antimony trioxide catalyst is a suspected carcinogen • Non-renewable feedstock	• PET made with optimised catalysts, such as titanium dioxide • Bio-based resins (with optimised catalysts) • rPET (with optimised catalysts)
Nylon 6	Excellent technical nutrient	• Non-renewable feedstock	• Recycled content with optimised chemistry
Nylon 6,6	Excellent technical nutrient	• Non-renewable feedstock	• Recycled content with optimised chemistry
Polypropylene (PP)	Excellent technical nutrient; widely recycled with established infrastructure	• Non-renewable feedstock	• Recycled sources • Bio-based polypropylene from renew-able feed-stocks, such as sugar cane
Polyethylene (PE)	Excellent technical nutrient; widely recycled with established infrastructure	• Non-renewable feedstock	• Recycled sources • Bio-based polyethylene sources in development
Modacrylic	Low nutrient potential	• Non-renewable feedstock • Toxic monomer: acrylonitrile (CMR)	• Modacrylic with low to no residual acrylo-nitrile (CMR)
Acrylic	Low to moderate nutrient potential: possible to recycle mechanically since it is thermosplastic	• Non-renewable feedstock • Sensitising monomer(s): various alkylacrylates	• Acrylic with low to no residual acrylate monomer (sensi-tising)
Lastex	Low nutrient potential (hybrid of biological- and technical nutrient fibres)	• Non-renewable feedstock (if Nylon used as a wrapping fibre) • Residual pesticides/ herbicides (if traditional cotton is used) • Chlorine-based bleaching agents (for cellulosic fibres)	• A collection, separation, and reutilisation plan to ensure that this material remains in multiple use phases
Orlon	Low nutrient potential	• Non-renewable feedstock • Toxic monomers: acrylonitrile (CMR) and various alkylacrylates (sensitisers)	• Orlon with low to no residual acrylonitrile (CMR) and acrylates (sensitisers)
Aramids (incl. Nomex and Kevlar)	Low nutrient potential (they don’t melt)	• Non-renewable feedstock	• A collection, separation, and reutilisation plan to ensure that this material remains in multiple use phases

Table 12: Fibres and blends that are NOT preferred from a C2C Certified perspective

Fibre	Nutrient Potential	Concerns	Factors to look for
Silk	Excellent bio nutrient; but not preferred because of silkworm mortality	• Harvesting conditions – death of silkworm pupa in processing • Possible pesticide residue • Weighting bath chemistry	• Silk harvested from worms not exposed to pesticides during feeding phase
Elastane (Spandex)	Poor bio or tech nutrient	• Possible residual diisocyanate molecules (sensitising) • Non-renewable feedstock • Not recyclable, and inhibits recycling of blended fibres	• Other fibre selections and mechanical constructions to achieve stretch without elastane
Technical /Bio-logical blends (PET/ cotton, nylon/ cotton, PET/wool, PET/ viscose)	Poor bio or tech nutrient; fibres can't be separated for recycling/ composting	• Non-renewable feedstock • Possible pesticide residue • Non-optimised catalysts for polyester • Chlorine-based or organohalogen bleaching agents	• Biological/ biological blends or single-fibre textiles
Technical/ Technical blends (PET/ nylon, nylon/ modified nylon, PET/ modified PET)	Poor bio or tech nutrient; fibres can't be separated for recycling/ composting	• Non-renewable feedstock • Non-optimised catalysts for polyester • Chlorine-based or organohalogen bleaching agents	• Single-fibre textiles

3. C2C CERTIFIED CONSIDERATIONS FOR DYES & FINISHES

The right choices of dye & finish can reduce garment complexity, increase compostability, and provide additional social and environmental benefits.

LINK TO CRADLE TO CRADLE

Dye & finish choices directly affect level of achievement in the areas of Material Health, Material Reutilisation and Water Stewardship.

C2C Certified brings Material Health criteria to the selection of:

- dyes
- performance additives
- finishes
- process chemicals

Table 13: Dyes

	Nutrient Potential	Concerns	Factors to look for
Direct Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Carcinogenic by-products due to azo linkages • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity	• C2C assessment of individual dyes
Reactive Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Carcinogenic by-products due to azo linkages • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules • Sensitisation via skin contact and via inhalation	• C2C assessment of individual dyes
Vat Dyes	Good, depending on chemistry	• Process chemistry (reducing agents, oxidising agents and soaping agents) residuals & aquatic toxicity • Mutagenicity of dye compounds • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules	• C2C assessment of individual dyes
Disperse Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules	• C2C assessment of individual dyes
Acid Dyes	Good to poor	• Mutagenicity of dye compounds • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules • Presence of heavy metals (e.g. hexavalent chromium, cobalt, and nickel)	• C2C assessment of individual dyes

Table 13 (continued): Dyes

Basic Dyes	Good to poor	• Mutagenicity of dye compounds • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules	• C2C assessment of individual dyes
Natural Dyes	Good	• Mutagenicity of anthraquinone-based dye compounds • Potential ecotoxicity • Carcinogenic by-products due to azo linkages • Presence of heavy metals from mordants (e.g. antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, organotins, radioactive elements, and vanadium)	• C2C assessment of individual dyes
Solution Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Carcinogenicity • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Halogenated organic content	• C2C assessment of individual dyes
Salt-Free Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Carcinogenic by-products due to azo linkages • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules • Sensitisation via skin contact and via inhalation	• C2C assessment of individual dyes
High Affinity Dyes	Good, depending on chemistry	• Mutagenicity of dye compounds • Carcinogenic by-products due to azo linkages • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules • Sensitisation via skin contact and via inhalation	• C2C assessment of individual dyes

Table 13 (continued): Dyes

Mordant Dyes	Good, depending on chemistry	Possible toxicity associated with some of the metal salts used in this process – most notably, hexavalent chromium (CMR)	• C2C assessment of individual dyes
Azoic Dyes	Good, depending on chemistry	Possible toxicity associated with a subset of azo dyes, as some may cleave carcinogenic aromatic amines	• C2C assessment of individual dyes
Sulphur Dyes	Good, depending on chemistry	• Process chemistry (reducing agents, oxidising agents and soaping agents) residuals & aquatic toxicity • Mutagenicity of dye compounds • Ecotoxicity from bioaccumulation, poor biodegradation, and/or aquatic toxicity • Presence of non-hydrolysable halogenated organic dye molecules	• C2C assessment of individual dyes

Table 14: Performance Additives

	Nutrient Potential	Concerns	Factors to look for
Softeners	Good	• Irritation & aquatic toxicity • Skin sensitisation	• C2C assessment of specific formulation
Antioxidants	Good	• Bioaccumulative potential • Persistence in biosphere	• C2C assessment of specific formulation
UV Stabilisers	Good	• Bioaccumulative potential • Persistence in biosphere	• C2C assessment of specific formulation
Plasticisers	Poor to Good	• Use of PVC (banned within C2C Certified) • Need to avoid bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and dibutyl phthalate, all of which have endocrine disruptors, and most of which are carcinogens, mutagens, teratogens, and reproductive toxins	• C2C assessment of specific formulation • Silicones, acrylic-based films • Bio-based and biodegradable plasticisers • Alkyl citrate, acetyl tri-n-butyl citrate, alkylsulphonic phenyl ester, epoxidised soybean oil (ESBO)

Table 15: Finishes

	Nutrient Potential	Concerns	Factors to look for
Soil and stain repellents	Poor to Good	• Fluorinated organic compounds • PFOA (used in the manufacture of some fluorochemicals) – associated with developmental and adverse effects, and very persistent • Alternatives often use nanoparticles, whose effects on human/eco health remain incompletely understood	• C2C assessment of specific formulation • Fluoro-chemical-free
Water repellents and waterproofing	Poor to Good	• Fluorinated organic compounds (Gore-Tex)	• C2C assessment of specific formulation • Silicones • Sympatex, DSM's Arnitel VT with optimised catalysts
Anti-wrinkle/ easy care/ durable press	Poor to Good	• Sensitisation • Use of formaldehyde (carcinogen, mutagen and reproductive toxin)	• C2C assessment of specific formulation • BTCA as a better choice, though still has mutagenicity concerns • Citric acid as an alternative currently under development
Anti-microbials	Poor	• Presence of organotins (banned) • Presence of triclosan (endocrine dis-ruption, aquatic toxicity, moderately bioaccumulative, and its production/ incineration may lead to dioxin formation) • Aquatic toxicity, bioavailability and persistence • Skin sensitisation	• C2C assessment of specific formulation
Flame retardants	Poor to Good	• Halogenated organic compounds	• C2C assessment of specific formulation • Preference for phosphorus-based flame retardants
Antistatic/ Antistat Agents	Poor to Good	• Aquatic toxicity, biodegradation • Endocrine disruption	• C2C assessment of specific formulation • phosphoric acid ester derivatives (e.g. Clariant's Afilan®)

Process Chemistry

Process chemicals are defined as chemicals that come into contact with the finished textile during manufacture but do not remain present in the finished garment. The most relevant chemical classes in cotton and PET processing are:

- non-ionic surfactants
- acids
- caustic
- chelating Agents
- peroxides

Typical hazards associated with these types of chemicals are: irritation to eyes, skin, and mucous membranes; corrosivity; and aquatic toxicity.

The functions of process chemicals are typically: pre-treatment of the fibres to remove residue from manufacture or shipping; bleaching and removal of natural colour; desizing; and caustic mercerisation to improve fibre strength, resist shrinkage, and improve lustre and dye affinity.

It is important to understand not just the obvious toxicity concerns but also the ecological health profile of each chemical, specifically aquatic toxicity, biodegradation rate, and bioaccumulative potential (i.e. tendency to become concentrated in tissue). Since many of the aforementioned chemical classes often have high aquatic toxicity characteristics, it is imperative to ensure that the selected chemicals are readily biodegradable and non-bioaccumulative.

Textile factories with on-site water recycling and/or treatment are preferred if the garments are to be wet-processed. Another promising prospect is that of emerging technologies that allow waterless dyeing.

4. C2C CERTIFIED CONSIDERATIONS FOR PRINTING, FINDINGS AND TAGS

Accessories and graphics are often made of materials that compromise the garment's ability to be a true biological or technical nutrient. Considerations can be divided into three groupings:

- garment printing
- findings & trims
- tags

Garment printing

Much like traditional dyes for garments, printing inks may contain pigments, acids, caustics, solvents, UV stabilisers, brighteners, and other performance additives. Hence the associated assortment of human and ecological health hazards and risks, and hence the recommendation for a full C2C Certified Material Health assessment.

Findings & trims

The relevant materials here include ribbons, braids, lace, sequins, thread, closures, elastics and labels. They raise important design considerations, as they should flow in either technical or biological cycles, depending on the garment they are attached to.

Two examples:

- An organic cotton T-shirt with optimised dyes is designed to return safely to the soil, so any printed labels and sewing thread should also be designed to return safely to the soil.
- A polyester dress with optimised dyes and chemistry is designed to be recycled perpetually, so all buttons and closures should also be optimised and recyclable concurrently with PET.

Designers have the opportunity to make their garments assets instead of future liabilities, by simply considering the intended metabolism (biological/technical) for each individual homogeneous material.

Hang tags

Although the hang tag and attaching string are not technically part of the finished garment, some consideration should be given to the materials used. Ideally, the hang tag and string would be designed for the same metabolism as the garment that they are attached to.

For example, a cotton garment with optimised chemistry and dyes (biological nutrient) could be accompanied by an organic cotton string and an unbleached cellulosic tag with compostable inks.

At a minimum, materials in the tag and string should be screened for chemicals present on the C2C Certified Banned List.

C2C CERTIFIED™ "HOW-TO" GUIDE

Further Resources

Apparel Standards Comparison to C2C Certified

APPAREL STANDARDS COMPARISON

1. INTRODUCTION

The apparel industry provides a number of sustainability marks and certifications, and manufacturers often suffer from "certification fatigue" through having to meet multiple standards. This section gives a brief overview of how the C2C Certified™ Products Program[1] compares with the following standards:

- Bluesign
- ZDHC
- OEKO-TEX Standard 100 plus
- HIGG Facility Module
- Fair Trade USA Factory Standard

The charts below summarise the different documentations required for each standard, and provide a translation between the two; e.g. if a manufacturer has one of these certifications already and would like that same BoM to become C2C Certified, or vice versa.

2. C2C CERTIFIED & BLUESIGN

Both C2C Certified and Bluesign rely on the precautionary principle, establish limit values, and evaluate chemicals on the basis of exposure. Bluesign relies more on an extensive Banned List and accepts varying limit levels depending on exposure, while C2C Certified has a general limit of <100ppm for all chemicals.

Manufacturers can submit the BoM data to both programmes: the programmes will differ on outcomes, and percentages will have to be recalculated as they use different methodologies

Table 16: C2C Certified & Bluesign

	Bluesign to C2C Certified (GOLD)	C2C Certified (GOLD) to Bluesign
Material Health	Bluesign BoM can be used for C2C, but involves different analysis/endpoints	C2C BoM can be used – screen for Bluesign status and recalculate percentages
Material Reutilisation	Requires info	Requires calculations of ecological footprint
Renewable Energy	Same data	C2C data collected meets or exceeds Bluesign
Water Stewardship	Same data	C2C data collected meets or exceeds Bluesign
Social Fairness	Bluesign social data meets C2C criteria	Social data & strategy meet the info requirement if no issues; otherwise, third-party audit required

[1]Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

3. C2C CERTIFIED & ZDHC

Zero Discharge of Hazardous Chemicals (ZDHC) aims at eliminating toxic discharges from the textile and footwear value chain. It does so by working with brands to implement sustainable chemistry and best practices within the value chain, focused on sustainable chemistry and Water Stewardship.

Table 17: C2C Certified & ZDHC

	ZDHC to C2C Certified (GOLD)	C2C Certified (GOLD) to ZDHC
Material Health	ZDHC relies on Banned List – will need deeper info on BoM	C2C mostly exceeds ZDHC; some thresholds are lower, and may require testing
Material Reutilisation	No ZDHC criteria – will need further info	n/a
Renewable Energy	No ZDHC criteria – will need further info	n/a
Water Stewardship	Requires local ecosystem research, strategy & intent	Needs additional work, including testing and reporting
Social Fairness	No ZDHC criteria – will need info and tools & training	n/a

4. C2C CERTIFIED & OEKO-TEX STANDARD 100/STEP

OEKO-TEX has two relevant certifications: Standard 100, which focuses on testing products for possible harmful substances, and STeP, which focuses on environmentally friendly and socially responsible manufacturing. C2C Certified shares the goals of OEKO-TEX but approaches matters differently – optimising a product's BoM from the outset and including Material Reutilisation as part of the overall criteria for material use.

Table 18: C2C Certified & Oeko-Tex Standard 100/Step

	OEKO-TEX Standard 100/STeP to C2C Certified (GOLD)	C2C Certified (GOLD) to OEKO-TEX Standard 100/STeP
Material Health	Will require additional research for compiling BoM	C2C criteria exceed those of OEKO-TEX, but will require materials testing
Material Reutilisation	No OEKO-TEX criteria – will need further info	n/a
Renewable Energy	Same data, will need info on Renewable Energy strategy, carbon offsets, embodied-energy calculations based on the product	Same data, additional requirements for carbon footprinting, air emissions, energy-management policy
Water Stewardship	Same data	Same data
Social Fairness	Requires info on innovative social programmes	Requires formal social-responsibility management & Quality Management system
Social Benefit	Requires info on innovative social programmes	Requires formal social-responsibility management & Quality Management system

5. C2C CERTIFIED & FAIR TRADE USA FACTORY STANDARD

The purpose of the Fair Trade USA Certified Factory Standard is to promote economic empowerment for workers, in addition to ensuring high social and environmental performance in the workplace.

Table19: C2C Certified & Fair Trade Usa Factory Standard

	Fair Trade USA Factory Standard to C2C Certified (GOLD)	C2C Certified (GOLD) to Fair Trade USA Factory Standard
Material Health	Some info applicable, but C2C requires product-specific BoM at a more detailed level	C2C criteria exceed those of Fair Trade USA, but required info is factory-focused, not product-focused
Material Reutilisation	No Fair Trade USA criteria – will need further info.	n/a
Renewable Energy	Fair Trade USA covers some data requirements, needs renewable-energy/ carbon-management plan, offsets/ RECs tied to product. Embodied-energy calculations are required for PLATINUM	C2C covers most data requirements but will need to develop an articulated efficiency plan for energy, materials & water, and waste management
Water Stewardship	No Fair Trade USA criteria – will need further info.	n/a
Social Fairness	Exceeds C2C requirements	C2C GOLD and above align with Fair Trade USA if third-party verified

6. C2C CERTIFIED & HIGG (FACILITY MODULE)

C2C Certified is a product-based certification, while HIGG's Facility Module does not concentrate on products but instead considers an individual factory's social and environmental performance as a whole. However, the two certifications have similarities when it comes to the kinds of data that have to be gathered for energy, water and social criteria.

Table 20: C2C Certified & Higg (Facility Module)

	HIGG Facility Module to C2C Certified (GOLD)	C2C Certified (GOLD) to HIGG Facility Module
Material Health	No HIGG criteria for products – will need further info	n/a
Material Reutilisation	No HIGG criteria for products – will need further info	n/a
Renewable Energy	HIGG energy-use data is relevant, but will need to calculate product footprint and calibrate offsets/ RECs. Also needs a Renewable Energy/ carbon-management strategy. For PLATINUM level, will also need embodied-energy calculations.	C2C energy-use data is relevant, but will need info on environmental-management plan
Water Stewardship	HIGG water data should meet some data requirements, but C2C will also require qualitative description of effluent management; assessment of local water issues; assessment of process chemistry; info on supply-chain water issues	C2C water data should meet HIGG reporting criteria
Social Fairness	No HIGG criteria – will need further info	n/a
Air Emissions	n/a	No C2C criteria for air emissions
Waste Management	n/a	No C2C criteria for waste management
Chemicals Management	n/a	C2C Material Health info can meet some of these criteria

CONTACT

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We welcome your questions and comments regarding this handbook or your journey to become C2C Certified. Please feel free to contact us via our website or by email: contact@fashionforgood.com

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