

Life Cycle Assessment (LCA)

Focusing on the climate impact of
Paxxo's Longopac Maxi & Mini cassettes and
traditional waste bags



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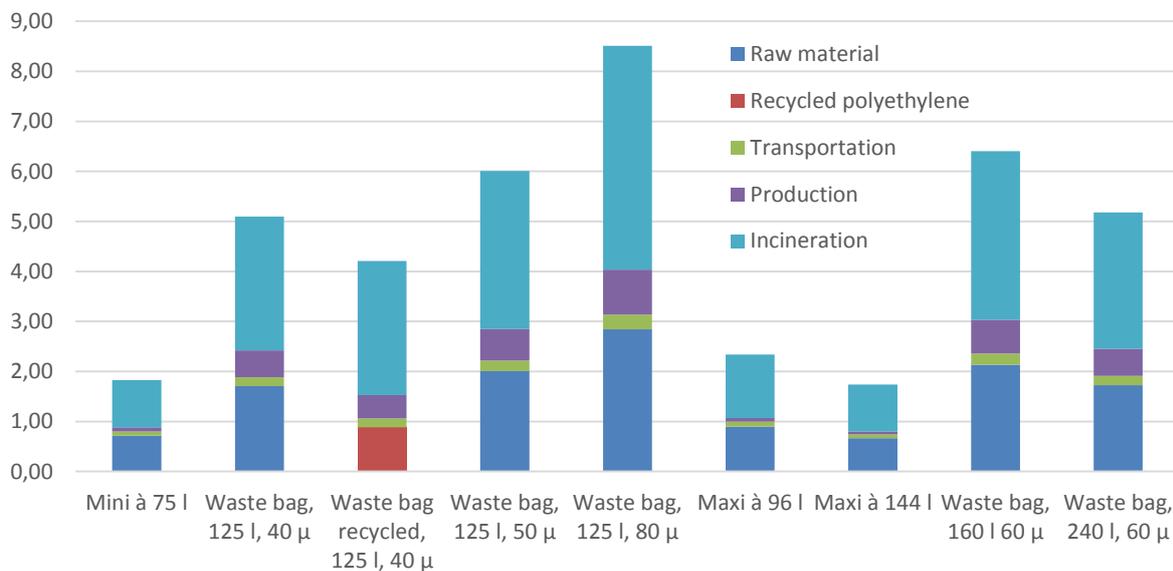
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Summary

The analyzed products are Paxxo's Longopac Maxi and Longopac Mini bag cassettes, which are compared to six traditional waste bags with different thicknesses and volumes. Maxi and Mini are made of Medium Density Polyethylene (MDPE) and the traditional waste bags of Low Density Polyethylene (LDPE).

The functional unit (FU) is storage of 1000 liters of waste and the study takes into account all processes from cradle to grave, i.e. from extraction of raw materials to end-of-life. The base scenario occurs in Sweden, with incineration as the end-of-life process. All traditional waste bags are assumed to have a fill grade of 60% to represent the general practice of using such bags.

The resulting total climate impact per 1000 liters of waste of the analyzed products is as follows ('μ' represents the unit for a millionth of a meter relating to the thickness of plastic film):



If the Longopac Mini is compared to a 125 L traditional waste bag, its carbon footprint is 2.8 times lower than 40 μ bag, and 2.3 times lower than a recycled bag of the same properties. Even though the Mini is only 18 μ thick, its composition still makes it stronger than a 80 μ bag, which has 4.7 times higher carbon footprint than the Mini. If the Maxi is replaced with the same frequency as a traditional 160 L 60 μ bag (i.e. at 60% fill grade), hence storing the same volume of waste, its carbon footprint is 2.7 times lower. If the Maxi is simulated to be exchanged less often, holding 144 L of waste per bag, the Maxi obtains a 3 times lower carbon footprint than the 240L 60 μ bag holding 144 L. Similar to the Mini, the Maxi is still stronger than a traditional waste bag.

The major reason for a lower climate impact from Maxi and Mini compared to traditional waste bags is the lower weight of Polyethylene per volume of waste, which is a result of a better fill grade and thinner plastic film. These advantages reduce emissions at both extraction and processing of raw materials as well as during the incineration of Maxi and Mini.

The main climate impact from all the products derives from the incineration of polyethylene. Raw material extraction was generally the second most significant proportion of the climate impact during the products' life-cycle, whereof polyethylene constituted for the major impact compared to the smaller quantities of other materials composing the products.

Goal

The reason for carrying out this study is to calculate the climate impact of Paxxo's two waste solutions, Longopac Maxi and Mini, and to compare the results with traditional waste bags.

Scope

The following products are analyzed:

- Longopac Maxi and Longopac Mini cassettes
- Traditional waste bags (125 L 40/50/80 μ , 160 L 60 μ , 240 L 60 μ)
- Traditional waste bag, 100% recycled material (125 L 40 μ)

Description of Paxxo's products



The waste system consists of a bag holder, Longopac Stand, on which the waste bag cassettes are mounted. The bag holder comes fitted to two sizes of cassettes, the larger version called Longopac Maxi, and the smaller cassette called Longopac Mini. The Maxi holds about 200 liters per bag if filled to its maximum, and Mini holds about 80 liters of waste. The Longopac Stand bag holder is not included in this assessment.

The ancillary bag cassettes Maxi and Mini, consist of an open-ended horizontal folded polyethylene tubing that is pleated/folded into a compact cassette. When filled with waste, the user simply cuts the tube to create a separate bag, which is then sealed using a plastic cable tie, referred to as a clip in this report. On delivery, the cassettes are compact and include a number of plastic clips.

The Longopac bag system is economical, easy to use, efficient and saves time. The design allows for less bag material to be used compared to traditional waste bags.

Product description - Longopac Maxi and Longopac Mini



Longopac Maxi bag cassette

(excl the Longopac Stand bag holder)

- Polyethylene Medium Density (PE MD)
- Flat width of 895 mm, Diameter = 570mm, Length: 110 meters
- Film thickness: 25 μ



Longopac Mini bag cassette

(excl Longopac Stand bag holder),

- Polyethylene Medium Density (PE MD)
- Flat width of 560 mm, Diameter = 357mm, Length: 60 meters
- Film thickness: 18 μ





Polyamide plastic Clips for sealing the tubing into separate bags
Supplied in the package together with the Longopac bag cassette
For Mini 75 per/bag
For Maxi 130 per/bag



Packaging in corrugated cardboard

The functional unit

In LCA:s, the term functional unit (FU) is used to make a fair comparison of two different product systems, in this case systems for waste disposal. Both products should be able to meet the same needs and be related to the same function.

The functional unit (FU) of this study is storage of 1000 liters of waste.

System boundaries

This LCA takes into account all processes of Maxi and Mini from cradle to grave. This includes the extraction of raw material to end-of-life (incineration or landfill). All transportation from raw material production to the final production site at Paxxo are included. Transportation to customers and incineration/landfill are excluded. The base scenario occurs in Sweden, which means that the end-of-life process is mainly incineration. In the Results section below, calculations are also made in a European scenario using European figures for general waste management schemes.

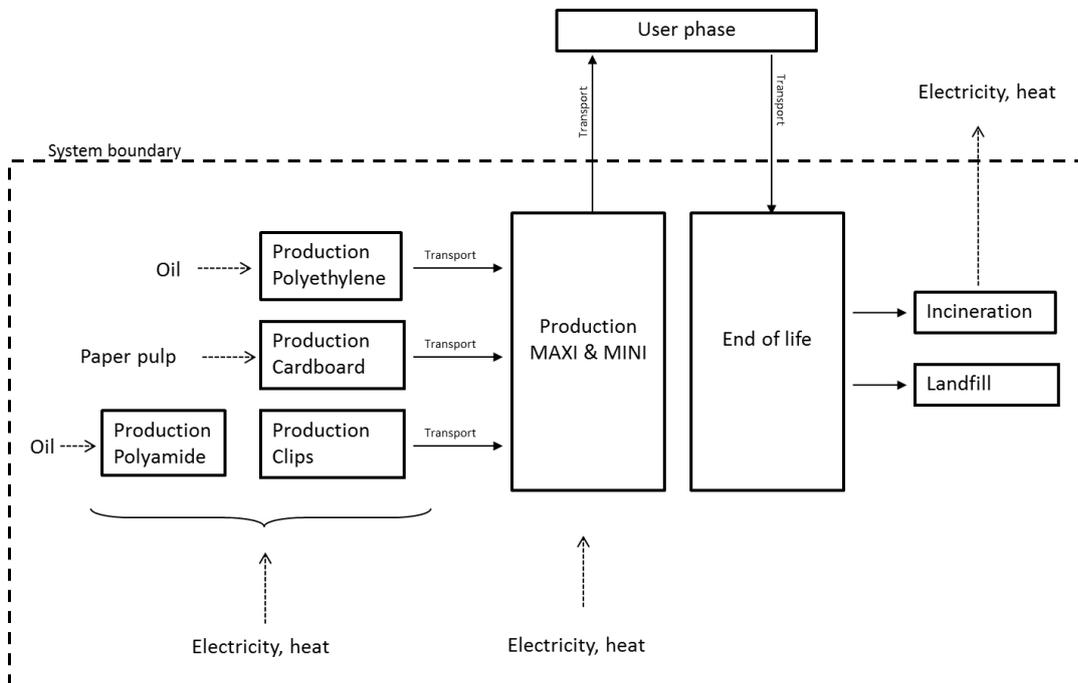


Figure 1. System boundaries for LCA calculations of Maxi and Mini

Assumptions and limitations

The end-of-life of the waste bags is assumed to occur in Sweden. According to the Swedish Waste Management¹, in 2014 only 1% of household waste ended up in landfills, and for that reason the study will assume all waste to be incinerated.

According to the general perception of Paxxo's customers and other people in the industry, the fill grade of the traditional waste bag is assumed to be 60%². To be directly comparable with the traditional bags, Mini is assumed to be filled to the same volumes as a 60% filled 125 L, resulting in 75 L. Maxi is filled correspondingly to a 160 L bag, resulting in 96 L of waste per bag, as well as another scenario for 144 L, corresponding to a 60% filled 240 L bag.

The CO₂ emissions related to the traditional waste bag's packaging are assumed to be the same as the Maxi packaging CO₂ emissions.

Spill-over granulates in Paxxo's production amount to 3%, out of which 75% of the spill-over is reinserted and reused in production. This is incorporated in the LCA.

Longopac Stand bag holders are excluded.

Data collection

LCA data, such as CO₂ emissions and process data, are collected from Henrik Péters, managing director at Paxxo in Malmö, and from the databases:

- Ecoinvent, one of the world's most recognized databases containing environmental data for more than 2000 industrial processes.
- Idemat, a database of The Program Design for Sustainability, School of Industrial Design, Engineering and Production at Technical University in Delft, The Netherlands.
- Database of Plastic Europe, a leading European trade association.

See ANNEX 4 for detailed sources and databases of the input materials.

¹ http://www.avfallsverige.se/fileadmin/uploads/Rapporter/annualreport_2014.pdf

² Confirmed by Henrik Péters, managing director at Paxxo, 2015

Inventory analysis

Quantification of products per functional unit

In order to determine the weight of raw material input per functional unit (FU), 1000 liters of waste, the amount of cassettes or waste bags needed per FU is calculated, see Table 1 below.

Table 1. Number of waste bags needed per FU

	Fill grade	Waste volume per waste bag (liters)	Number of waste bags needed for 1000 liters of waste
125 liters	60%	75	13.3
160 liters	60%	96	10.4
240 liters	60%	144	6.9

To store 75 liters of waste, the required length of Mini amounts to 1.19 m and the length of Maxi needed to store 96 litres of waste is 0.95 m according to Paxxo's measurements. The bag holder for Maxi is however built to store 200 L, more than twice of what the above scenario displays. A second scenario representing Maxi holding 144 liters, using 1.18 m of the cassette per bag, is therefore also shown to give a relative view of the performance of Maxi if utilized at larger volumes. The specific volume of 144 L was chosen to make the scenario comparable to 240 L bags filled to 60%, which is the largest scenario for traditional waste bags in this study. The number of cassettes needed per FU is shown in Table 2 below.

Table 2. Number of cassettes needed per FU

	Fill grade	Waste volume per waste bag (liters)	Number of cassettes needed per FU
125 liters	60%	75	0.29
160 liters	60%	96	0.10
240 liters	60%	144	0.08

When a bag is full, it is separated from the cassette by cutting it loose. The bottom of the next bag is sealed by using a polyamide clip, as illustrated in Figure 2 below. To represent the length of cassette needed to separate a full bag and attach a clip to a new/empty one, two times 0.4 dm is incorporated in the required length of cassette needed per bag

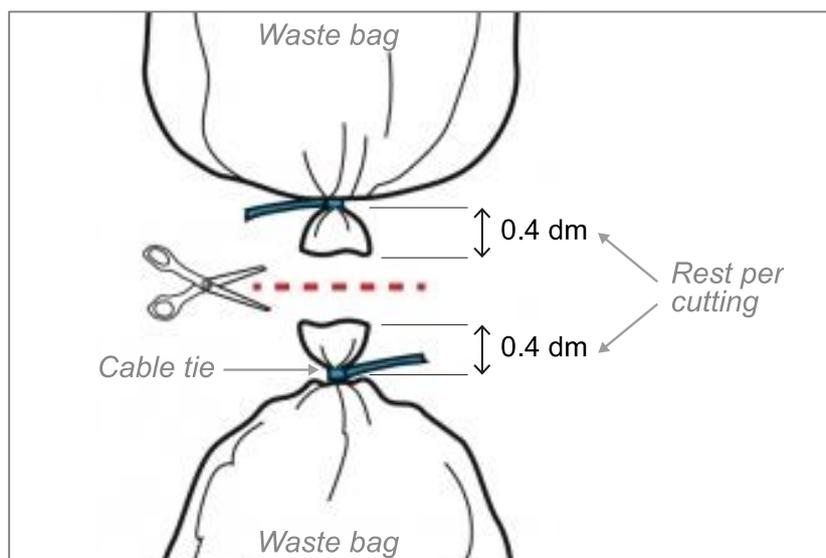


Figure 2. The cutting between two Mini or Maxi waste bags

In order to store 1000 liters of waste, 0.3 Mini cassettes are required, and correspondingly 0.1 and 0.08 Maxi cassettes à 96 liters and 200 liters are needed. The number of separate traditional waste bags needed to store 1000 liters of waste if filled to 60% is the following: 13.3 125 liter bags, 10.4 160 liter bags or 6.9 240 liter bags.

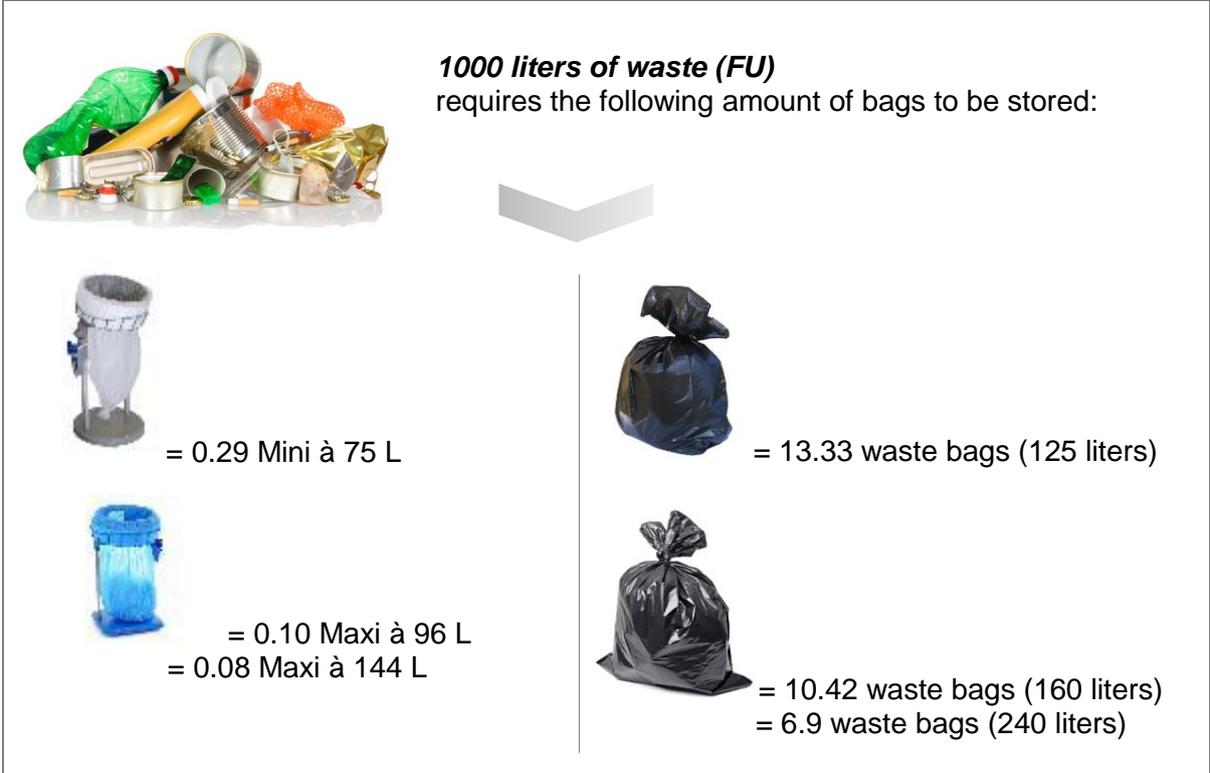


Figure 3. Amount of Mini cassettes, Maxi cassettes and waste bags needed to store 1000 liters of waste (FU)

Maxi and Mini cassettes

Raw material input per FU

Paxxo’s two waste solutions, Maxi and Mini, consist of:

- The cassette in medium density polyethylene (PE-MD)
- Clips in Polyamide, PA66
- Packaging – Corrugated cardboard, single wall, recycled.

See Table 3 below for the raw material quantity per Functional unit used to produce Maxi and Mini:

Table 3. The raw material quantity used to produce Maxi and Mini and the traditional waste bags

	kg material / functional unit (FU)							
	Mini à 75 L	Maxi à 96 L	Maxi à 144 L	Trad. Waste bag 125 L 40 µ	Trad. Waste bag 125 L 50 µ	Trad. Waste bag 125 L 80 µ	Trad. Waste bag 160 L 60 µ	Trad. Waste bag 240 L
Polyethylene PE MD	0,31	0,42	0,31					
Polyethylene LDPE				0,89	1,05	1,49	1,13	0,91
Corrugated cardboard, packaging	0,02	0,01	0,01	0,07	0,07	0,07	0,03	0,03
Polyamide, clips	0,02	0,01	0,01					

Spill-over Paxxo's for Maxi and Mini amount to 3%, out of which 75% is reinserted and reused in production. Hence 0,75% (0,03 x 0,25) PE is added the raw material quantities for Maxi and Mini in Table 3. Spill-over is 0,003 kg resp. 0,002 kg for Maxi resp. Mini.

For detailed weights per cassettes see ANNEX 2.

Production

Maxi and Mini are produced at Paxxo's plant in Malmö. The energy equivalent of 2.57 kWh is required for production of one Maxi cassette. Mini uses 1.02 kWh per cassette. Supporting processes, such as packing and folding, are added with 5%. The total electricity use results in 0.58 kWh/kg for Maxi and 0.93 kWh/kg for Mini.

The emission factor for the Swedish electricity mix of 0.06 kg CO₂/kWh is applied. However, calculations related to emissions associated with traditional bags are based on the Global electricity mix of 0,6 kg CO₂/kWh, since it is assumed that the traditional waste bag is produced in Shanghai, China, with the process of film extrusion.

The reference data shows that electricity consumption during the process of extrusion varies, which can have numerous explanations. According to Paxxo's primary production data, the thinner film for Mini results in a higher ratio for electricity use per extruded weight unit. Since *Plastics of the Environment* refers to Low Density Polyethylene, and Maxi/Mini are Medium Density PE, this implies that the extruded film referred to in *Plastics and the Environment* would be relatively thick to result in a lower kWh/kg compared to Maxi and Mini. There may however be a number of other underlying reasons for the variation of the data, bound to the specifics of the production process. Conclusively, this LCA uses Paxxo's own primary data for electricity consumption, which are shown to be within realistic boundaries compared to other data for PE extrusion processes.

Transportation

Paxxo buys Polyethylene (PE) granulates from large plastic producers. Production of PE takes place at various locations in North and Central Europe. Granulates are delivered in 100%-filled tank trucks (26 tons) 2-3 times per month. In the calculations an average distance of 1345 km has been assumed.

The polyamide clips are delivered in 100%-filled containers by boat from Shenzhen, China.

Packaging material is delivered by truck after being produced about 40 km from Paxxo's production site in southern Sweden.

The traditional waste bags are assumed to be produced in China and shipped to Malmö, Sweden.

See ANNEX 3 for details on distances, calculations and emission factors.

End of life

The base scenario occurs in Sweden. Only 1% of all waste ended up at landfill in 2014, according to the Swedish Waste Management,³ and therefore PE and Polyamide waste is assumed to be incinerated at the end-of-life. According to the Packaging and Newspaper Collection Service,⁴ 77.9% of paper packaging was sent to recycling and the rest, 21.1%, ended up at incineration. The emission factor for recycling of cardboard is neglected in this study due to its minimal effect on the total emissions.

Table 4. The emission factors for Maxi and Mini materials at incineration.

Material	kg CO2/kg	Database
Disposal, packaging cardboard, 19.6% water, to municipal incineration	0.025	Ecoinvent
Disposal, polyethylene, 0.4% water, to municipal incineration	2.99	Ecoinvent
Disposal, Polyamide to municipal incineration	1.7	Eco It

Traditional waste bags

Raw material

The traditional waste bags of varying thickness (measured in the unit 'µ', one in a million, which is usually referred to as an indirect measure of the strength of the material), to be compared with Maxi and Mini, consist of Low Density Polyethylene (LDPE). This report examines both LDPE made from raw materials as well as one recycled product.

The weight of packaging for the 125 L bags is assumed to correspond to that of Mini and the 160 L and 240 L bags to the packaging of Maxi, which is an underestimation due to Maxi and Mini's better utilization of waste per material of bags.

For detailed weights per FU and for weights per waste bag see ANNEX 2.

Production

The traditional waste bag is assumed to be produced in Shanghai, China, with the process of film extrusion. The emission factor for this process is 0.5 kg CO₂/kg PE (Ecoinvent). This emission factor is slightly higher than the emission factor at Paxxo's own production site, which is 0.19 and 0.33 kg CO₂/kg PE for Maxi and Mini respectively.

Transportation

The traditional waste bags are assumed to be transported by boat from Shanghai to Malmö. Transportation from raw material supplier to production site of waste bags is neglected.

End-of-Life

Same as Maxi and Mini.

³ http://www.avfallsverige.se/fileadmin/uploads/Rapporter/annualreport_2014.pdf

⁴ <http://www.ftiab.se/180.html>

Results

Mini à 75 L

The climate impact of Mini cassette per 1000 liter waste is 1.83 kg CO₂. 39% of the impact comes from the extraction of raw materials, 52% comes from the incineration, 5% production and 4% from transportation. 83% of climate impact of the raw material comes from production of polyethylene. Polyethylene makes up for more than 96% of the climate impact related to transportation and incineration respectively, and the distribution of climate impact amongst the three materials is therefore not displayed graphically for these activities.

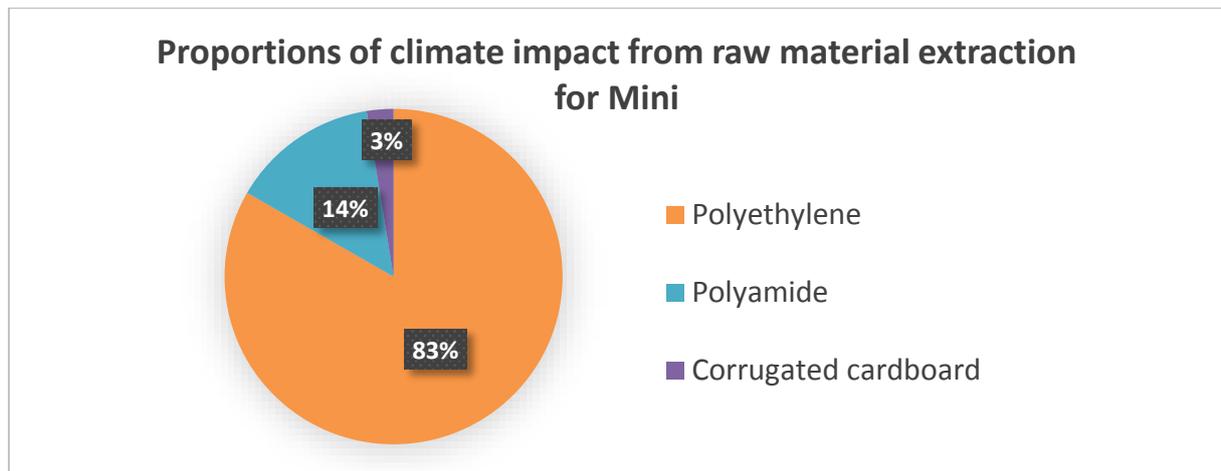


Figure 4. Proportions of climate impact from raw material extraction for Mini

Maxi à 96 L and 144 L

The total climate impact from Maxi (96 L / 144 L) per 1000 liters of waste is 2.4 / 1.74 kg CO₂. The emission from incineration is the main emission source, 54%. Raw materials represent 38.5%, transportation 4.5% and production 3% of total CO₂ emissions. Polyethylene is the main CO₂ emission source (91%) among the raw materials. Similar to the case of Mini, Polyethylene makes up for more than 98% of the climate impact relates to transportation and incineration, and the distribution of climate impact amongst the three materials is therefore not displayed graphically for these activities.

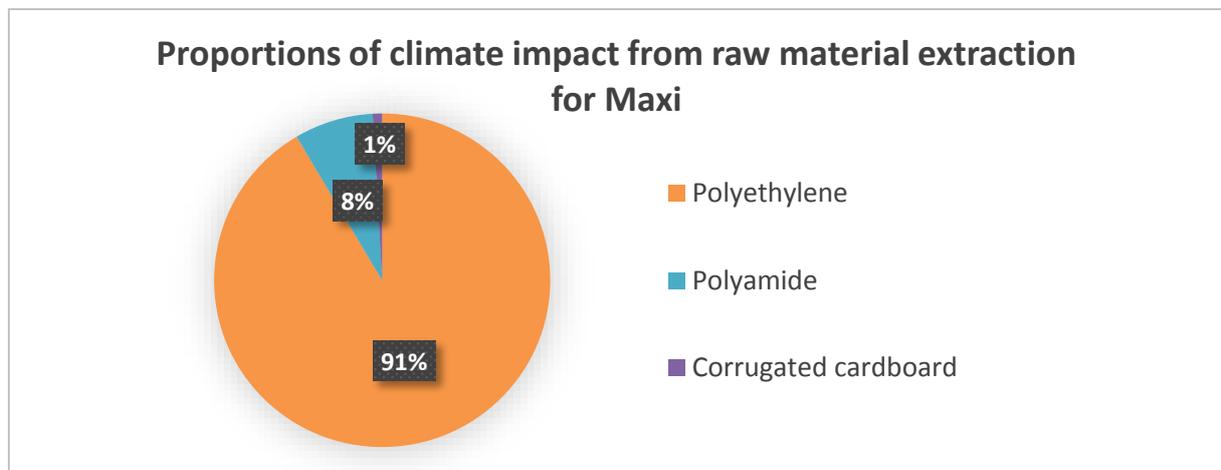


Figure 5. Proportions of climate impact from raw material extraction for Maxi

Traditional waste bags

The total climate impacts from the traditional waste bags made of polyethylene (LD-PE) are:

Table 5. Weight of the waste bags per 1000 liters waste.

	kg CO ₂ /FU
125 liters waste bag, 40 μ, 70 gram	5.3
125 liters waste bag, 40 μ, 70 gram, recycled LDPE	4.3
125 liters waste bag, 50 μ, 80 gram	6.2
125 liters waste bag, 80 μ, 112 gram	8.8
160 liters waste bag, 60 μ, 108 gram	6.6
240 liters waste bag, 60 μ, 131 gram	5.3

The total impact of the 125 liters waste bag is 5.3 kg CO₂, where 36% of the impact comes from raw material, 51% from incineration, 9% from production and 4% from transportation.

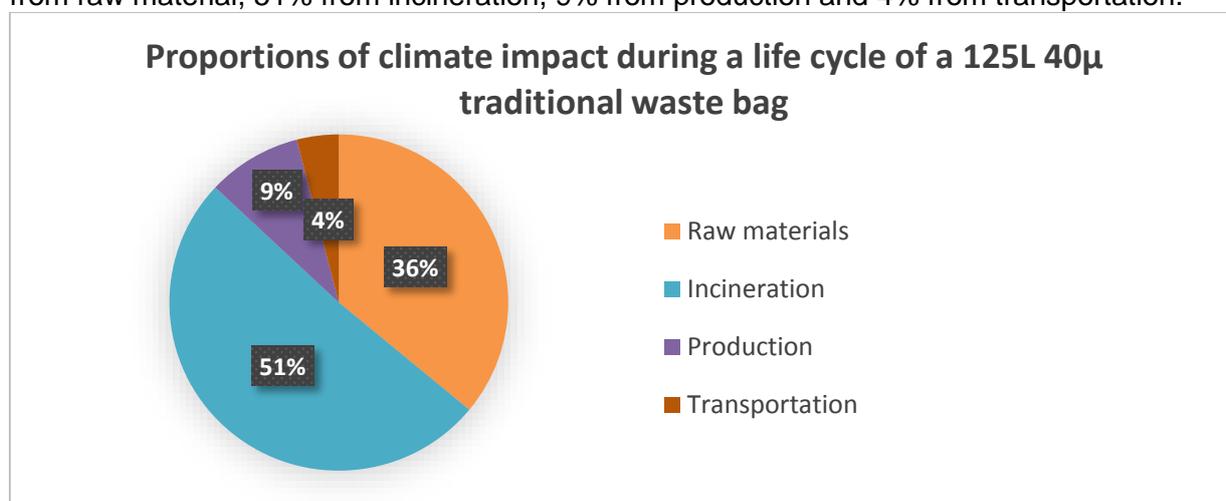


Figure 6. Proportions of climate impact during a life cycle of a 125 L 40 μ traditional waste bag

The total climate impact from a waste bag (125 liters, 40 μ) made of recycled polyethylene is 4.2 kg CO₂ per 1000 liters of waste. 63% of the impact comes from incineration, 20% from production of recycled polyethylene, 11% from production and 4% from transportation. Only 2% derives from the extraction of raw materials, i.e from the production of packaging materials.

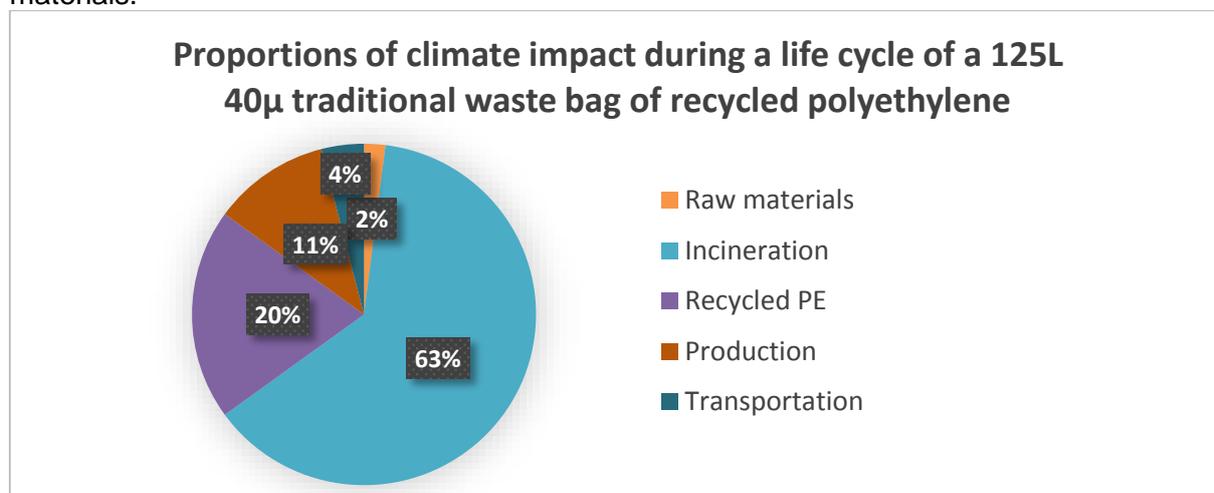


Figure 7. Proportions of climate impact during a life cycle of a 125 L 40 μ traditional waste bag of recycled polyethylene

Summary of results

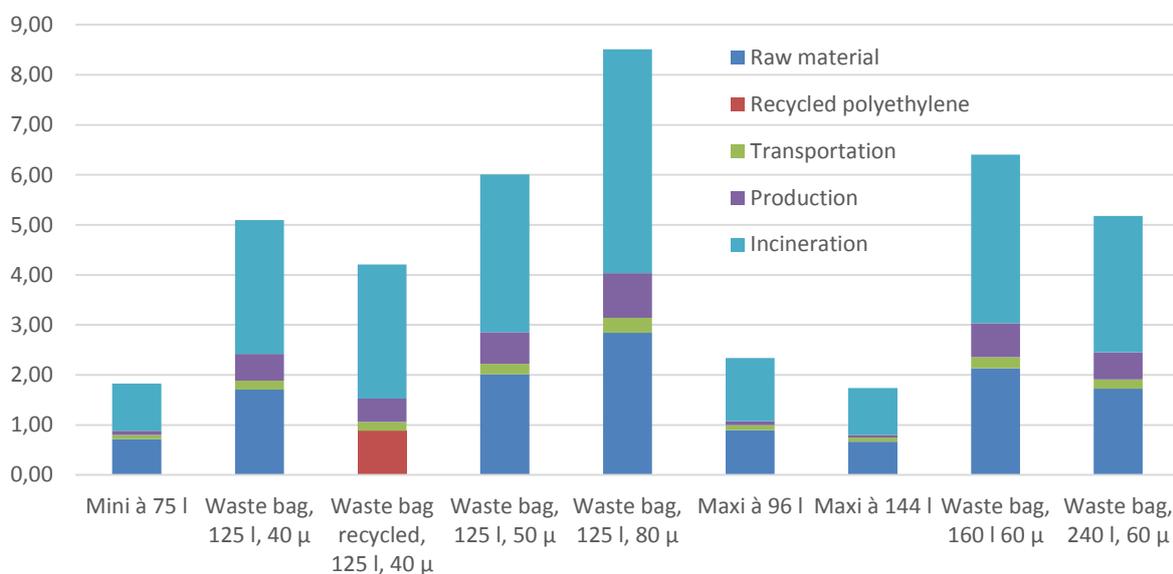
Swedish waste scenario

The total climate impact per 1000 liters of waste of the analyzed products is as follows:

Table 6. Total climate impact per 1000 liters of waste of the analyzed products, Swedish waste scenario.

	kg CO ₂ /FU
Mini à 75 L	1.8
Maxi à 96 L	2.3
Maxi à 144 L	1.7
125 liters waste bag, 40 µ, 70 gram	5.1
125 liters waste bag, 40 µ, 70 gram, recycled PE	4.2
125 litres waste bag, 50 µ, 80 gram	6.0
125 liters waste bag, 80 µ, 112 gram	8.5
160 liters waste bag, 60 µ, 108 gram	6.4
240 liters waste bag, 60 µ, 131 gram	5.2

Figure 8. Total climate impact of the analyzed products.



European waste scenario

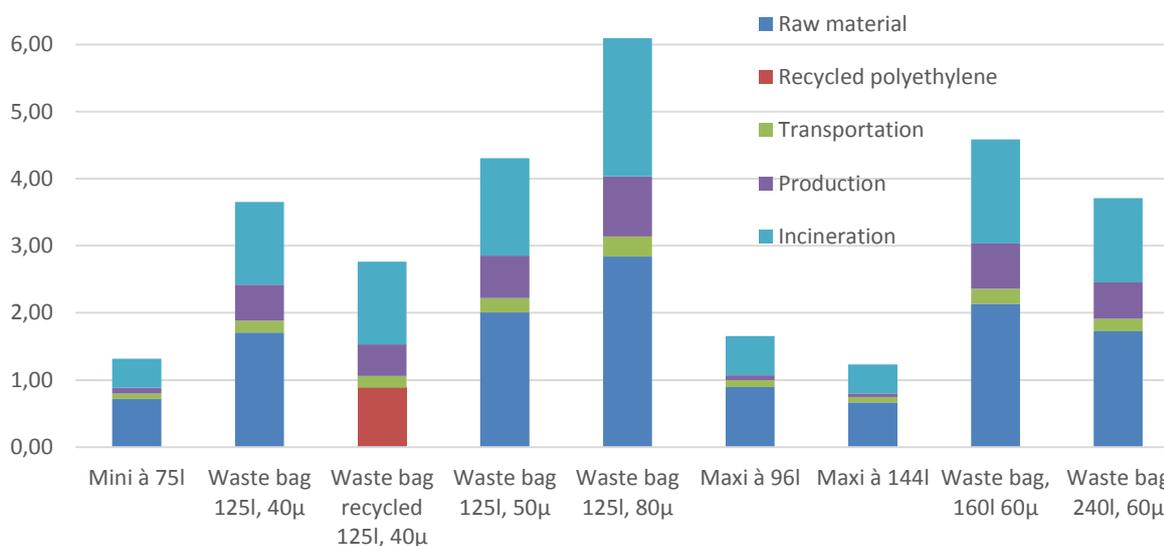
In a European scenario, 31% of the waste bags will end up at landfill, 26% end up at incineration, 15% composted and 28% is recycled⁵. Since no waste bags will be recycled or composted everything goes to landfill or incineration. Which, with the same percentage share, results in 54% to landfill and 46% to incineration.

Table 7 and Figure 9 below display the results of the European scenario for waste treatment. The figures are slightly lower than for the base (Swedish) scenario since the emissions from incineration are higher than for landfill.

Table 7 Total climate impact per 1000 liters of waste of the analyzed products, European waste scenario.

	kg CO ₂ /FU
Mini à 75 L	1.3
Maxi à 96 L	1.7
Maxi à 144 L	1.2
125 liters waste bag, 40 µ, 70 gram	3.7
125 liters waste bag, 40 µ, 70 gram, recycled PE	2.8
125 litres waste bag, 50 µ, 80 gram	4.3
125 liters waste bag, 80 µ, 112 gram	6.1
160 liters waste bag, 60 µ, 108 gram	4.6
240 liters waste bag, 60 µ, 131 gram	3.7

Figure 9. Results in European waste scenario, 54% to landfill and 46% to incineration.



⁵ Eurostat Database on Waste, 2013 - <http://ec.europa.eu/eurostat/data/database>

Conclusion

The main reasons to why Maxi and Mini incur a lower climate impact than traditional waste bags is the lower weight of polyethylene per volume of waste, which is possible due to a better fill grade and thinner plastic film in the Paxxo products. This reduces emissions at both extraction and production of raw material as well as during the incineration of Maxi and Mini. Even when compared to the recycled polyethylene bag, Maxi and Mini incur significantly lower figures on climate impact.

Due to Paxxo's relatively low electricity use at production compared to the Ecoinvent data for film extrusion used for the traditional bag, approximately 0,5 kg more CO₂ per FU is emitted from the production of the traditional waste bag (125 L 40 μ). Conclusively, if using Paxxo's electricity use for extrusion (including packaging and folding) the traditional bags' total carbon emissions only decrease about 6% compared to using Ecoinvent's data.

Due to that Maxi is only filled to half of its potential volume in the 96 L scenario, and hence does not utilize its full circumference to the degree of a Mini bag, the Maxi hence shows a higher carbon footprint than the Mini. The 144 L scenario for Maxi shows that if bags are exchanged less frequently, hence producing larger volumes per bag than in the 96 L scenario, the circumference of the bag is better utilized which results in a lower carbon footprint than for the 96 L scenario. The final result is however that the Mini and Maxi end up obtaining the same carbon footprint. The Longopac Stand Maxi can however be utilized for volumes of up to 200 L per bag, and would hence be the better option when bags are exchanged less frequently.

In the European scenario, the climate impact for all products is lower. The reason for this is that less material end up at incineration in Europe than in Sweden. The CO₂ emission/kg PE is lower for landfill than for incineration.

ANNEX 1

Comparison with other LCA:s of traditional waste bags

A literature review has been performed to gather information to compare and ensure the accuracy the results of the traditional waste bag. In Figure 10 the results are compared with the other studies from IFEU⁶ and INTERSEROH⁷ in Germany. The conclusion is that this report's results for the 125 l waste bag (and the recycled one) are in line with other studies results. Also data of Polyethylene (PE) from the database Ecoinvent is in line with data from the study INTERSEROH.

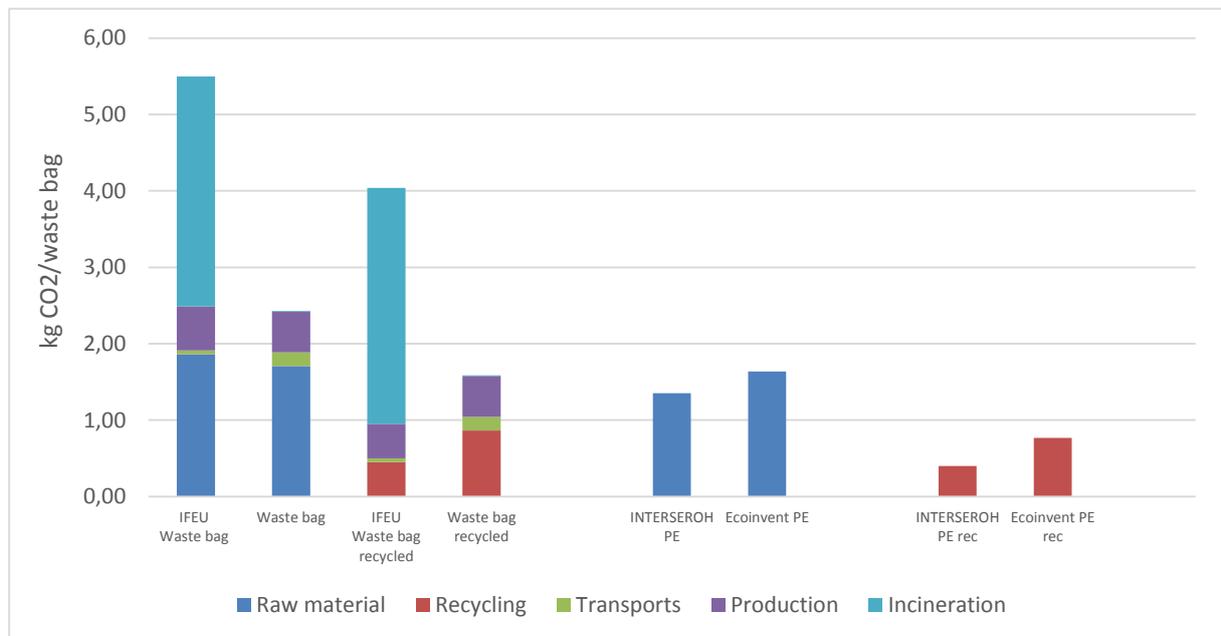


Figure 10. The four left staples represent results from this LCA compared to corresponding traditional waste bags (125 L 40 µ) in other similar LCA:s. The four right bars compare the data of Polyethylene and recycled Polyethylene from Ecoinvent with data from the report INTERSEROH.

⁶ Life Cycle Assessment of Waste Bags, June 2009, Author: IFEU - Institut für Energieund Umweltforschung Heidelberg GmbH

⁷ Recycling for climate protection, 2009, Author: Fraunhofer Institute for Environmental, Safety and Energy Technology (UMSICHT) and INTERSEROH

ANNEX 2

Weight of raw material per cassettes (Mini and Maxi) and traditional waste bags and per functional unit.

	kg material /cassette or bag						
	Mini (kg/cassette)	Maxi (kg/cassette)	Trad. waste bag 125L 40µ	Trad. waste bag 125L 50µ	Trad waste bag 125L 80µ	Trad. waste bag 160L 60µ	Trad. waste bag 240L 60µ
Polyethylene PE MD	1,15	4,60					
Polyethylene LD-MD			0,07	0,08	0,11	0,11	0,13
Corrugated cardboard, packaging	0,02	0,01					
Polyamide, Clips	0,02	0,01					
Total	1,19	4,63					

	kg material / functional unit (FU)							
	Mini à 75 L	Maxi à 96 L	Maxi à 144 L	Trad. waste bag 125L 40µ	Trad. waste bag 125L 50µ	Trad. waste bag 125L 80µ	Trad. waste bag 160L 60µ	Trad. waste bag 240L 60µ
Polyethylene PE MD	0,31	0,42	0,31					
Polyethylene LDPE				0,89	1,05	1,49	1,13	0,91
Corrugated cardboard, packaging	0,02	0,01	0,01	0,07	0,07	0,07	0,03	0,03
Polyamide, clips	0,02	0,01	0,01					

ANNEX 3

Emission factors and climate impacts per 1000 liters of waste of all processes (raw material, transportation, production and incineration) of Maxi, Mini, Traditional waste bag and Traditional waste bag recycled.

		Calculations based on 60% fill grade of the product's volumes as stated below																		
Process/material	Emission factor	Unit	Maxi à 96 L		Maxi à 144 L		Mini à 75 L		Trad. waste bag (125 L 40 µ)		Trad. waste bag recycled (125 L, 60 µ)		Trad. waste bag (125 L 50 µ)		Trad. waste bag (125 L 80 µ)		Trad. waste bag (160 L, 60 µ)		Trad. waste bag (240 L, 60 µ)	
			Quantity (unit)	kg CO2/Maxi	Quantity (unit)	kg CO2/Maxi	Quantity (unit)	kg CO2/Mini	Quantity (unit)	kg CO2/bag	Quantity (unit)	kg CO2/bag	Quantity (unit)	kg CO2/bag	Quantity (unit)	kg CO2/bag	Quantity (unit)	kg CO2/bag	Quantity (unit)	kg CO2/bag
Raw material				0,89		0,67		0,72		1,71		0,88		2,01		2,84		2,13		1,73
Polyethylene (PE)	1,96	kg	0,42	0,82	0,31	0,60	0,31	0,60												
Clips - Polyamide	6,40	kg	0,01	0,07	0,01	0,06	0,02	0,10												
Box - Corrugated cardboard	0,75	kg	0,01	0,01	0,01	0,01	0,02	0,02	0,02		0,02		0,02		0,02		0,01		0,01	
Recycled Polyethylene	0,97										0,89	0,86								
Polyethylene (LDPE)	1,89								0,89	1,69			1,05	1,99	1,49	2,82	1,13	2,13	0,91	1,72
Transports				0,11		0,08		0,08		0,18		0,18		0,21		0,30		0,23		0,18
Polyethylene: Truck. Europe - Malmö	0,19	km	1345	0,10	1345	0,08	1345	0,08												
Polyamide: Boat. Thailand - Malmö	0,01	km	18000	0,00	18000	0,00	18000	0,00												
Packaging: Truck. Skåne - Malmö	0,24	km	40	0,00	40,00	0,00	40	0,00												
Trad. Waste bags: Boat. Shanghai- Malmö	0,01	km							20000	0,18	20000	0,18	20000	0,21	20000	0,30	20000	0,23	20000	0,18
Production				0,07		0,05		0,09		0,54		0,47		0,63		0,90		0,68		0,55
Maxi (EU electr mix)	0,30	kWh/kg	0,58	0,07	0,58	0,05														
Mini (EU electr mix)	0,30	kWh/kg					0,93	0,09												
Traditional waste bag		kg CO2/kg							0,60	0,54	0,52	0,47	0,60	0,63	0,60	0,90	0,60	0,68	0,60	0,55
End of life				1,27		0,94		0,94		2,68		2,68		3,16		4,47		3,37		2,73
Incineration PE	3,00	kg	0,42	1,25	0,31	0,92	0,31	0,92	0,89	2,68	0,89	2,68	1,05	3,16	1,49	4,47	1,13	3,37	0,91	2,73
Incineration Polyamide	1,70	kg	0,01	0,02	0,01	0,01	0,02	0,03												
Incineration Packaging	0,03	kg	0,00	0,00	0,00	0,00	0,01	0,00												
Total kg CO2				2,34		1,74		1,83		5,10		4,21		6,01		8,51		6,40		5,18

ANNEX 4

Sources and databases of the input materials.

Process/material	Source/Database
Raw material	
Polyethylene (MD PE)	Plastic Europe, average between LDPE and HDPE.
Wraps - Polyamide	Ecoinvent
Box - Corrugated cardboard	Packaging Europe, Pro Carton
Recycled Polyethylene	Ecoinvent
Polyethylene (LDPE)	Ecoinvent
Transportation	
Polyethylene: Truck. Europe - Malmö	Ecoinvent. Transport, lorry 16-32t, EURO3
Polyamide: Boat. China Shenzhen - Malmö	Ecoinvent. Transport, transoceanic freight ship
Packaging: Truck. Skåne - Malmö	Ecoinvent. Transport, lorry 7.5-16t, EURO3
Trad. Waste bags: Boat. Shanghai- Malmö	Ecoinvent. Transport, transoceanic freight ship
Production	
Maxi (EU electr mix)	Journal of Industrial Ecology: Life Cycle Assessment of ICT, 2014, Malmodin et al.; Paxxo
Mini (EU electr mix)	Journal of Industrial Ecology: Life Cycle Assessment of ICT, 2014, Malmodin et al.; Paxxo
Traditional waste bag	Ecoinvent, Film extrusion
End of life	
Incineration PE	Ecoinvent, Disposal, polyethylene, 0.4% water, to municipal incineration
Incineration Polyamide	Ecoinvent, Disposal, polyamide, 19.6% water, to municipal incineration
Incineration Packaging	Ecoinvent, Disposal, packaging cardboard, 19.6% water, to municipal incineration