ECO-DESIGN OF BOVINE HIDES AND ITS IMPACT ON THE GLOBAL WARMING POTENTIAL OF AUTOMOTIVE LEATHER

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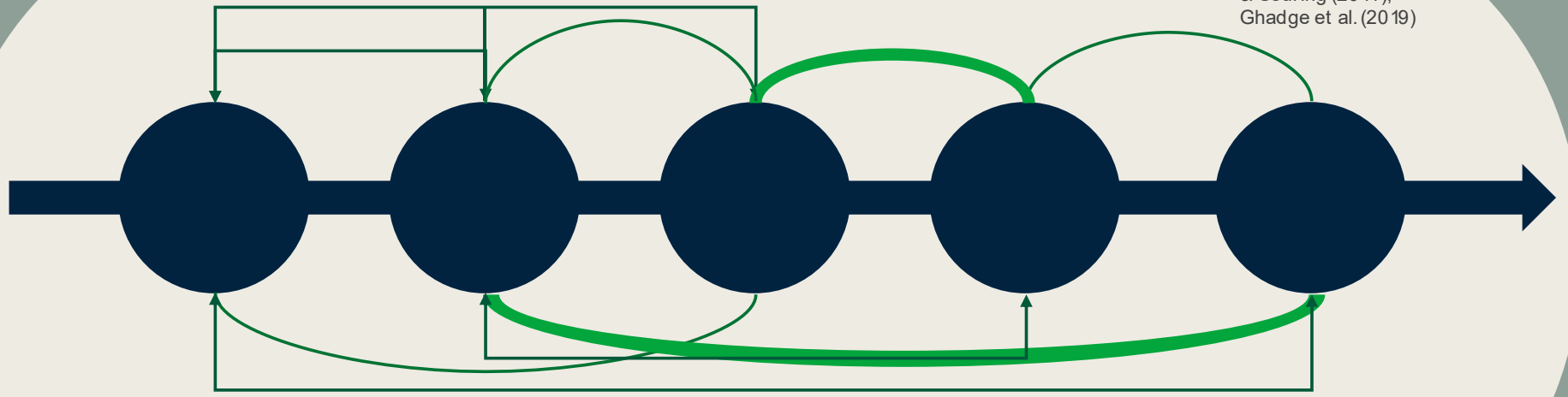
GLOBAL WARMING Khandekar at al. (2005); IPCC AR6 (2021); Haque & Islam (2017); Andrade & De Oliveira (2014); Cadez & Czerny (2016)

AUTOMOTIVE SECTOR Solaymani (2019); Hawkins et al. (2012)

UPHOLSTERY MATERIALS Yacout & Hassouna (2016); Schweimer & Levin (2016)

SUSTAINABLE SUPPLY CHAIN MANAGEMENT AND THE POWER OF COLLABORATION

Pagell & Wu (2009); Beske & Seuring (2014); Ghadge et al. (2019)



Navarro et al. (2020); Joseph et al. (2009)

Leather LCAs

Coproduction

Ecodesign

Boks (2006); Bonou et al. (2016)

Bremer & Meisch (2017)

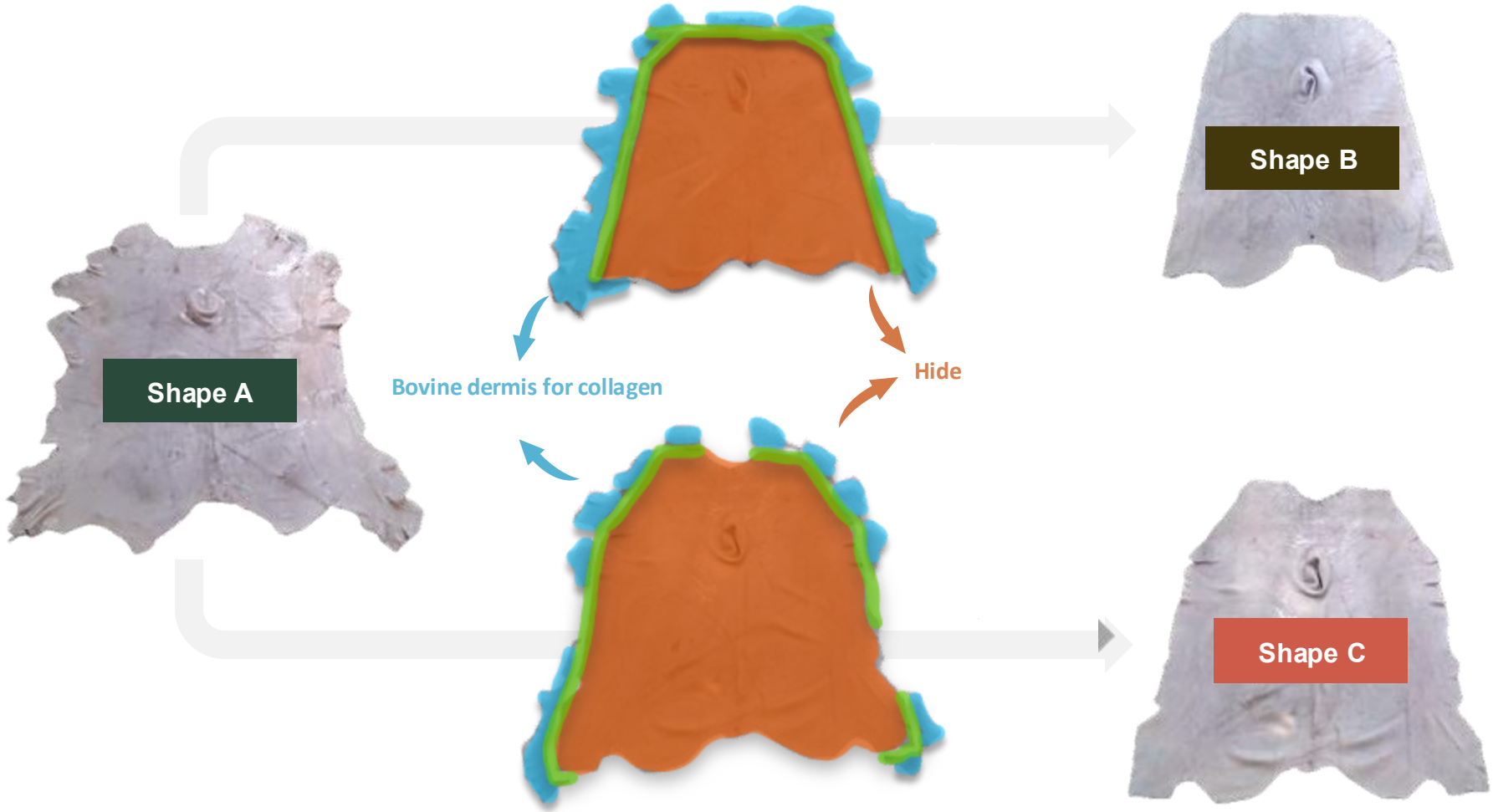
Hypothesis and Objective

Hypothesis

Lower emissions from the use of **leather in the automotive supply chain** can be achieved through **design interventions** on bovine hides **before their conversion into leather.**

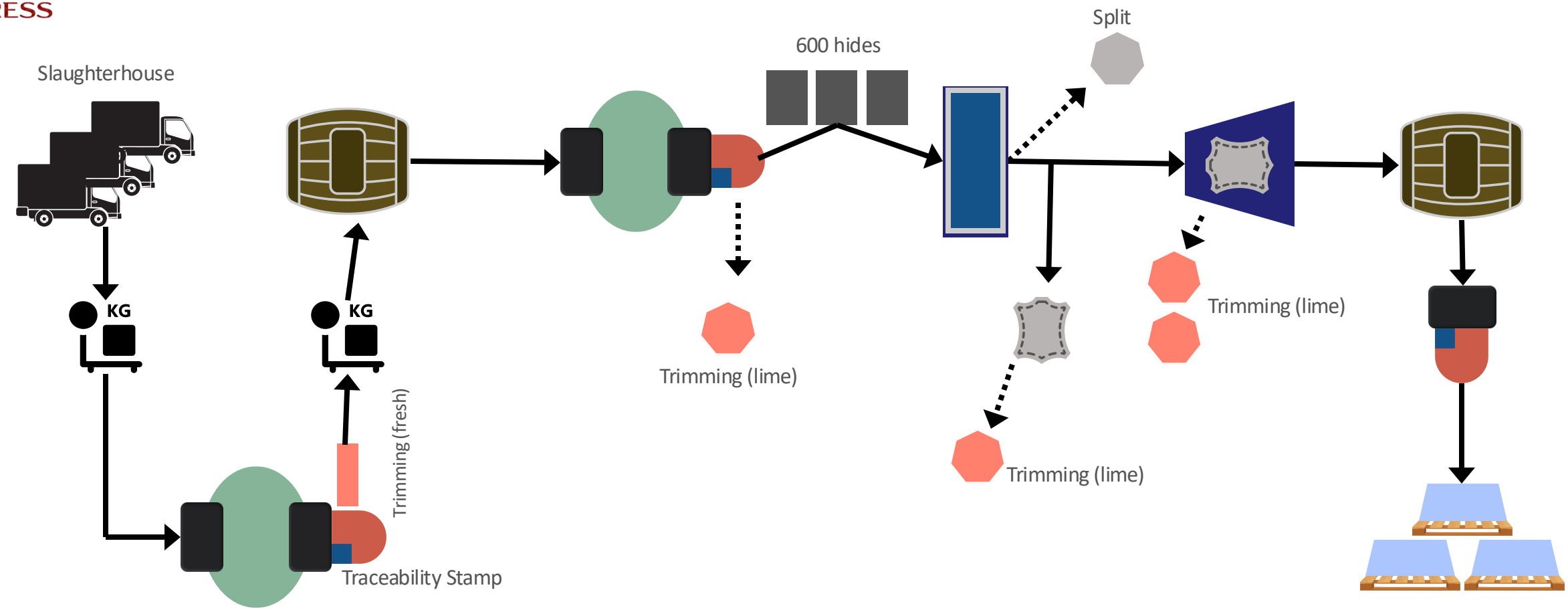
Objective

Analyze the **relationship** between **cutting yield** and the performance in terms of **global warming potential (GWP)** of different leather shapes.



Methodology

Beamhouse



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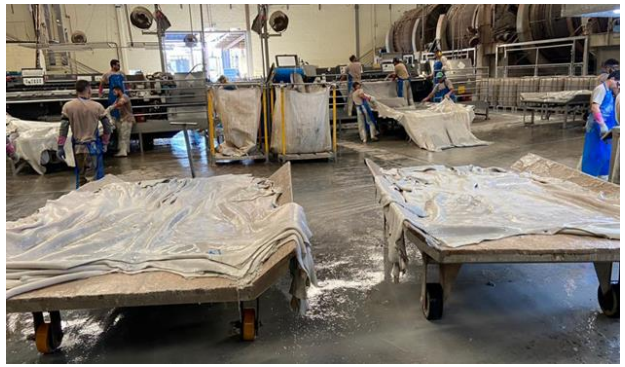


Separation of sample groups

Trimming (lime)

Numbering of hides

Methodology

Lime Trimming

Shape A

Shape B

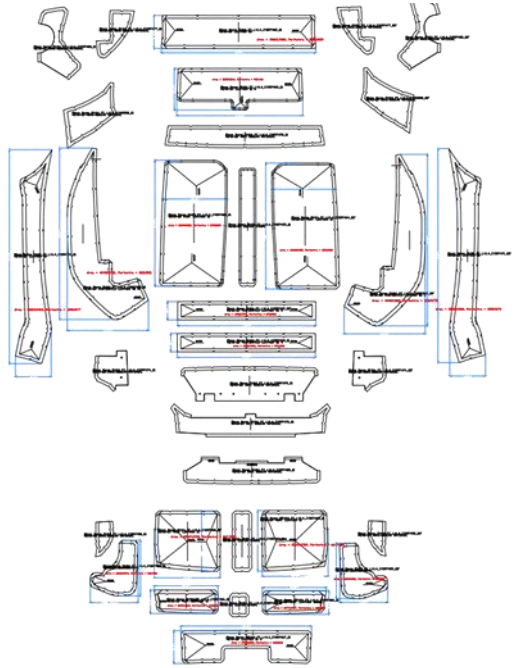
Shape C

Methodology

Scanning and Cutting

Parts of the Kit

1. Left front backrest
2. Right front backrest
3. Left front seat
4. Right front seat
5. Complete rear seat
6. Left rear backrest
7. Central rear backrest
8. Right rear backrest



Statistical Tests

1) Kruskal-Wallis Test

p-value = 8,77E-33

H_0 = No difference in medians

H_1 = At least one group differs

2) Dunn Test

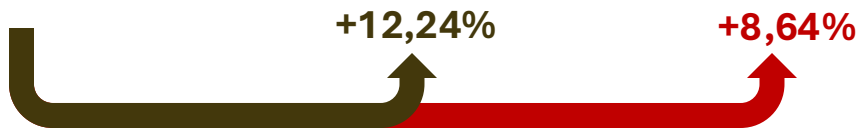
Group 1	Group 2	p-adj
A	B	1.56e-27
A	C	5.61e-23
B	C	1.00e+00

p-adj < 0.05: Medians between groups are significantly different

Results

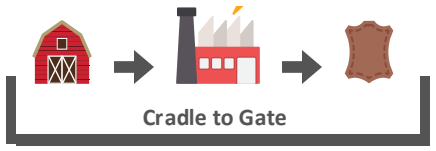
Coproduction Rate

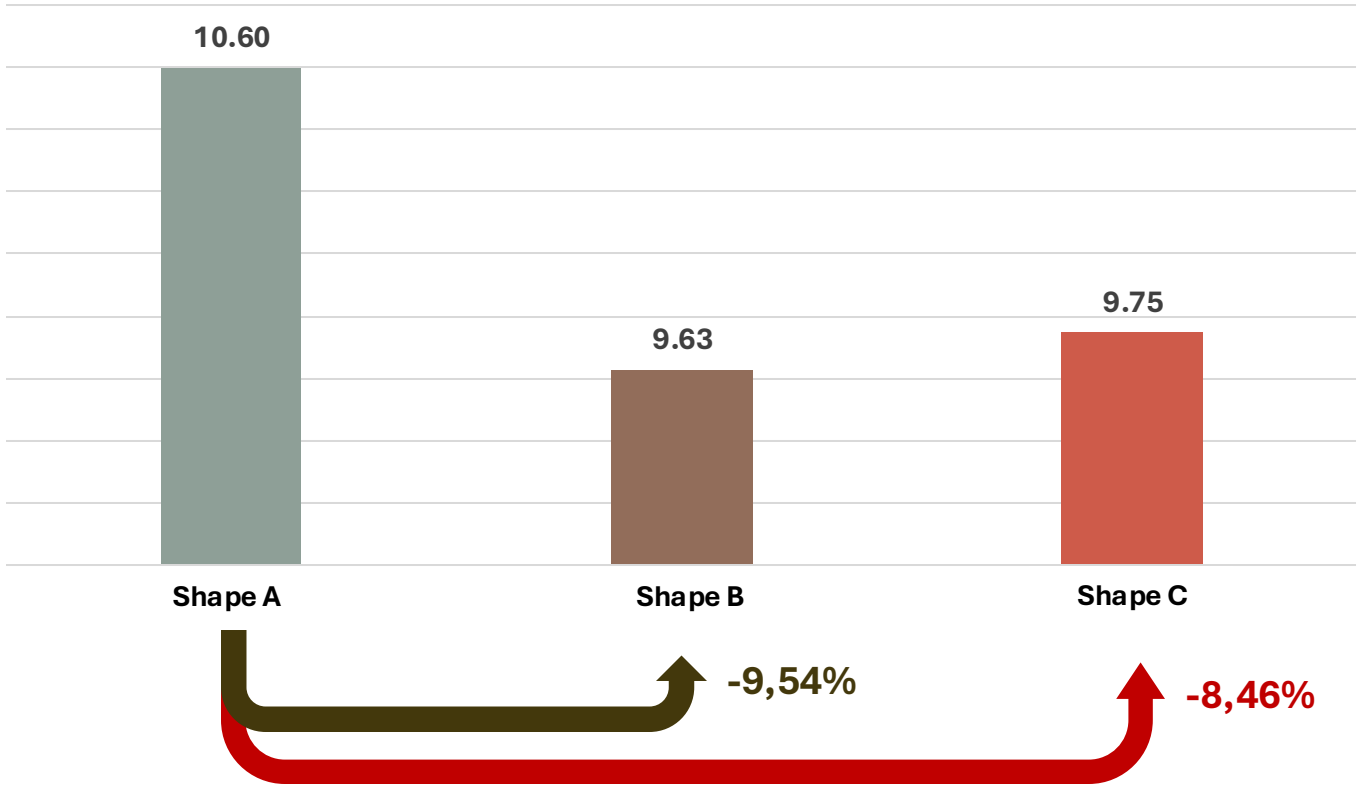
	Shape A		Shape B		Shape C	
	Gross Matter (kg)	Dry Matter (kg)	Gross Matter (kg)	Dry Matter (kg)	Gross Matter (kg)	Dry Matter (kg)
Fresh Hide	48,48	16,69	48,48	16,69	48,48	16,69
Total Coproducts	37,99	11,52	43,82	12,93	43,5	12,51
COPRODUCTION RATE	78,36%	69,01%	90,39%	77,46%	89,72%	74,97%



Results

Global Warming Potential





Results

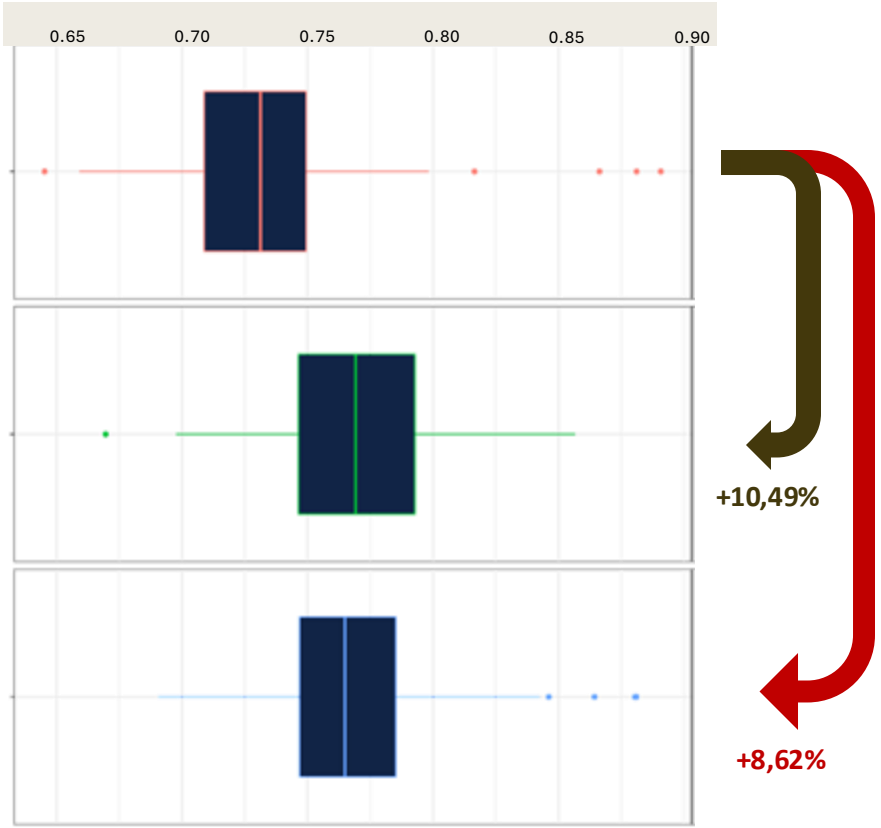
Cutting Yield

$$Cutting\ Yield = \frac{Net\ Surface\ Area(m^2)}{Gross\ Surface\ Area\ (m^2)}$$

Shape A

Shape B

Shape C

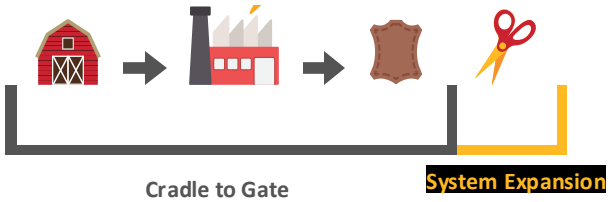


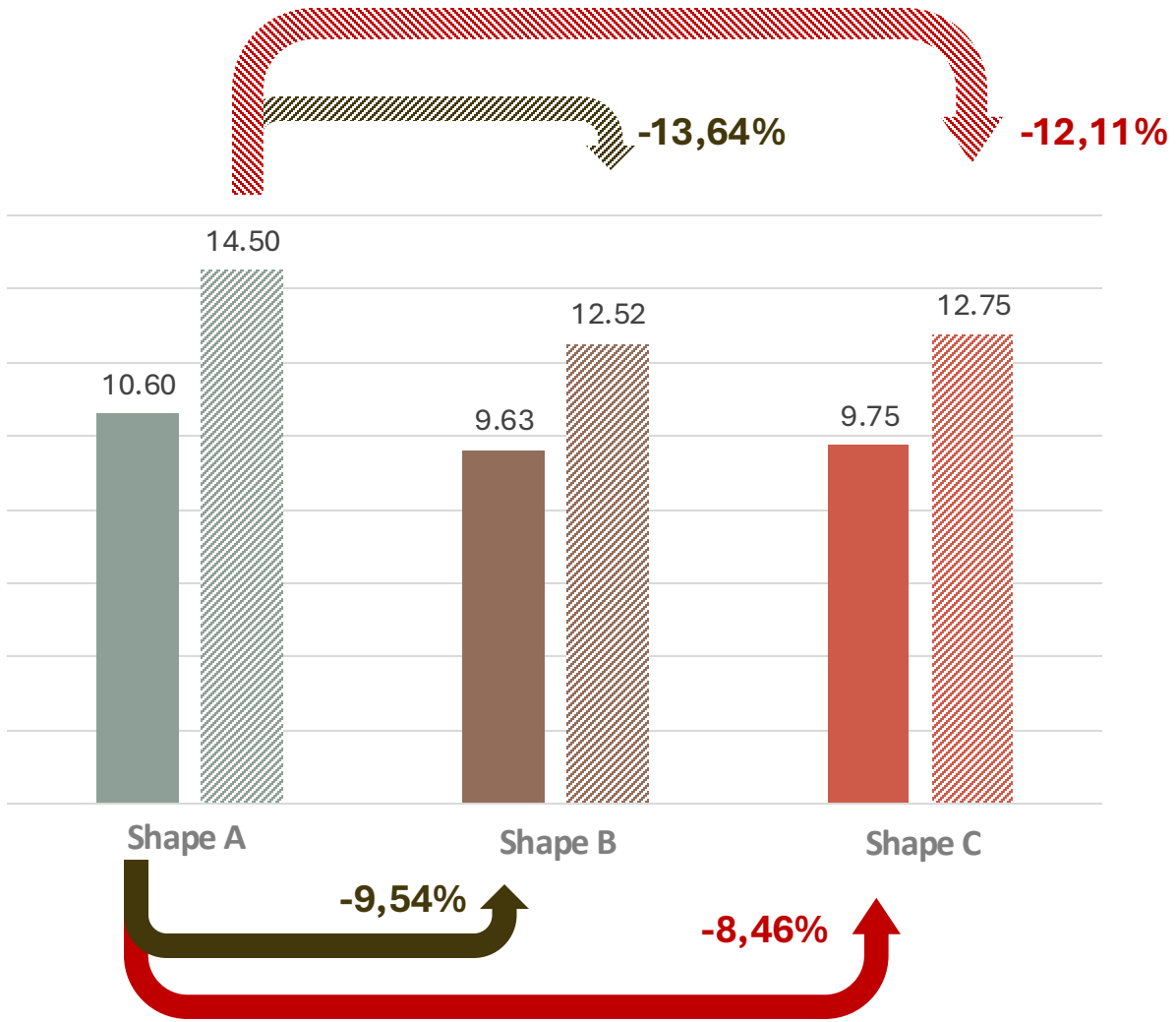
Results

Global Warming Potential – System Expansion

$$GWP100_{exp} = \frac{GWP100}{Cutting\ Yield}$$

	Cutting Yield (m^2 net / m^2 gross)
Shape A	0,731
Shape B	0,769
Shape C	0,765





Results

Global Warming Potential – System Expansion

	Measurement Unit	Shape A	Shape B	%	Shape C	%
Raw Material	kg/m^2	3,38E+00	2,95E+00	-13%	3,00E+00	-11%
Allocated Water	l/m^2	7,21E+01	6,36E+01	-12%	6,57E+01	-9%
Thermal Energy	kWh/m^2	3,03E+00	2,79E+00	-8%	2,75E+00	-9%
Electrical Energy	kWh/m^2	2,27E+00	2,37E+00	4%	2,20E+00	-3%
Chemical Products	kg/m^2	2,02E+00	1,89E+00	-6%	1,90E+00	-6%
Transportation	tkm/m^2	7,53E+00	7,39E+00	-2%	7,40E+00	-2%
Emissions to Water	g/m^2	1,76E+02	1,61E+02	-8%	1,64E+02	-7%
Waste	kg/m^2	1,85E+00	1,50E+00	-19%	1,69E+00	-9%
Effluent	l/m^2	6,44E+01	5,69E+01	-12%	5,87E+01	-9%

Future

- Explore the impact of ecodesign on leather produced with alternative tanning methods.
- Study the impact for leather used in **other sectors**.
- Investigate the effect of involving **automotive seat designers** in the hide ecodesign process.
- Measure how **traceability and process governance** can ensure the involvement of the necessary stakeholders for decision-making that results in lower environmental impact across value chains.