LIFE2015/ENV/PT/609

ENVIRONMENTAL CONSIDERATIONS ON MSW COLLECTION: A LOCAL CASE OF STUDY THROUGH LCA APPLICATION

Álvaro Fernández Braña[1,2], Gumersindo Feijoo Costa[2], Célia Dias Ferreira[1,3]

1) Research Centre for Natural Resources, Environment and Society (CERNAS), Polytechnic Institute of Coimbra
2) Department of Chemical Engineering, University of Santiago de Compostela
3) Materials and Ceramic Engineering Department, CICECO, University of Aveiro

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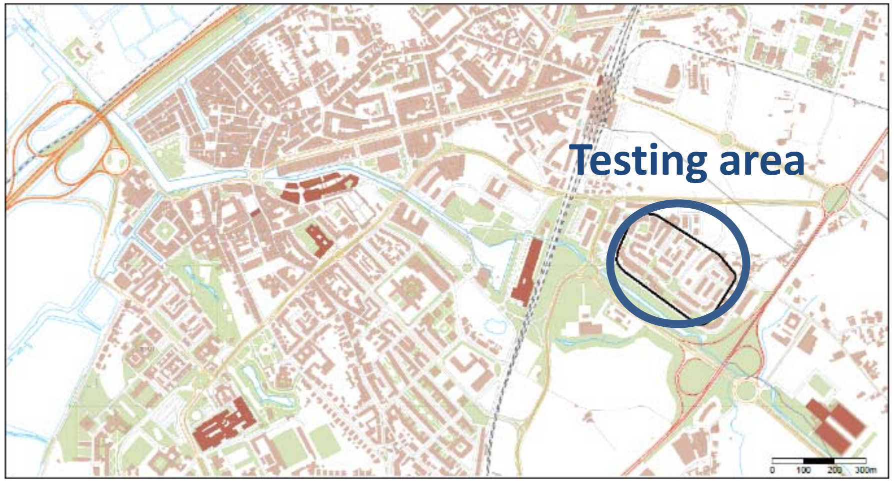
Case of study

- Life cycle assessment of residual MSW collection in the city of Aveiro (Portugal)
  - Located in Atlantic coast
  - Medium sized city in Portugal: 80,000 inhabitants
  - Industrial, trade, academic and touristic hub

Case of study

- The city is currently interested in a transition towards a *pay-as-you-throw* pricing scheme for mixed MSW collection.
- A neighbourhood (Forca Vouga), separated from main urban core, was designated as pilot testing area.



- Residential area: roughly 1200 inhabitants, mainly young medium-income families. There are also some shops, offices and bars / cafes

Goal and scope

- Prior to the implementation of the new policy, a thorough assessment of the waste management environmental performance is required in order to set a starting baseline.
- This study represents the first part of the environmental assessment, encompassing only the residual MSW collection system.
- **Environmental impacts of residual MSW collection system were analysed for a one year timeframe.**

Goal and scope

- The selected functional unit corresponds to the **annual production of residual MSW** in the neighbourhood.
- During four days, the daily residual MSW generated were collected by a single vehicle and weighted.
- The experimental values were then extrapolated to a whole year generation. Historical data records were requested from the municipality to take into account weekly and monthly variations.

- Result: **347 tonnes MSW per year** (estimated density: 75 kg/m³).

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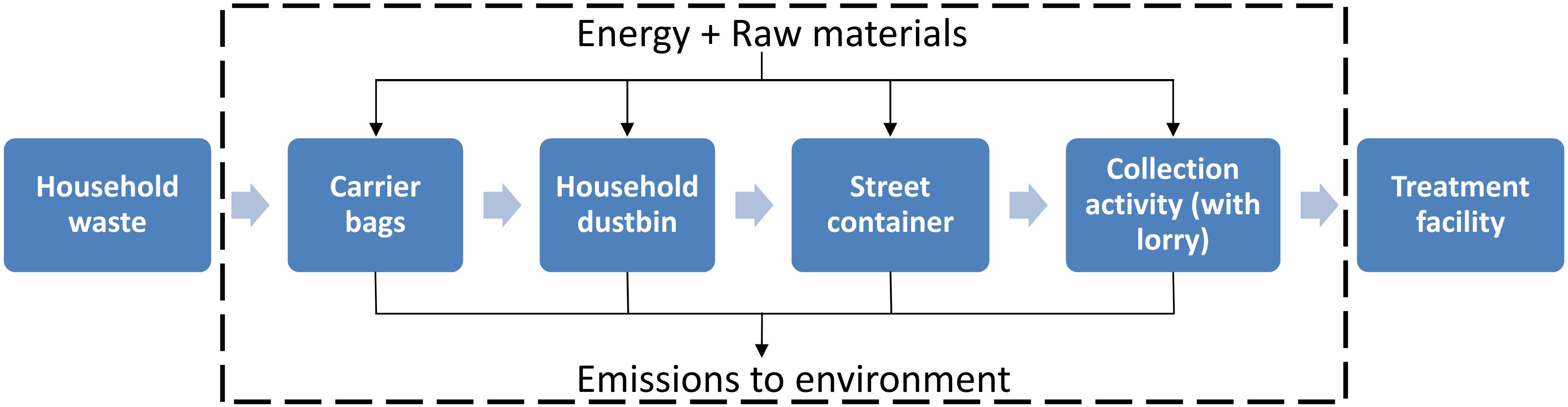
Goal and scope

- The residual MSW collection process was disaggregated into its main constituent elements to allow separate analysis.
- Definition of the studied system with boundaries:



Life cycle inventory

- Data concerning MSW collection process were obtained from the municipality of Aveiro at whole city level, and then adapted to the scale of the studied neighbourhood.
- All other information relative to raw materials, production processes and pollutant emissions associated to the elements previously described was obtained from the respective producers and reference lifecycle databases, namely ecoinvent 3.3 .

Life cycle inventory

Unit process	Weight per unit	Units per FU	Lifespan	Materials	Amount per FU
Carrier bags (30L)	8.7 g	154,222	----	HDPE	1370 kg
Household bins (30L)	0.75 kg	776	7 years	PP	83.6 kg
Street containers (800 L) 	43 kg	26	14 years	HDPE	70.3 kg
				Steel	8.2 kg
				Aluminium	1.0 kg
				Rubber	2.5 kg

- 23% of carrier bags is assumed to be recovered for recycling, while the rest is landfilled

Life cycle inventory

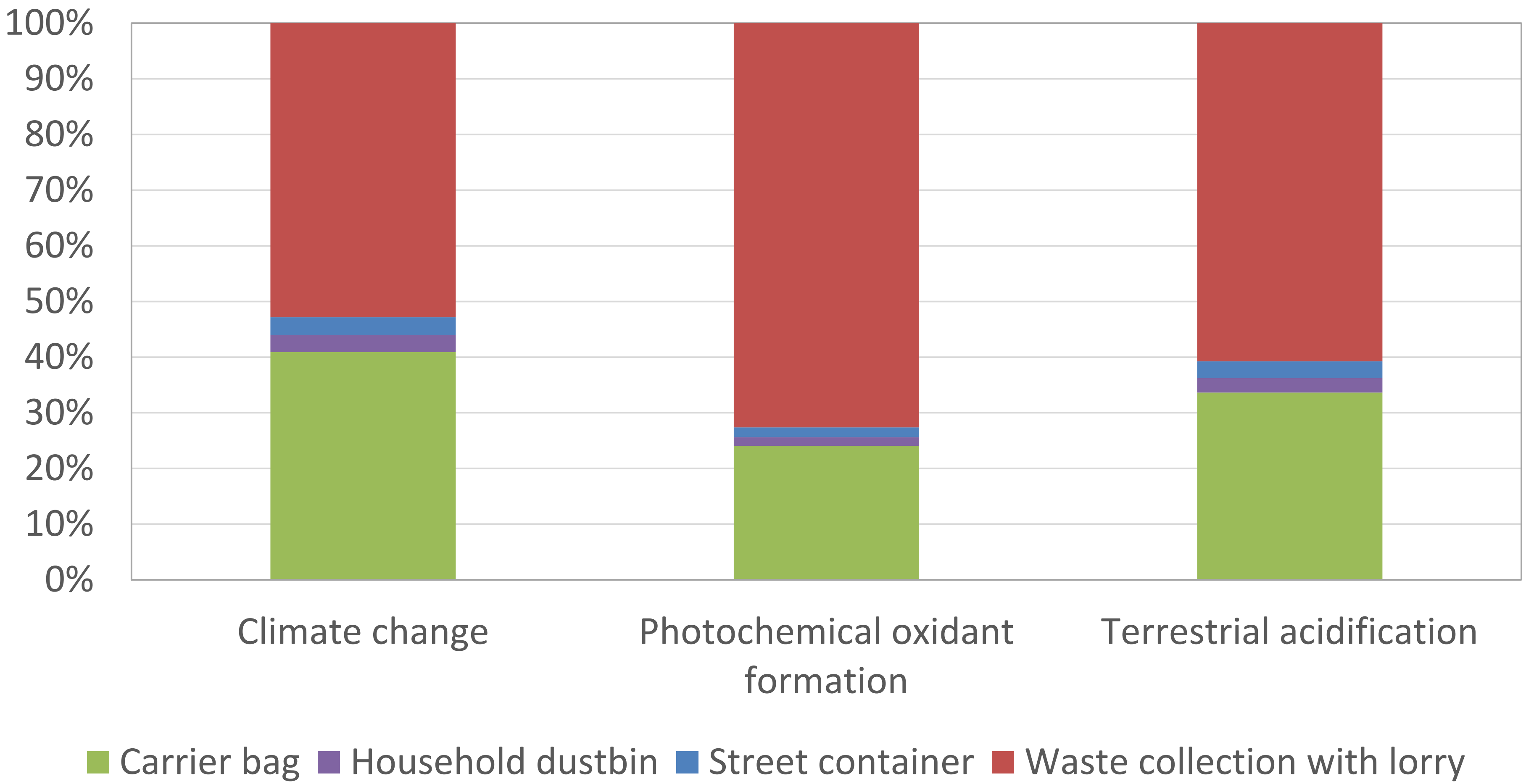
Unit process	Components	Consumption rate	Amount per FU
MSW collection activity	Collection lorry	$2.53 \cdot 10^{-6}$ parts/tonne	$8.78 \cdot 10^{-4}$ parts
	Diesel fuel	4.2 L/tonne	1457 L
	Transport distance	5.6 km/tonne	1943 tkm

- The inventory of emissions from ecoinvent 3.3 was adapted according to the actual consumption rates in this case.
- Indirect emissions were calculated following the EMEP/EEA guidelines

Methodology

- The impact assessment was performed using the commercial software SimaPro version 8.2.0.
- The impact assessment method chosen was the ReCiPe Midpoint (Hierarchist) version 1.12.

Results



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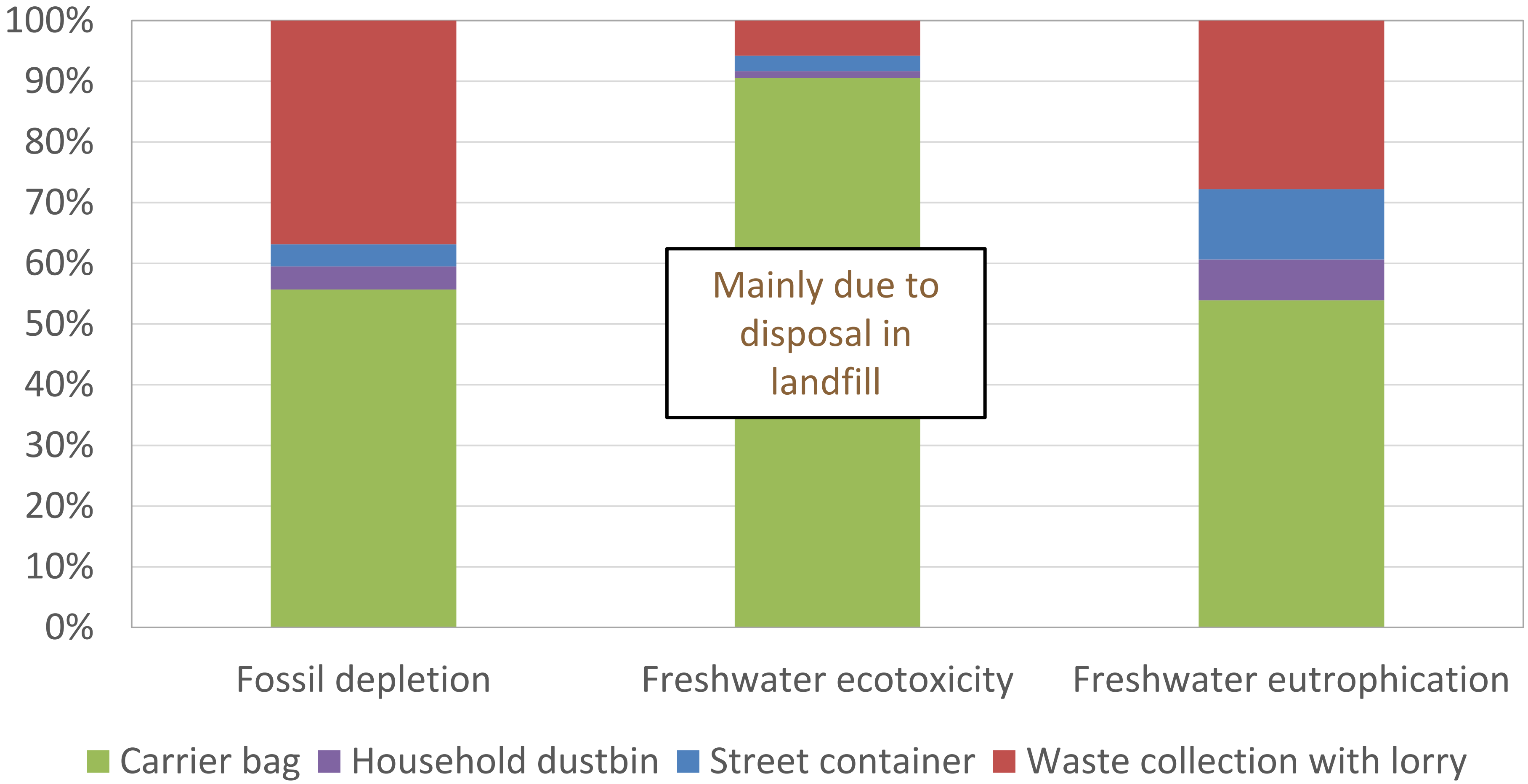
Results



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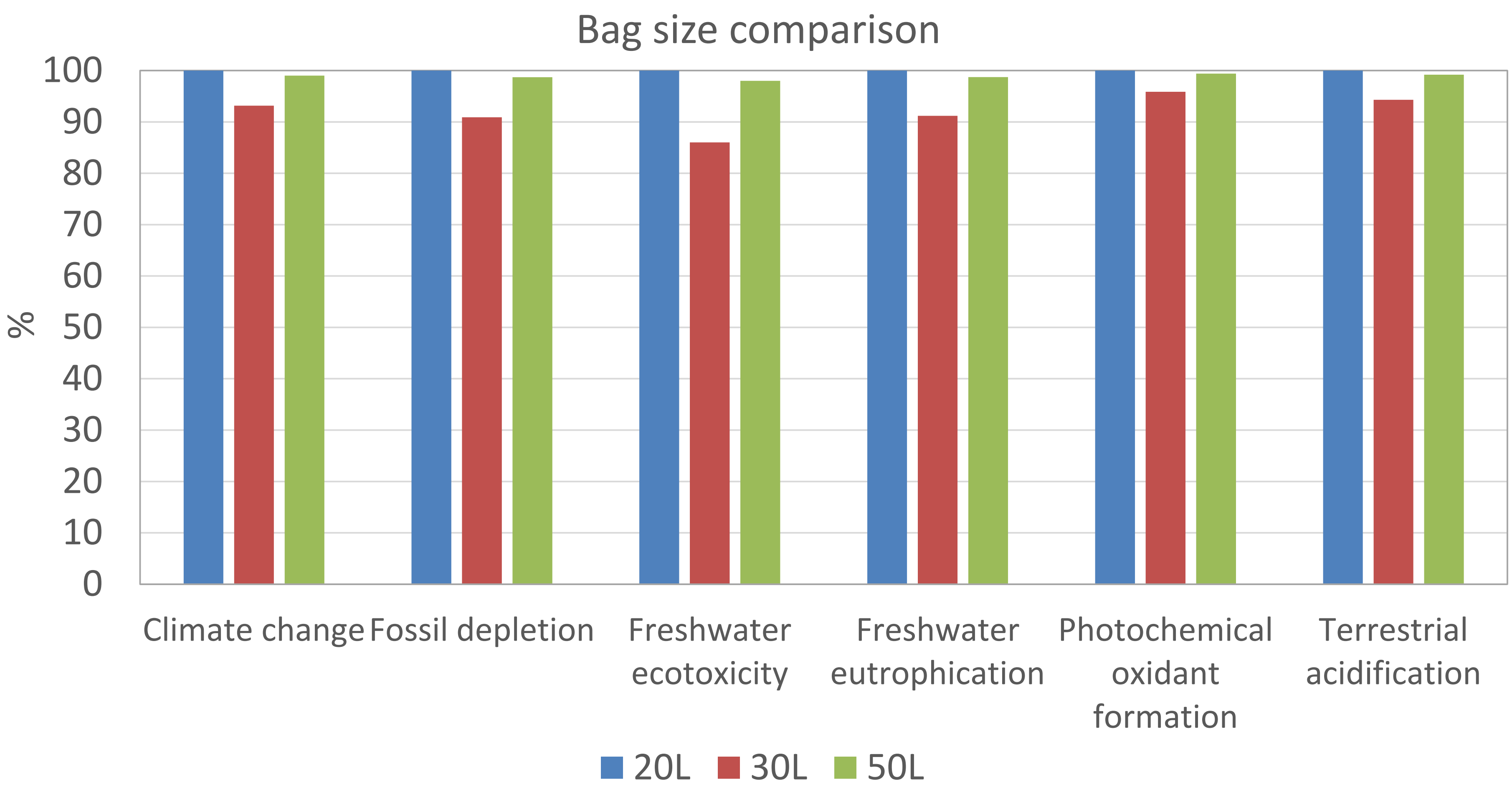
Results

- Three examples of household waste carrier bags of common sizes were compared: 20L, 30L and 50L.
- Weight of each bag varied with size:
  - Bag 20L: 7.0 g
  - Bag 30L: 8.7 g
  - Bag 50L: 17.0 g

Results



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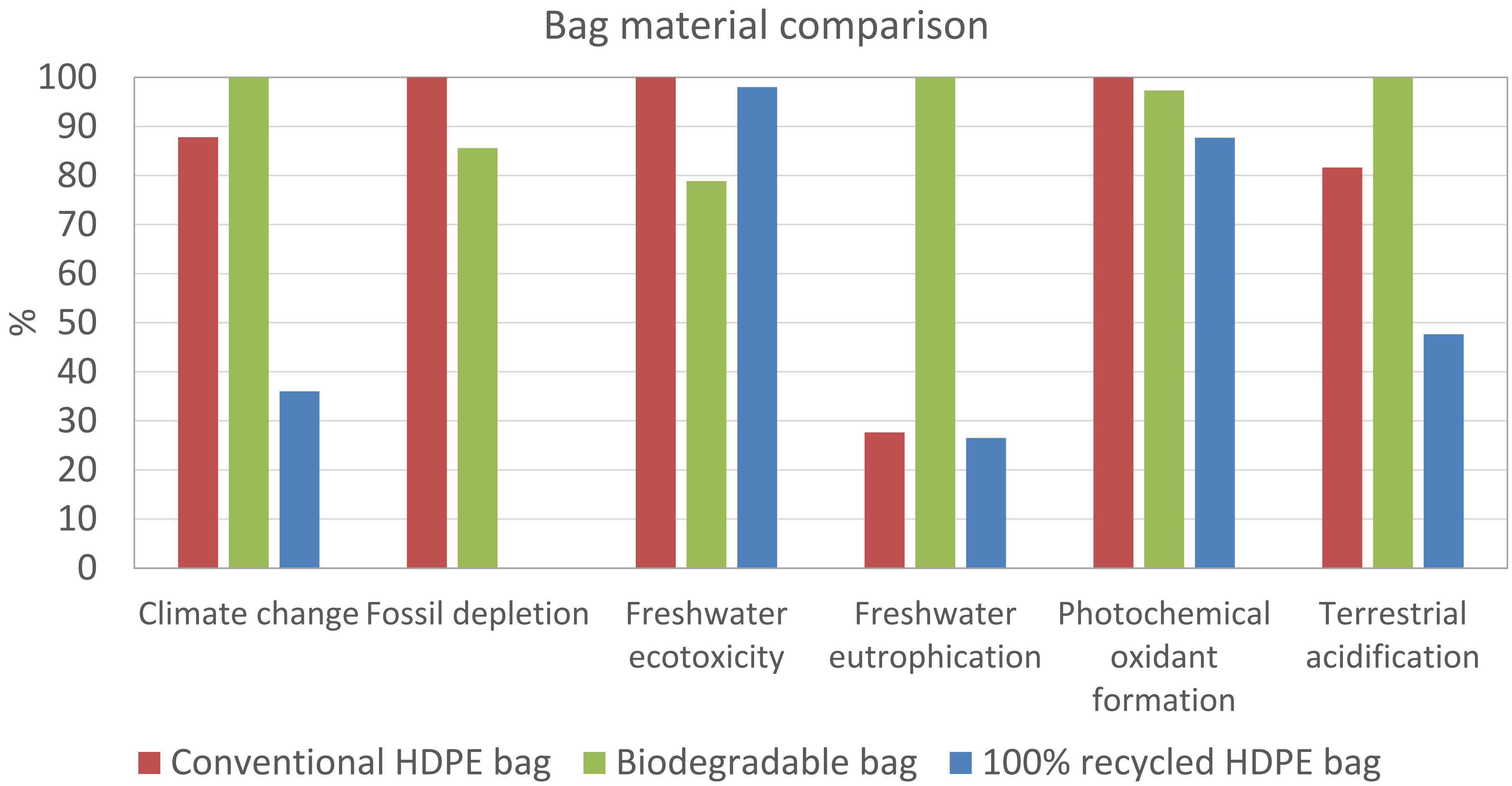
Results

- Three alternative raw materials for household waste carrier bags were also compared:

Type of bag	Material	Capacity (L)	Weight (g)	End of life	Biodegradability (in 100 years)
Conventional HDPE bag	HDPE	30	8.7	23% recycling 77% landfill	~0%
100% recycled HDPE bag	HDPE (recycled)	30	8.7	23% recycling 77% landfill	~0%
Biodegradable bag	Starch-polyester bioplastic	25	10.9	100% landfill	27%

Results



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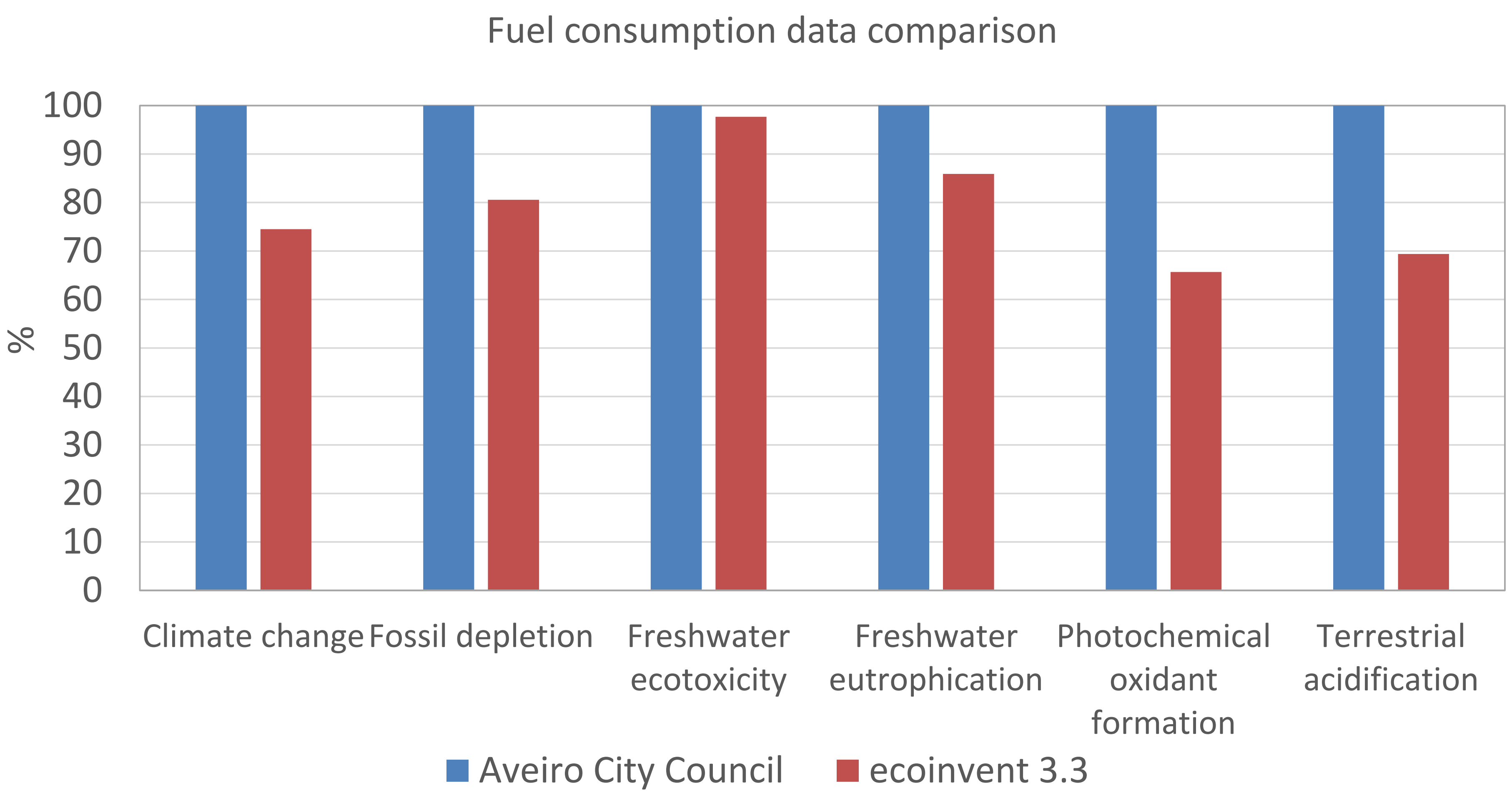
Results

- The fuel consumption rate provided by the municipality was compared with the reference given in ecoinvent 3.3 database to check the influence of this parameter:

Results



Fuel consumption data comparison
%
100
90
80
70
60
50
40
30
20
10
0
Climate change
Fossil depletion
Freshwater ecotoxicity
Freshwater eutrophication
Photochemical oxidant formation
Terrestrial acidification
Aveiro City Council
ecoinvent 3.3

Conclusions

- The use of conventional HDPE plastic bags for household waste collection and transport might lead to relevant environmental impacts, they are even the highest contributor in some categories.
- Impacts from bags are mainly due to the consumption of non-renewable raw materials for production and to environmental consequences of their landfilling.
- Even though there are collection schemes which skip their use, there is not a clear alternative to replace plastic bags with the same hygienic advantages. Notwithstanding, enhancing their recycling seems a suitable way to reduce impacts.

Conclusions

- Along with plastic bags, diesel fuel consumption is the other major source of environmental concern in MSW collection.
- Fuel consumption is found to be highly related to the site-specific conditions of each location. Therefore, it is recommended to gather local based data when possible.
- Switching to cleaner fuels, or to electric driven vehicles, might be an alternative to reduce the environmental impact of vehicles. Nevertheless, the optimisation and reduction of excessive collection frequencies should be the first option to explore.

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Álvaro F. Braña
alvaro.branha@esac.pt

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