Sherpack Final Workshop

End-of-life and life cycle of the Sherpack material

Antonio Dobon | ITENE

sherpack

End-of-life and life cycle of the Sherpack material

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RESEARCH CENTER ITENE

Bio-based Industries Consortium

Horizon 2020 European Union Funding for Research & Innovation

BBI JU

ITENE – Packaging, Transport and Logistics Research Center

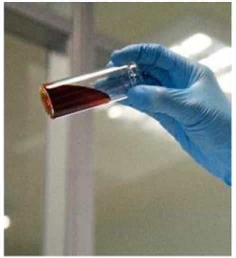
ITENE is the reference research centre in packaging, transport and logistics.

25 years creating technological solutions through R&D

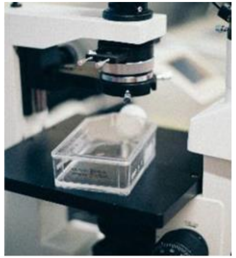
ITENE – Packaging, Transport and Logistics Research Center

150	Professionals. 16% PhD.
93	R&D projects
7,150	m^2 of facilities
258	Innovation and technical assistance projects
767	Customers
532	Testing services performed

ITENE – Packaging, Transport and Logistics Research Center

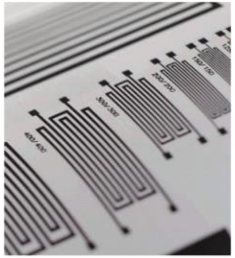


New advanced materials



Nano-materials

Packaging and packaging systems



Integrated intelligent systems

Circular economy & sustainability

Packaging for distribution

Logistics, transport and distribution

Urban mobility and intermodality

Security of goods and people

We work with all the **state-of-the-art technologies.**

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PILOT PLANT

- Packaging
- New materials and processing
- Packaging production
- Modification and synthesis of additives
- Compostability assessment of packaging materials

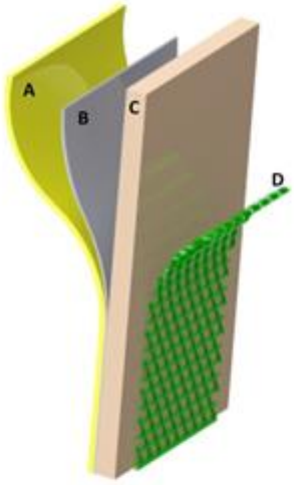
CENTRES

- Transportation simulation

LABORATORIES

- Chemical characterisation of materials
- Physical-mechanical characterisation of materials
- Microbiological analysis
- Nano-security
- Packaging assessment
- Approval of dangerous goods packaging

Proofs-of-Concept



Layer		PoC#1	PoC#2
ID	Layer type	wt%	wt%
A	Base paper	72	60
B	MFC layer	19	21
C	PLA-blend	8	9
D	Starch	---	9
Total		100	100

End-of-life: Recyclability trials

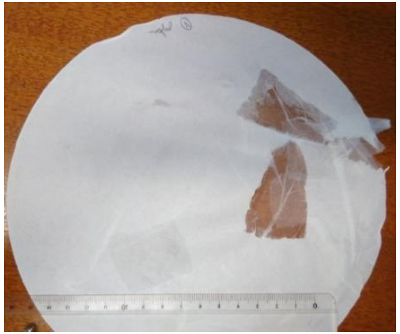
Disintegration

- For 15min
- Production of handsheets

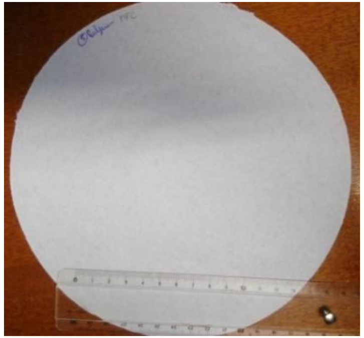
Somerville screening

- 2 steps (0.15 and 0.10mm)
- Production of handsheets

PE/Paper (ref. material)
No screening



MFC/Paper
No screening



Sherpack Proofs-of-Concept

Less than 1% rejects after Somerville screening

Very good visual aspect of handsheets

End-of-life: Compostability trials

Adapted method for small lab-scale simples in Sherpack

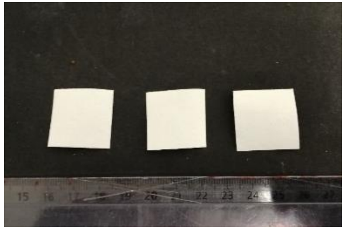
Test		Standard	Test duration	Sample weight	Sample form	Starndard
Chemical characterization of material: - **Dry and volatile solids** - **Regulated metals** (Zn, Cu, Ni, Cd, Pb, Hg, Cr, Mo, Se, As, Co) - **Hazardous substances** (F) - **Infrared transmission spectrum**		EN 13432:2000 PT-04-63	2 weeks	20 g	Scraps	Yes
Biodegradation under composting conditions		EN 13432:2000 **ISO 14855-1:2012**	6 weeks – 6 months	100 g	Scraps	Yes
Disintegration under composting conditions and physico-chemical properties of compost (total dry solids, volatile solids, pH, N-NH4, N-NO2, N-NO3, N, P, K, Mg, salt content, density, and maturity level)	Pilot-scale	EN 13432:2000 ISO 16929:2013	12 + 2 weeks	14 kg	Final form	Yes
	Lab-scale	**ISO 20200:2015 (home compost)**	**90 days (+ 90 days)**	**300 g**	**Final form**	**Sherpack**
Ecotoxicity in 2 plant species: - **Garden cress** (*Lepidium sativum*) - **Summer barley** (*Hordeum vulgare*)		EN 13432:2000 **OECD 208 (2006)**	3 weeks, after disintegration test	(compost samples from disintegration)		Yes

End-of-life: Compostability trials

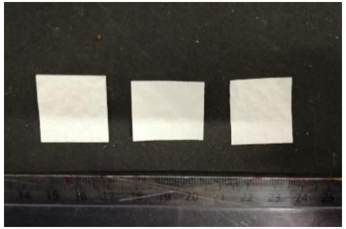
Sample	Bioegradation (ISO 14855-1:2012)	Disintegration (ISO 20200:2015)	Ecotoxicity (OECD 208 2006)
Gerstar base paper HDS + MFC	✔	Not tested	Not tested
PoC#1: Gerstar HDS base paper + MFC + PLA blend	On-going	✔	On-going
PoC#2: Gerstar HDS base paper + MFC + PLA blend + starch-grid	On-going	✔	On-going

Gerstar HDS base paper + MFC

PoC#1



PoC#2



End-of-life: Compostability trials

Biodegradation (ISO 14855-1:2012)

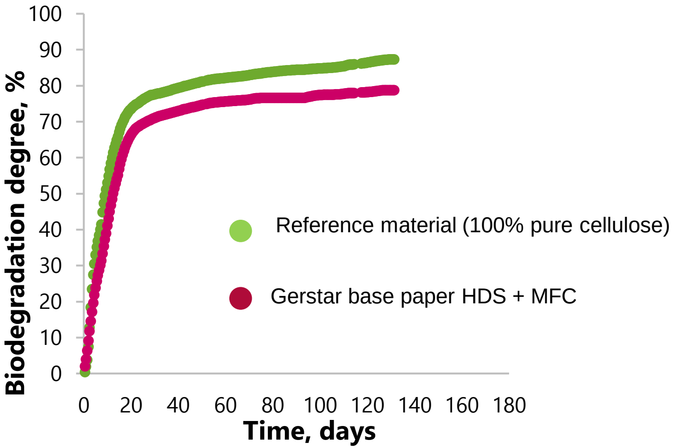
Sample description	C (%)
100% pure cellulose	42.12
Gerstar base paper HDS + MFC	32.21

Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions. Method according to the analysis of generated carbon dioxide

$D_t \geq 90\%$

$$D_t = \frac{(CO_2)_T - (CO_2)_B}{ThCO_2} \times 100$$

$$ThCO_2 = M_{TOT} \times C_{TOT} \times \frac{44}{12}$$

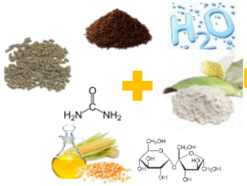


Biodegradability vs reference material = **90.18%**

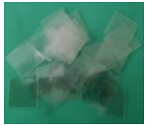
End-of-life: Compostability trials

Disintegration (ISO 20200:2015 home compost adapted method for Sherpack)

Biowaste



Test material



Flip of the sample

Simulated composting conditions in lab (58ºC for 90 days)

2 mm sieve

Recovered material must be ≤ 10 wt%

End-of-life: Compostability trials

Disintegration (ISO 20200:2015 home compost adapted method for Sherpack)

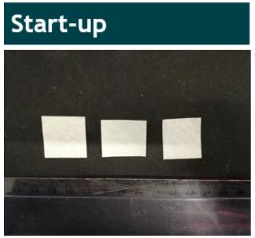
PoC#1

Full disintegration after 6 weeks

End-of-life: Compostability trials

Disintegration (ISO 20200:2015 home compost adapted method for Sherpack)

PoC#2

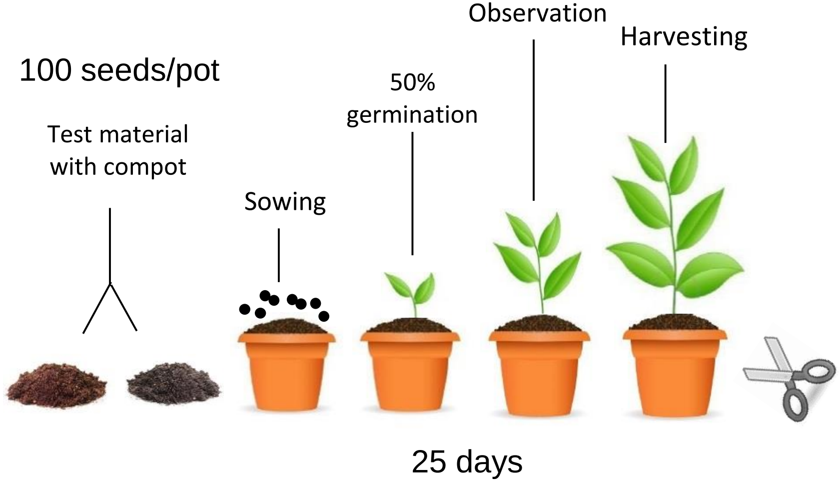


Full disintegration after 7 weeks

End-of-life: Compostability trials

Ecotoxicity (OECD 208:2006, tests on-going)

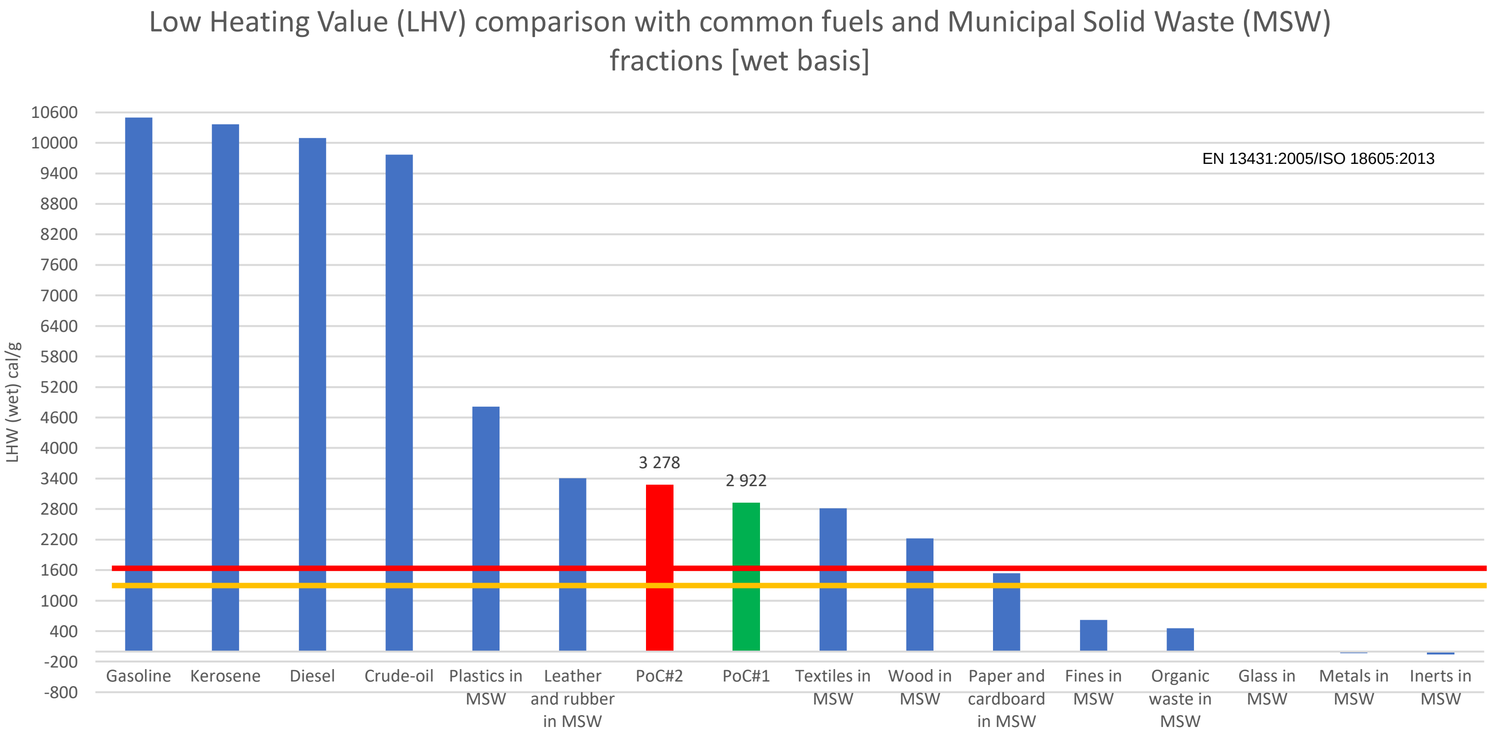
The method evaluates the effects on germination and growth of higher plants sown in a mixture consisting of compost (white or with test material) and reference substrate.



Germination rate ≥ 90%

Biomass production≥ 90%

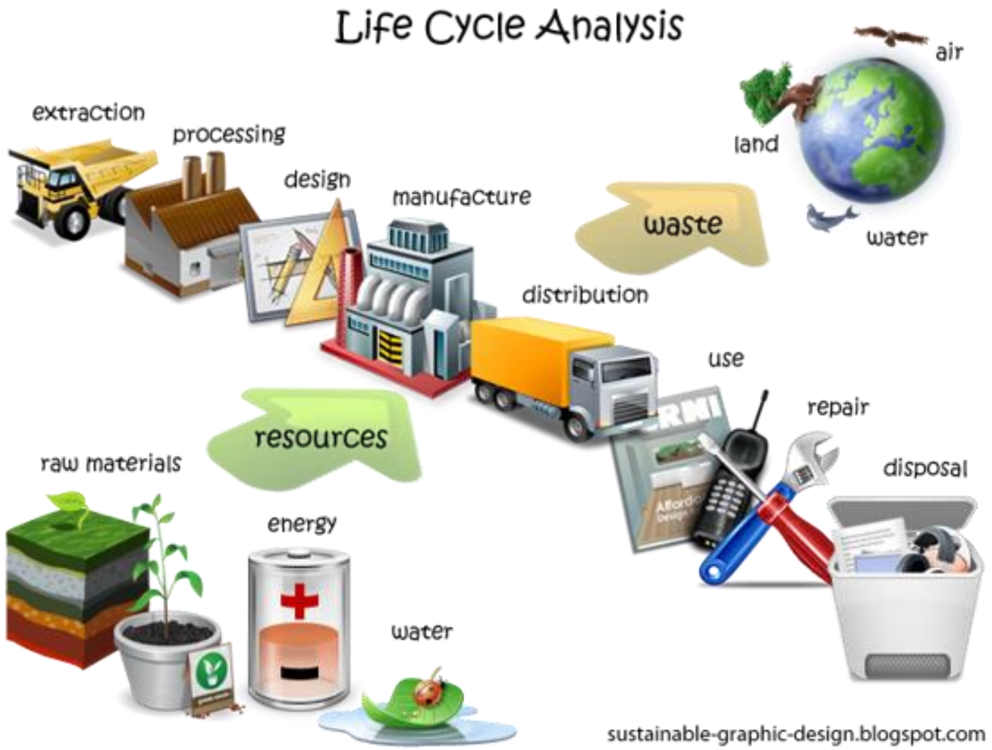
End-of-life: Incineration trials



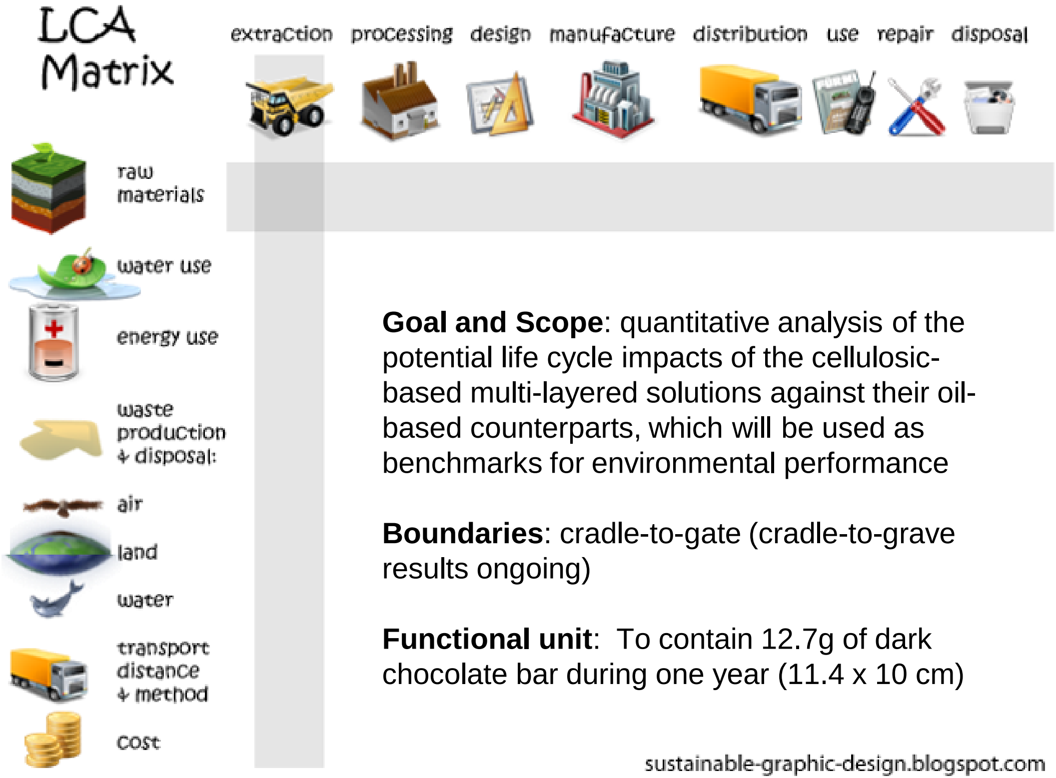
Minimum LHV to operate in a MSW incinerator (≈1600 cal/g) [ISWA]

Minimum LHV to be considered a paper and board packaging suitable for energy recovery (≈1200 cal/g) [EN 13431:2004]

Environmental impact: Life Cycle Assessment (LCA)



Environmental impact: Life Cycle Assessment (LCA)



Goal and Scope: quantitative analysis of the potential life cycle impacts of the cellulosic-based multi-layered solutions against their oil-based counterparts, which will be used as benchmarks for environmental performance

Boundaries: cradle-to-gate (cradle-to-grave results ongoing)

Functional unit: To contain 12.7g of dark chocolate bar during one year (11.4 x 10 cm)

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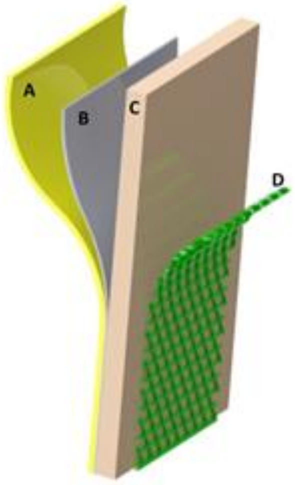
Proofs-of-Concept



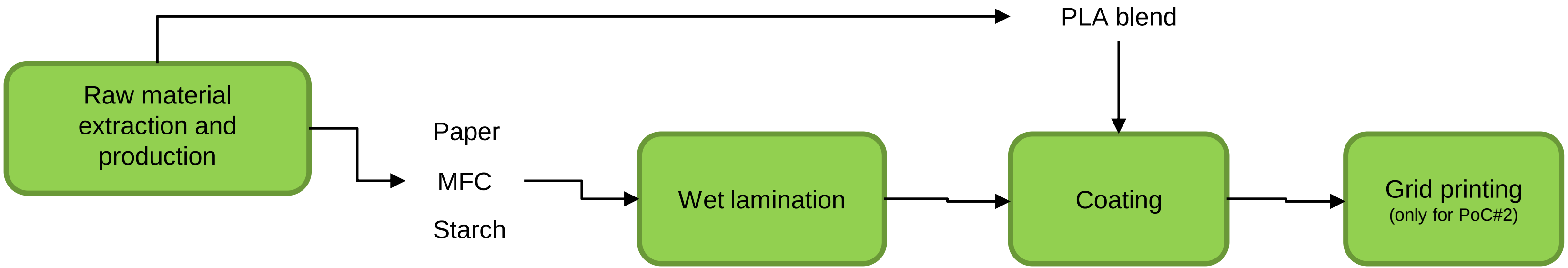
Layer		PoC#1	PoC#2	Benchmark	
ID	Layer type	wt%	wt%	Layer type	wt%
A	Base paper	72	60	Polypropylene	99
B	MFC layer	19	21	Aluminium	1
C	PLA-blend	8	9	---	---
D	Starch	---	9	---	---
Total		100	100		100

Environmental impact: Life Cycle Assessment (LCA)

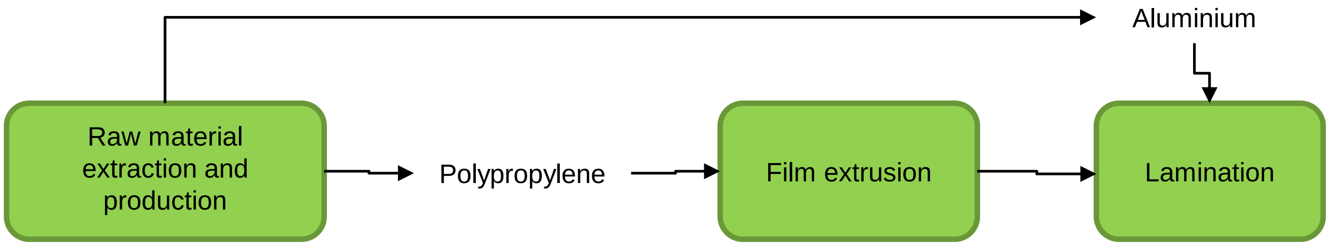
System boundaries

Transports included

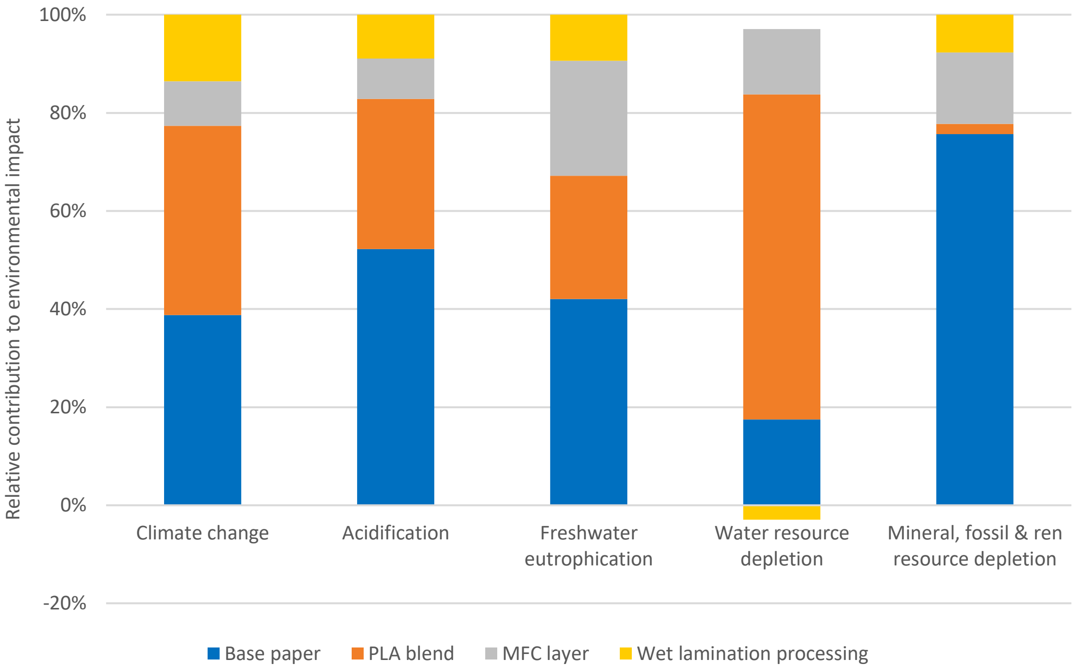
Sherpack materials



Benchmark materials



Life Cycle Assessment (LCA) PoC#1



Main contributions to impacts are:

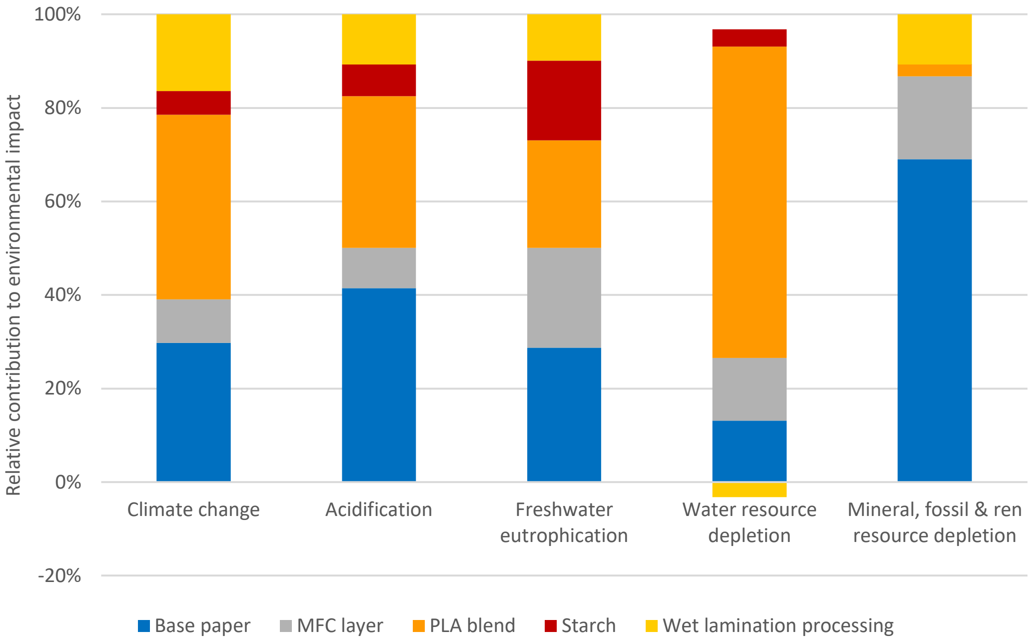
- PLA blend preparation
- Base paper

Other impacts:

- MFC does not play a key role on the impact in the PoC (max 20% of impact)
- Environmental credits because of wastewater treatment (only in water resource depletion)

Calculation performed with ILCD 2011 Midpoint+ method

Life Cycle Assessment (LCA) PoC#2



Main contributions to impacts are:

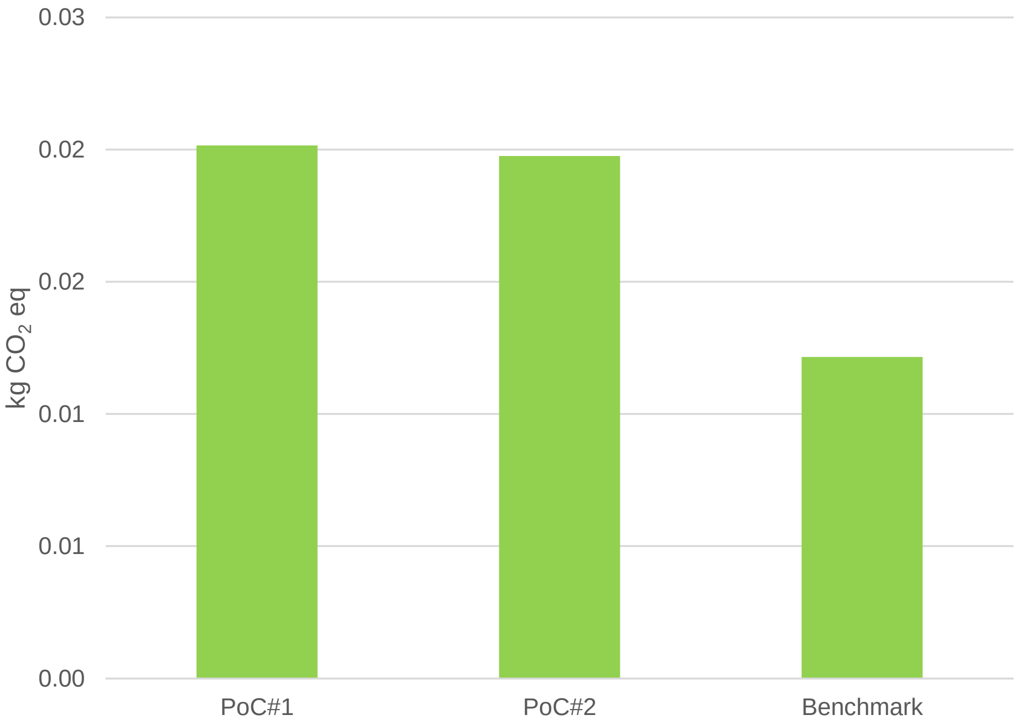
- PLA blend preparation
- Base paper

Other impacts:

- MFC does not play a key role on the impact in the PoC (max 20% of impact)
- Environmental credits because of wastewater treatment (only in water resource depletion)

Calculation perfomed with ILCD 2001 Midpoint+ method. Starch not accounted in the impact about Mineral, fossil and renewable resource depletion

Life Cycle Assessment (LCA): carbon footprint



The carbon footprint of the PoC's is close to the fossil based counterpart (there is still room for improvement)

Layer	Carbon footprint (g CO_2 eq)
PoC#1	20.2
PoC#2	19.8
Benchmark	12.2

Calculation performed with ILCD 2011 Midpoint+ method

Conclusions

- ✓ Sherpack materials are compatible with recycling systems for paper-based packaging (< 1% of rejects after Somerville screening)
- ✓ Combined Sherpack base materials (Gerstar HDS base paper + MFC) are biodegradable
- ✓ Sherpack PoC's can be disintegrated in conditions similar to home composting
- ✓ If required, Sherpack PoC's can be also treated by incineration
- ✓ The carbon footprint of the PoC's is close to the fossil-based counterpart on PP/Al

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Thank you for your attention

Any question?

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