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# LCA assessment of the silk supply chain

## Use and interpretation of the results

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# › - The sustainability Wave

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**Hazardous chemicals  
in branded luxury textile products  
on sale during 2013**

**Kevin Brigden, Samantha Hetherington, Mengjiao Wang,  
David Santillo & Paul Johnston**

Greenpeace Research Laboratories Technical Report 01/2014, February 2014



# > LCA Analysis

## Steps of an LCA

How to assess the environmental impact?



Life cycle assessment (LCA) is more and more considered a reference method for the evaluation of supply chains, production and consumption systems, up to region

## › The considered supply chain

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1. Twisting
2. Yarn dyeing
3. Weaving
4. Fabric dyeing
5. Printing
6. Finishing

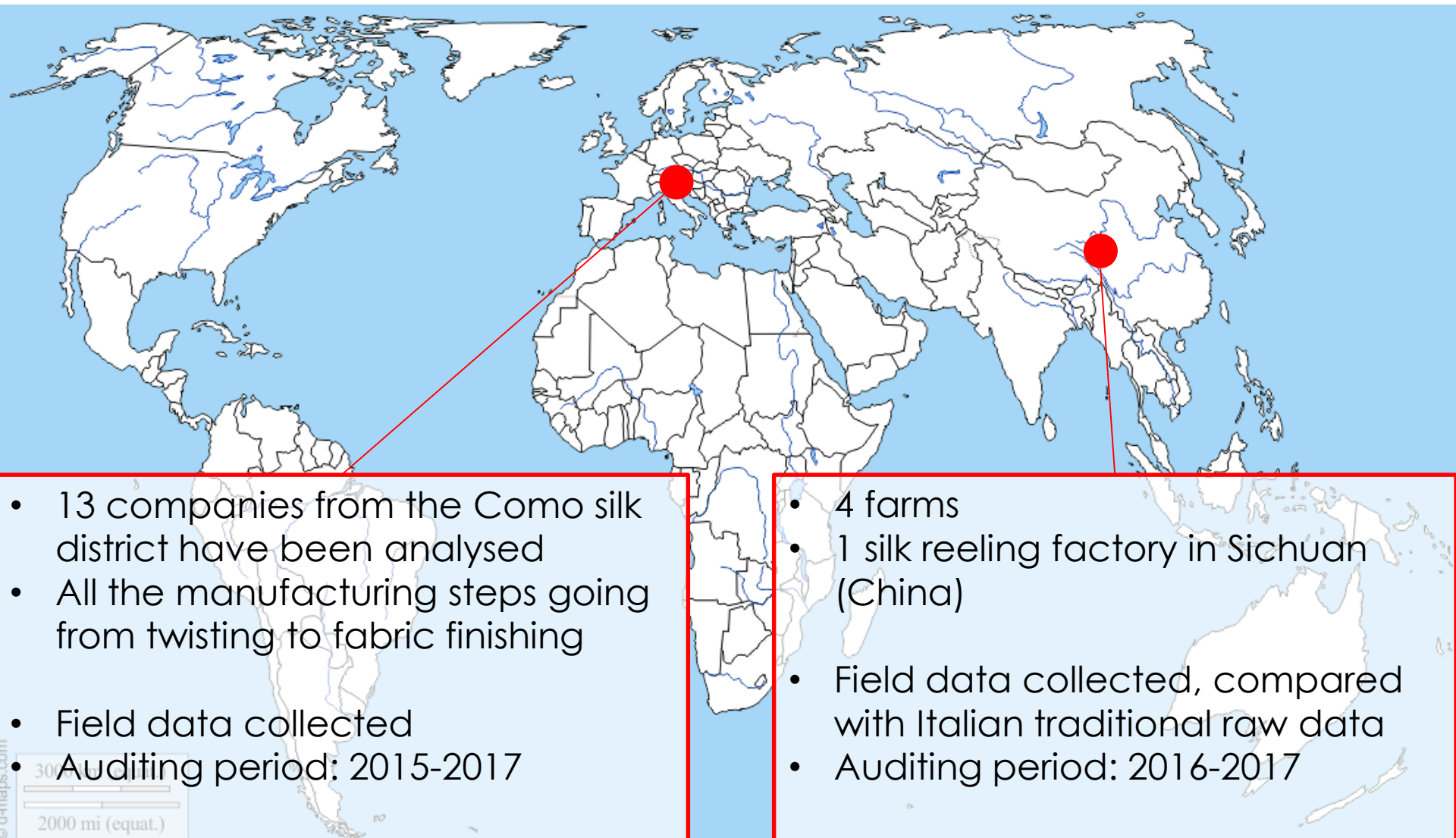
Como

1. Mulberry cultivation
2. Silk eggs production
3. Silkworm rearing
4. Silk reeling

China

100 kg of output was adopted as **functional unit**.

# › Inventory targets



100 kg of output was adopted as functional unit.

## › System Boundaries and Inventory in China: Silk reeling

Silk Reeling			
Process	Electric Power kW/8h	Water l/8h	Steam Kg/8h
Selection	18,80		
Cooking	15,2	12	154
Distributor	26,8	6,6	
Reeling	180,8	66,6	2500
Rereeling + soaking	48	2,6	100
Finishing and Inspection	12,4		
production waste ( Biss)	2	14,7	0
Total	304	102,5	2754
Boiler	24	9,9	
Cleaning		12	
Life - Ligthing	31	140	
Total	55	161,9	
Silk - Output - 132 Kg/8h			

## › System Boundaries and Inventory in China: Mulberry cultivation

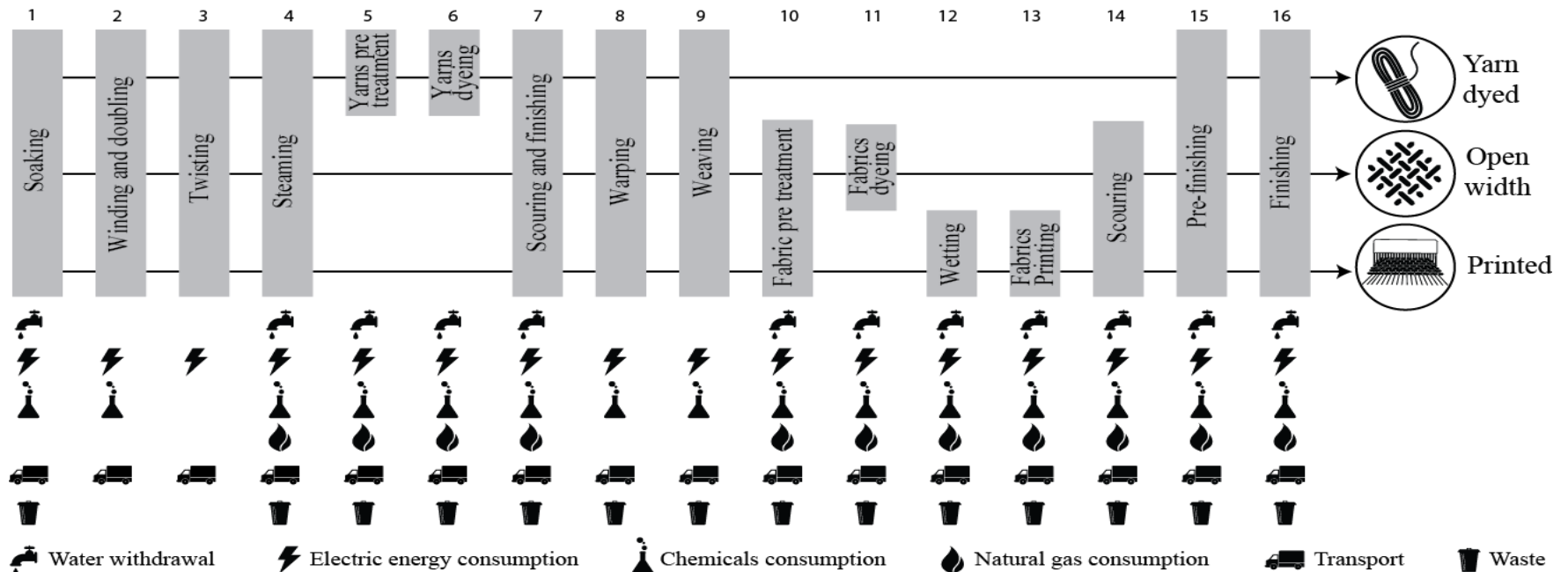
Consumption for 100 kg of silk – Functional Unit

Processes	Mulberry Cultivation		Silkworm Rearing			Total
Sub Processes	Soil cultivation	Watering	Rearing	Dryeing	Transport	
Electric power [kWh]		0.00	238.5	0,1		238,60
Water [m³]		0.00				0,00
Transport ocean					1000,0	1000,00
Transport lorry EURO6					50,0	50,00
Transport lorry EURO3					200.0	200,00
CO <sub>2</sub> capture [ha]	0.42					0,42
Pesticides [kg]	0.00					0,00



# › System boundaries - Como

Pursuing the goal to cover **the whole spectrum of silk fabrics manufacturing**, and relying on field data collected, **three methodologies of silk dyeing** have been considered, forming three different (alternative) **manufacturing paths**: a first path is called **Yarn-dyed** (fabrics), the second one **Open-width**, and the third one **Printing**. The three methodologies can be further split into **six macro-processes**: Twisting, Yarns dyeing, Weaving, Fabrics dyeing, Printing, and Finishing. Each of these can be further broken down in a **set of sub-processes (16)**, as represented in the Picture below





# Results

## Inventory in manufacturing

## Steps of an LCA

How to assess the environmental impact?



## › Step 2- LCI Inventory

### Indicators

Five **indicators** were calculated for each analysed process and for the entire supply chain. These dimensions aim at providing a sufficiently complete picture of the environmental profiles of the analysed entities.

Emissions in atmosphere and wastewater were also addressed but are not here reported.



**Electric energy**

**kWh**



**Natural gas**

**m<sup>3</sup>**



**Water**

**m<sup>3</sup>**



**Chemicals**

**kg**



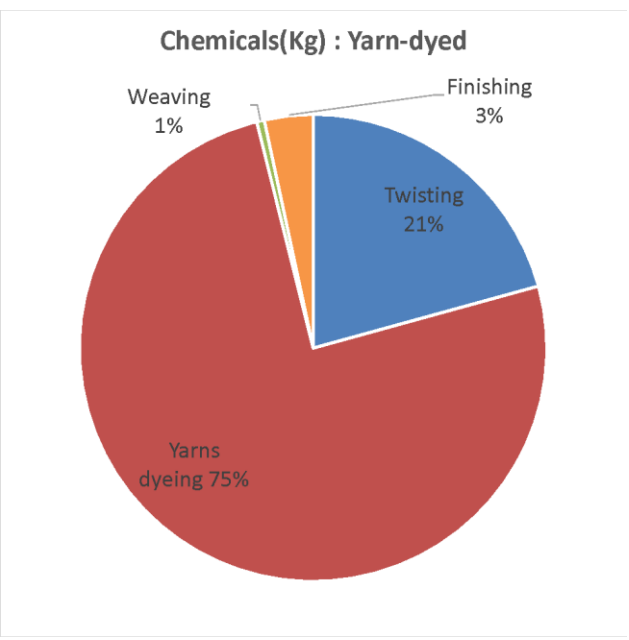
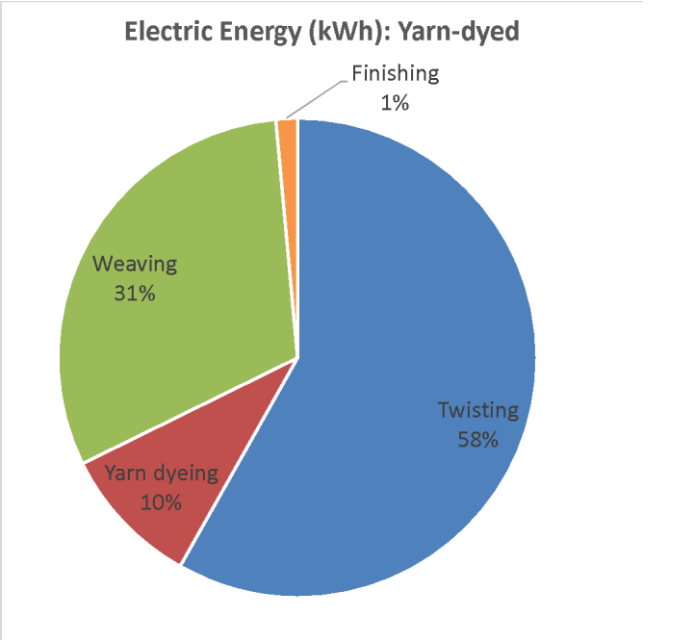
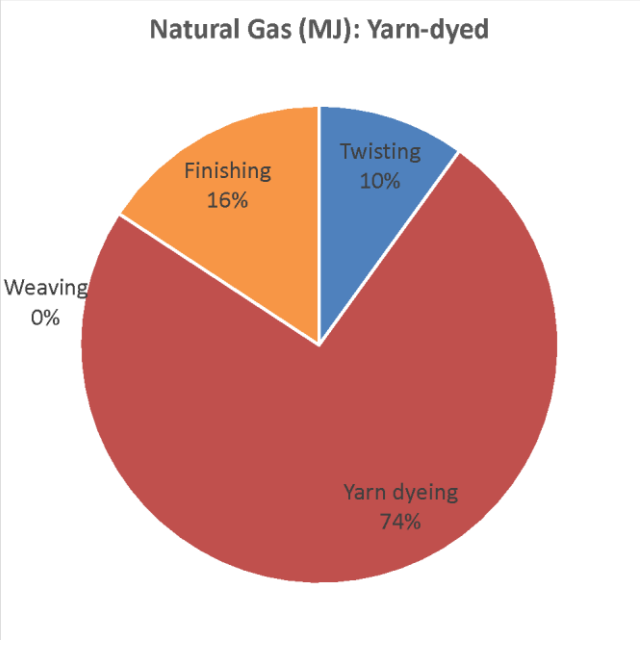
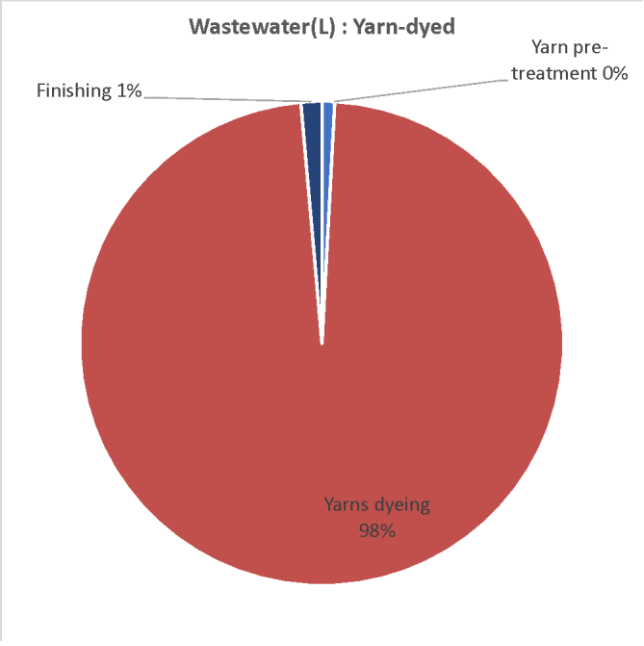
**Waste**

**kg**

Environmental impacts of silk products manufacturing – Yarn Dyed Silk Fabric

SYNOPSIS

100 kg of  
Yarn dyed  
Silk Fabric

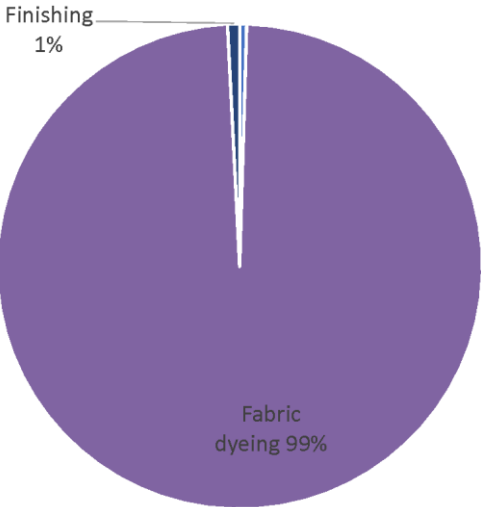


Environmental impacts of silk products manufacturing – Open Width dyeing of silk fabric

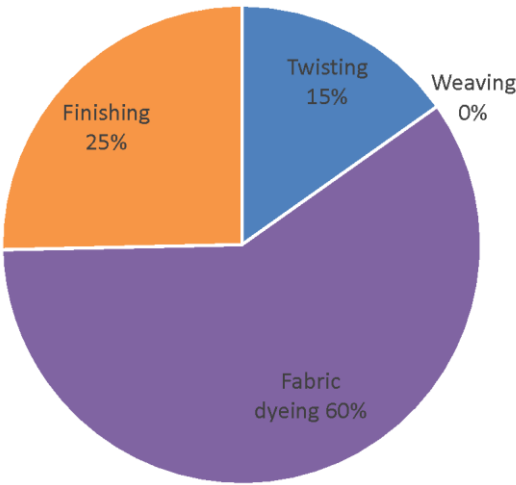
SYNOPSIS

100 kg of  
Open width dyeing  
Silk Fabric

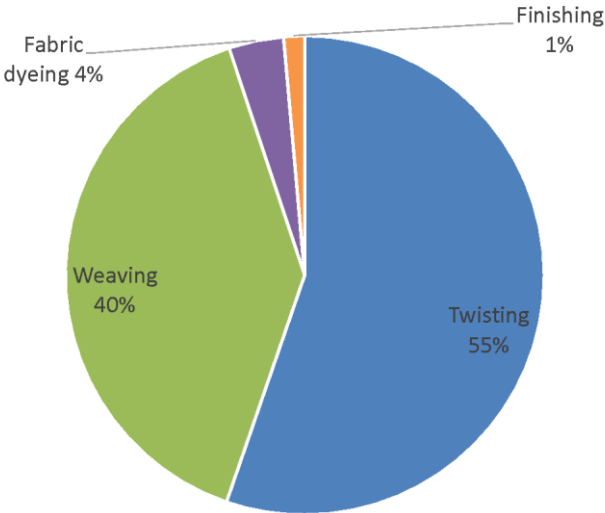
Wastewater(L) : Open-width



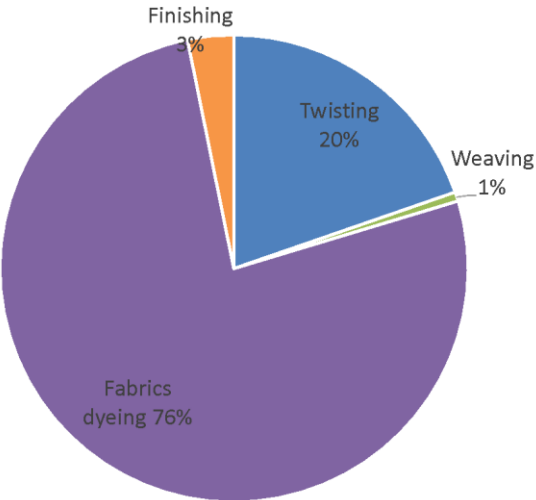
Natural Gas (MJ): Open-width



Electric Energy (kWh): Open-width



Chemicals(Kg) : Open-width

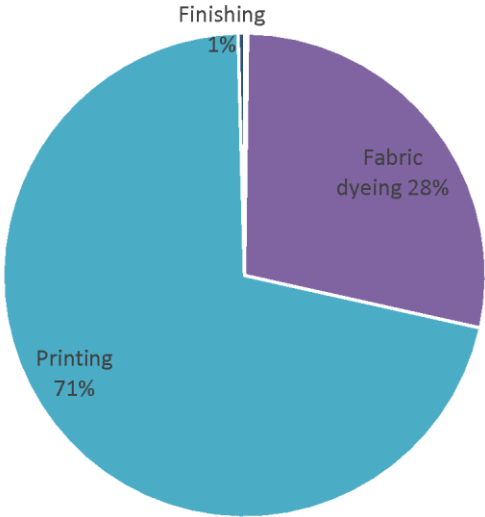


Environmental impacts of silk products manufacturing – Printed silk fabric

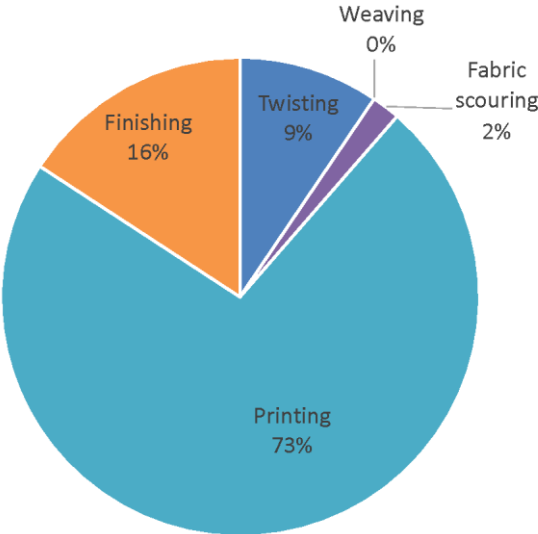
SYNOPSIS

100 kg of  
Printed  
Silk Fabric

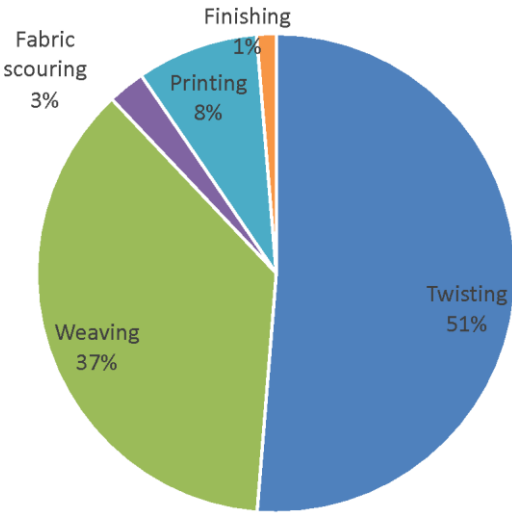
Wastewater(L) : Printed fabric



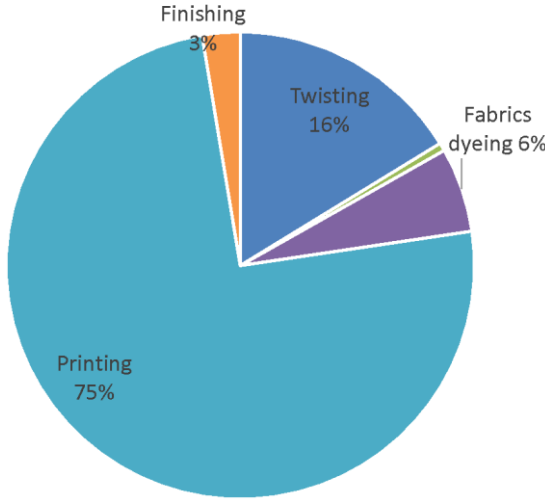
Natural Gas (MJ): Printed Fabric

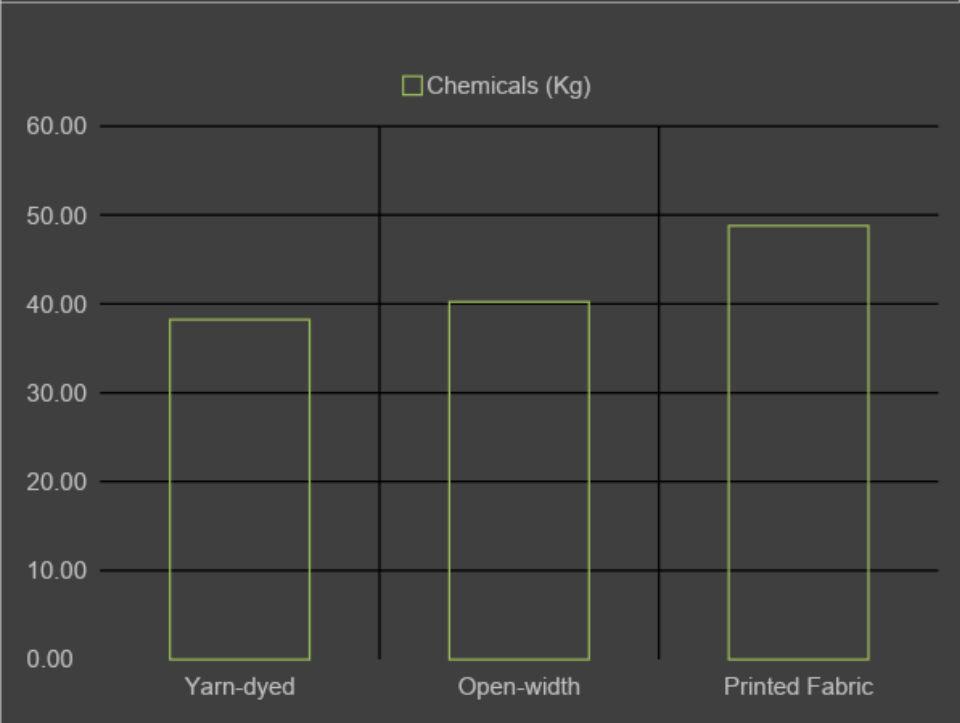
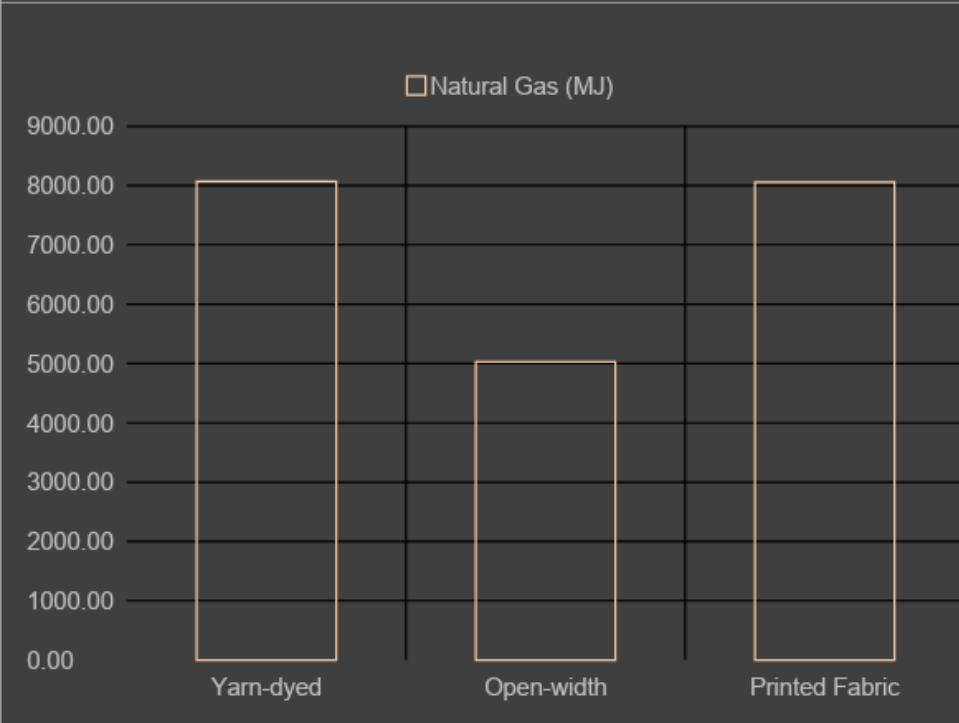
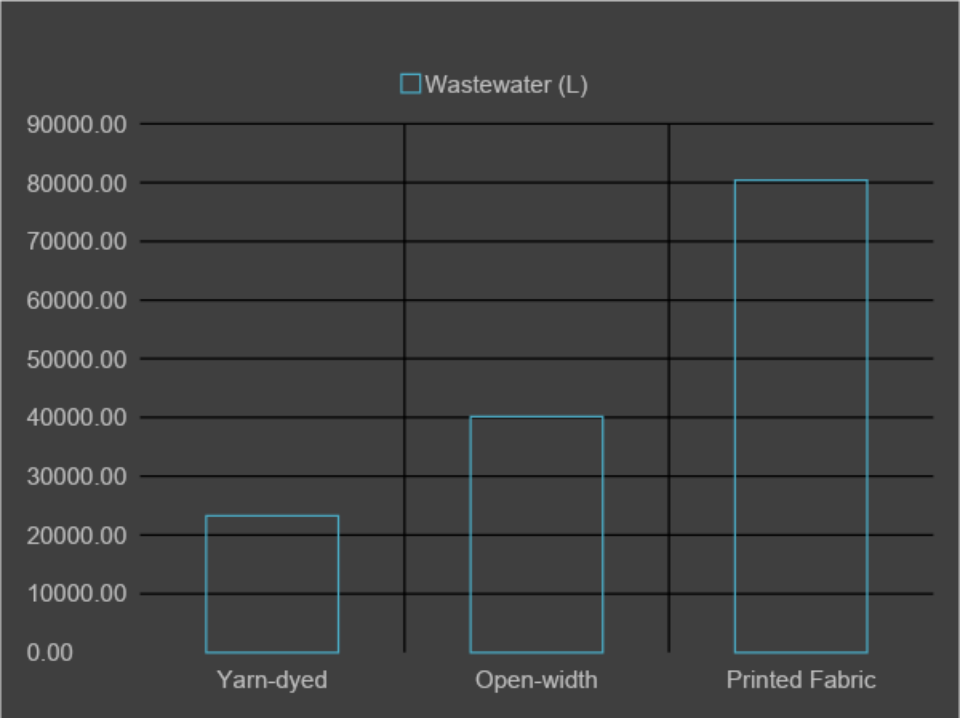
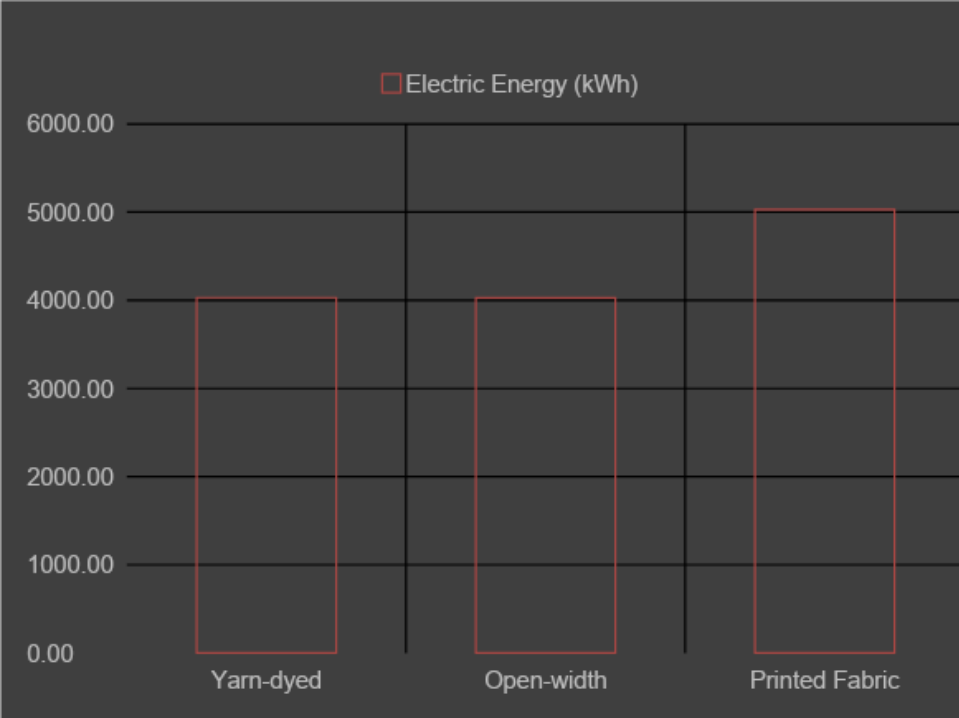


Electric Energy (kWh): Printed Fabric



Chemicals(Kg) : Printed fabric







# Results

LCA cradle to gate

# › LCA Analysis

## Steps of an LCA

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# LCA Indicators



## HUMAN HEALTH

Global warming potential (GWP)

Stratospheric ozone depletion  
(ODP)

Ionizing radiation (IRP)

Fine particulate matter formation  
(PMFP)

Photochemical oxidant formation:  
Human health (HOFP)

Human toxicity potential: cancer  
(HTPc)

Human toxicity potential: non-  
cancer (HTPnc)

Water consumption potential  
(WCP)

## ECOSYSTEMS

Global warming potential (GWP)

Photochemical oxidant formation:  
Ecosystem quality (EOFP)

Terrestrial acidification (TAP)

Terrestrial ecotoxicity potential  
(TETP)

Water consumption potential  
(WCP)

Land Use (LOP)

Freshwater eutrophication  
potential (FEP)

Marine ecotoxicity potential  
(METP)

Freshwater ecotoxicity potential  
(FETP)

## RESOURCES

Mineral resource scarcity (SOP)

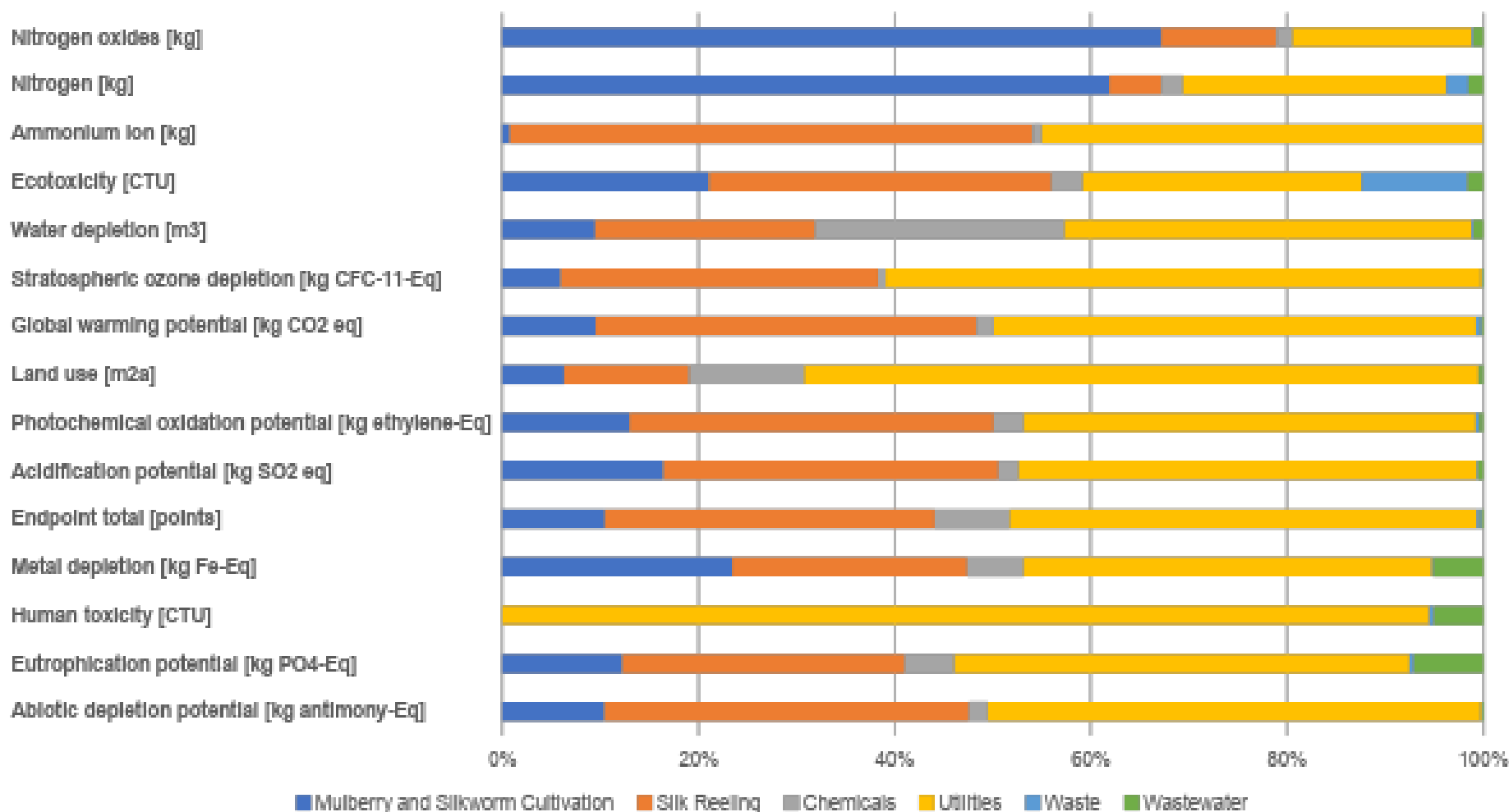
Fossil fuel scarcity (FFP)

**LIFE CYCLE IMPACT ASSESMENT (ReCiPe 2016)**

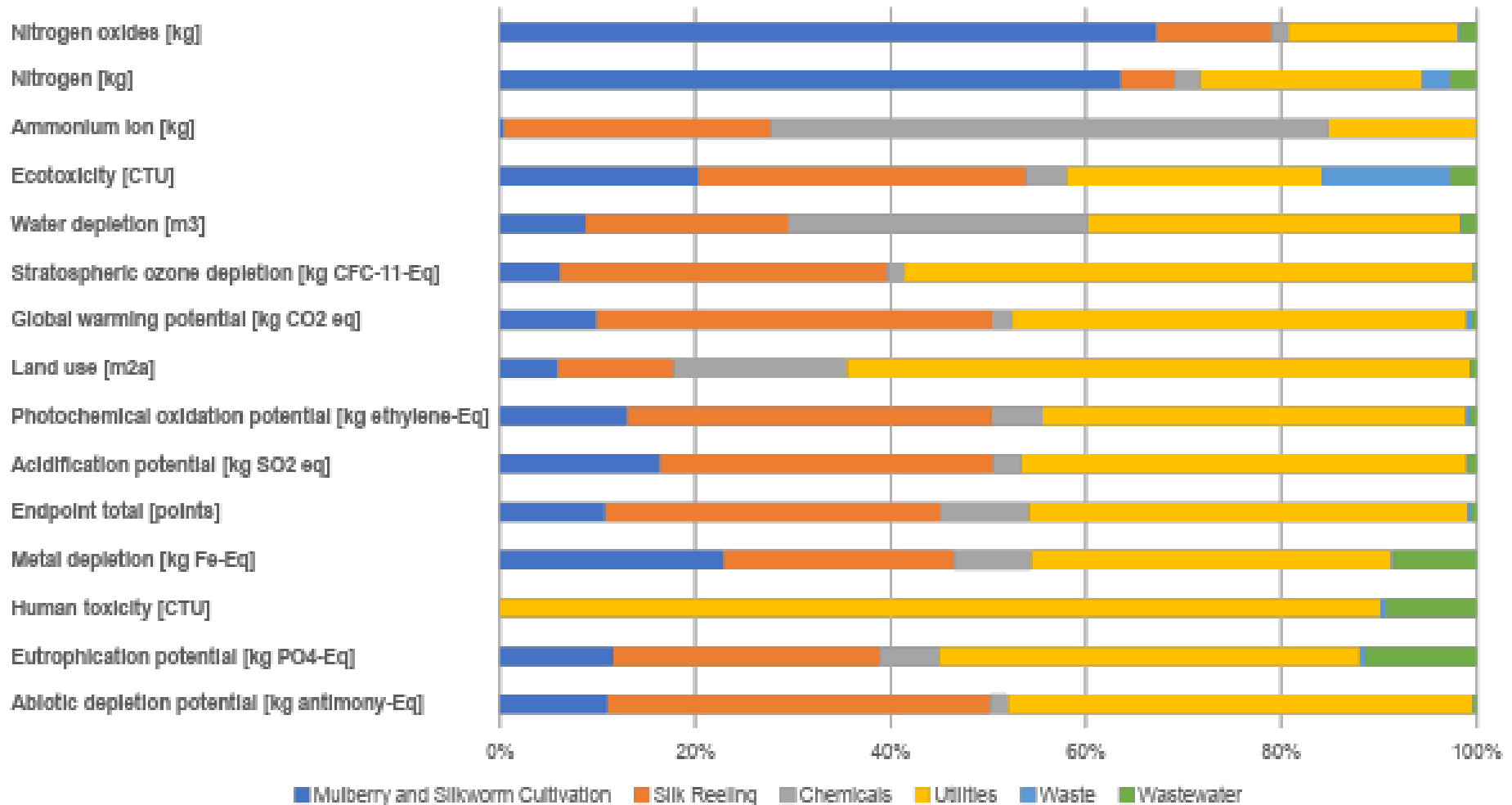
# > LCA for Chinese operations

	Abiotic depletion potential [kg antimony-Eq]	Acidification potential [kg SO2 eq]	Endpoint total [points]	Eutrophication potential [kg PO4-Eq]	Global warming potential [kg CO2 eq]	Human toxicity [CTU]	Land use [m2a]	Metal depletion [kg Fe-Eq]	Photochemical oxidation potential [kg ethylene-Eq]	Stratospheric ozone depletion [kg CFC-11-Eq]	Ecotoxicity [CTU]	Water depletion [m3]	Ammonium Ion [kg]	Nitrogen [kg]	Nitrogen oxides [kg]
Electric power (CN)	1,6630E+00	1,4250E+00	5,1695E+00	2,2683E-01	2,7592E+02	1,0477E-05	6,3198E+00	3,0000E+00	5,4773E-02	8,7367E-07	1,4648E+03	8,1929E-01	1,9751E-05	2,7808E-07	2,0872E-02
Irrigation	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00
Ocean Transport	7,7922E-02	2,3981E-01	2,2549E-01	2,4535E-02	1,1459E+01	2,9574E-07	1,5117E-01	2,5534E-01	7,6766E-03	1,5524E-06	1,2930E+01	1,2257E-02	1,5354E-06	1,5359E-08	8,7449E-04
Lorry EURO6	1,8348E-01	6,4136E-02	5,4901E-01	1,4931E-02	2,6085E+01	1,1546E-06	1,1872E+00	1,2997E+00	4,1305E-03	3,8825E-06	8,1793E+01	2,9109E-02	2,0681E-06	2,1521E-06	5,3227E-04
Lorry EURO3	7,4193E-01	5,9188E-01	2,2083E+00	1,2117E-01	1,0480E+02	4,6439E-06	4,7544E+00	5,2043E+00	1,9457E-02	1,5719E-05	3,2760E+02	1,1688E-01	8,2952E-06	8,6097E-06	5,3804E-01
CO <sub>2</sub> capture [ha]	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	-8,2501E+01	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00
Pesticide	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00	0,0000E+00
Total	2,6664E+00	2,3208E+00	8,1523E+00	3,8747E-01	3,3576E+02	1,6571E-05	1,2413E+01	9,7593E+00	8,6037E-02	2,2028E-05	1,8872E+03	9,7753E-01	3,1650E-05	1,1055E-05	5,6032E-01

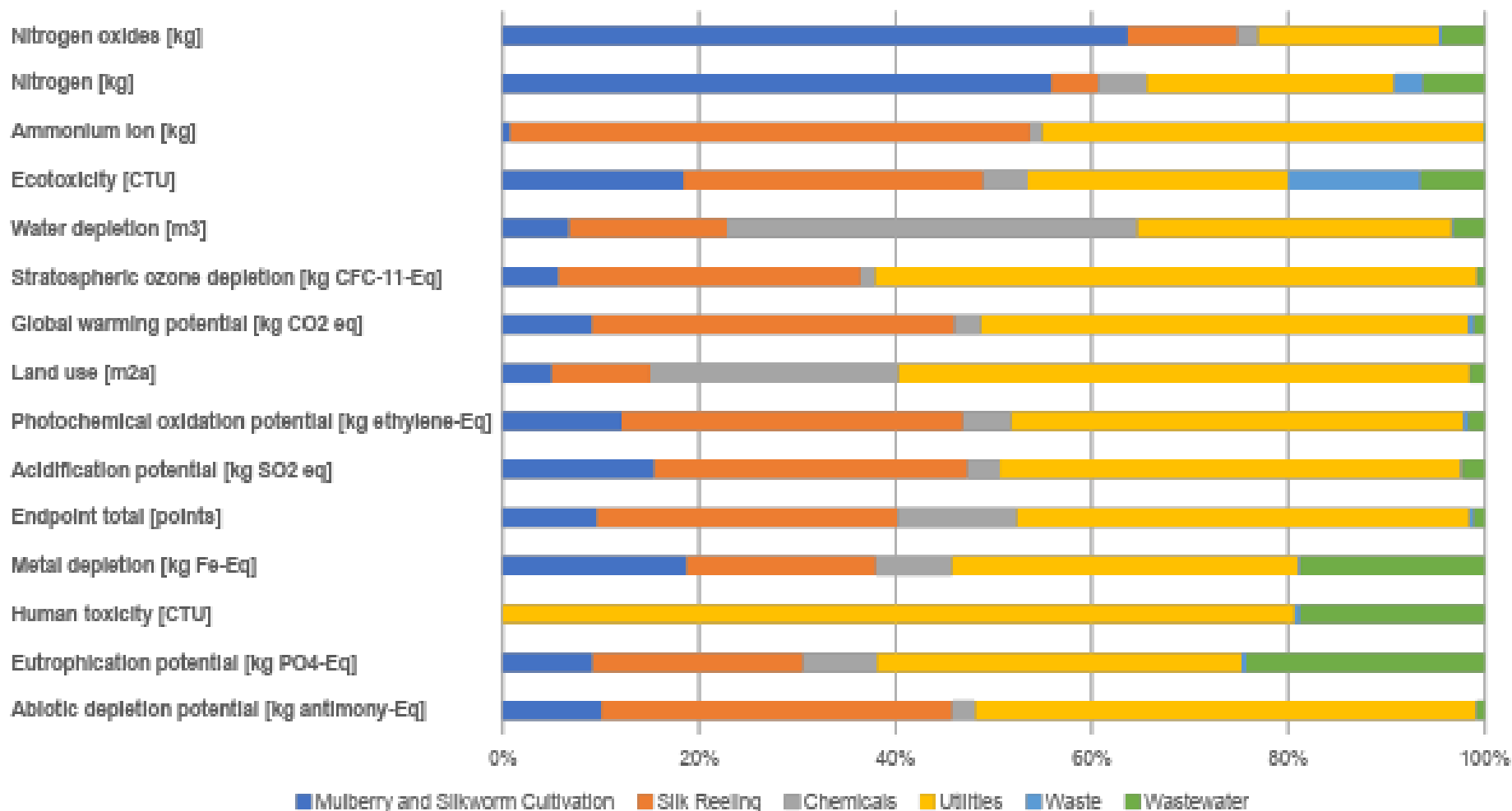
# › LCA for– yarn-dyed fabric



## > LCA for Italian operations – open-width dyed fabric

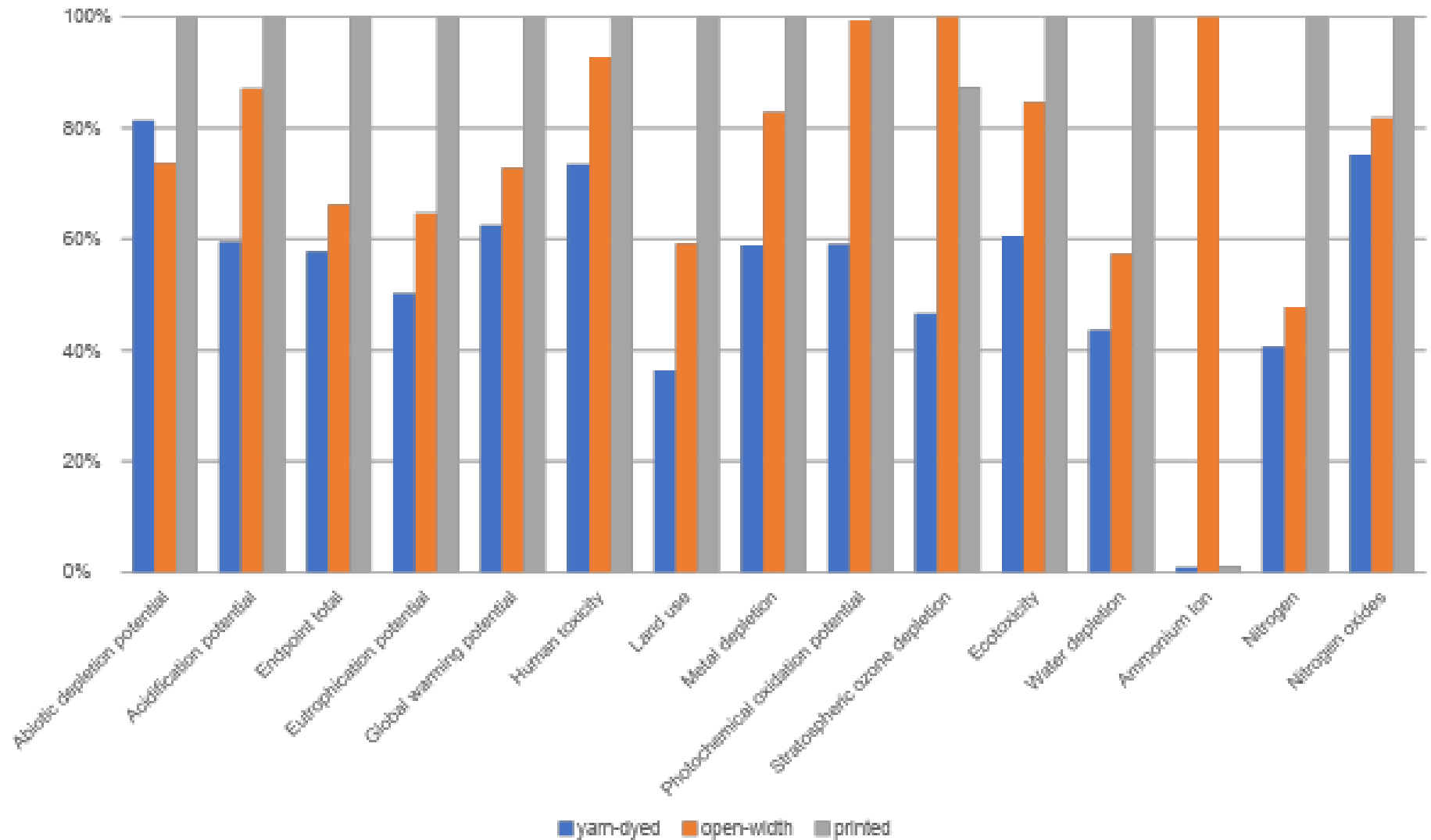


## > LCA for Italian operations – printed fabric





## Comparison of the three paths



## WOVEN FABRICS OF SILK AND SILK-LIKE FIBRES

PRODUCT CATEGORY CLASSIFICATION: UN CPC 2651

2019:03  
VERSION 1.0

VALID UNTIL: 2023-02-12



**EPD is a certification for the international market supervised by The Swedish Environmental Management Council**

<https://www.environdec.com/PCR/Detail/?Pcr=12384>

# Results interpretation and Conclusions

# > LCA Analysis

## Steps of an LCA

How to assess the environmental impact?



Life cycle assessment (LCA) is more and more considered a reference method for the evaluation of supply chains, production and consumption systems, up to region

# ➤ EU aims at harmonising the application of LCA


Guide for interpreting life cycle a x Google Google x +

https://ec.europa.eu/jrc/en/publication/guide-interpreting-life-cycle-assessment-result

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## EU SCIENCE HUB

The European Commission's science and knowledge service

European Commission > EU Science Hub > Publication > Guide Interpreting Life Cycle Assessment Result

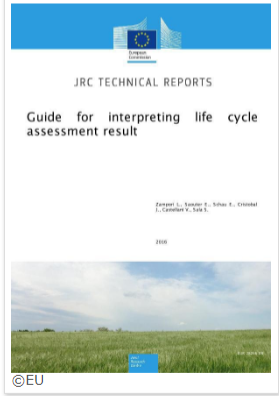
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## Guide for interpreting life cycle assessment result

**Abstract:**  
Interpretation of the results of a life cycle assessment (LCA) study is a mandatory phase of LCA and it is a key aspect in order to derive robust conclusions and recommendations. One of the key aims of LCA is to provide the decision makers with comprehensive and understandable information: this task is achieved by a proper interpretation of the results of an LCA study. The robust interpretation of a LCA study needs specific guidance to support the decision making process, both in policy and business contexts: existing standards and guidelines provide a framework, but they do not provide a clear and practical guidance on how to perform a comprehensive interpretation of an LCA. This report aims at providing practitioners with a practical guide on what are the aspects to be always taken into account when interpreting results of an LCA. Building on this report, as a next step further guidance needs



JRC TECHNICAL REPORTS  
Guide for interpreting life cycle assessment result  
Prepared by: [Name], [Institution]  
2018  
©EU

### Related topics

- Sustainable production and consumption
- Green and circular economy

# › Transparent interpretation

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The standard that covers the LCA process, ISO 14044, states interpretation should cover at least three major elements.



Identification of key issues: Hotspots analysis  
Identify the most relevant impact categories  
Identify the most relevant impact processes



Design New product



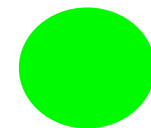
Technology transfer  
New innovative strategies  
New materials and suppliers



Improve business model  
Marketing and labelling and communication



# › Ecotextile publication



# ECOTEXTILE

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## Special supplement: The Life Cycle of Luxury

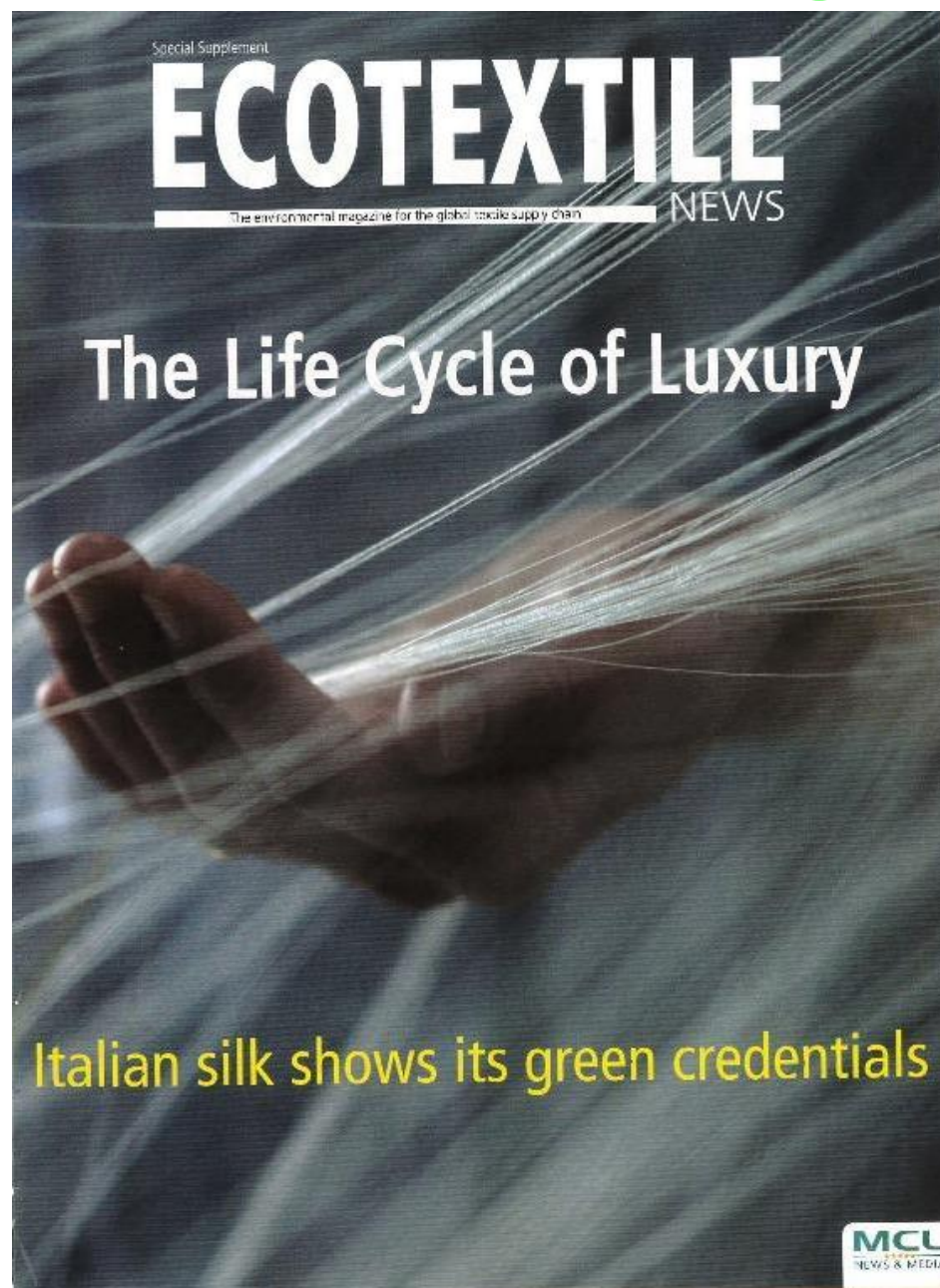
Published: 18 February 2019

Written by Kieran Mitchell

Print



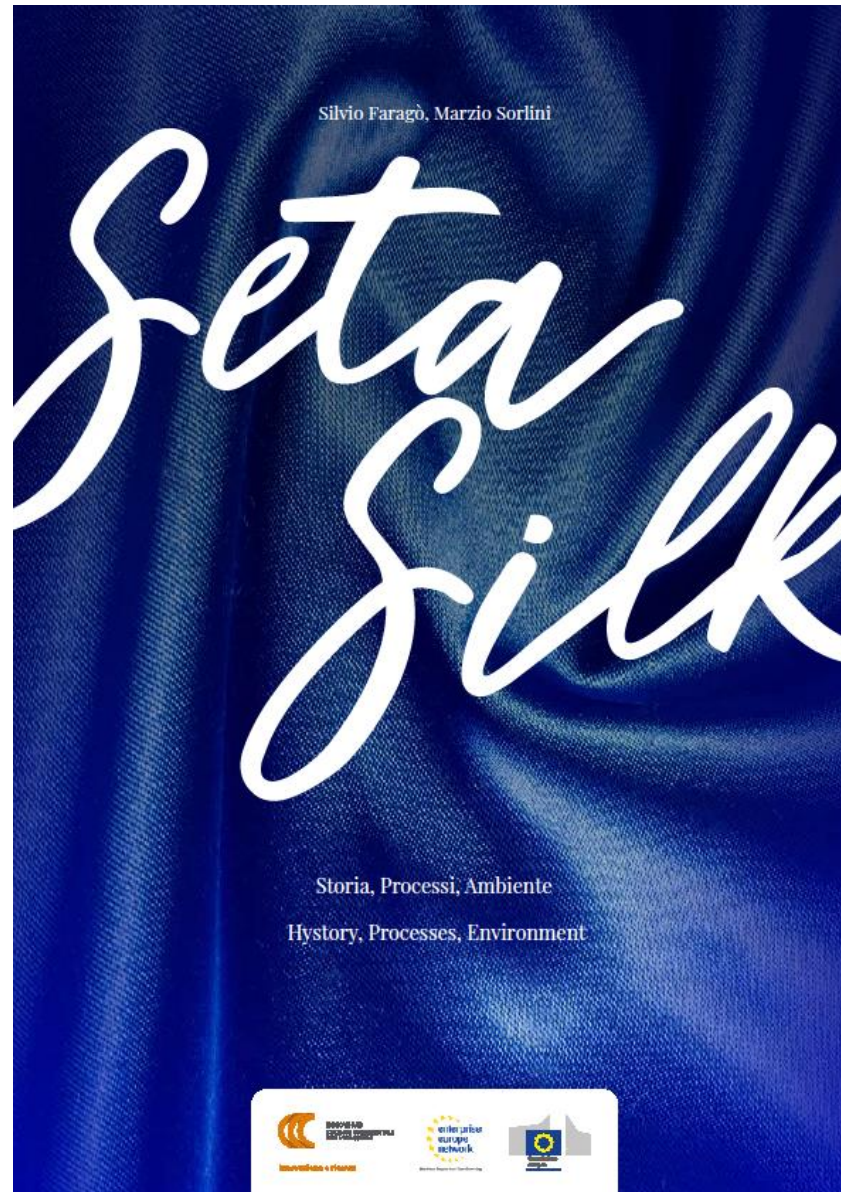
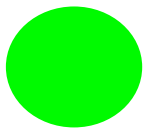
WAKEFIELD – The latest printed edition of *Ecotextile News* contains an exclusive 12-page bonus supplement on work done by the Italian textile sector to evaluate the environmental impacts of silk textile production through publication of a new LCA (lifecycle assessment) from silk production down to fabric finishing, [which you can view as an interactive PDF here](#).





# › Ecotextile publication

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Thank You  
for  
Your Attention