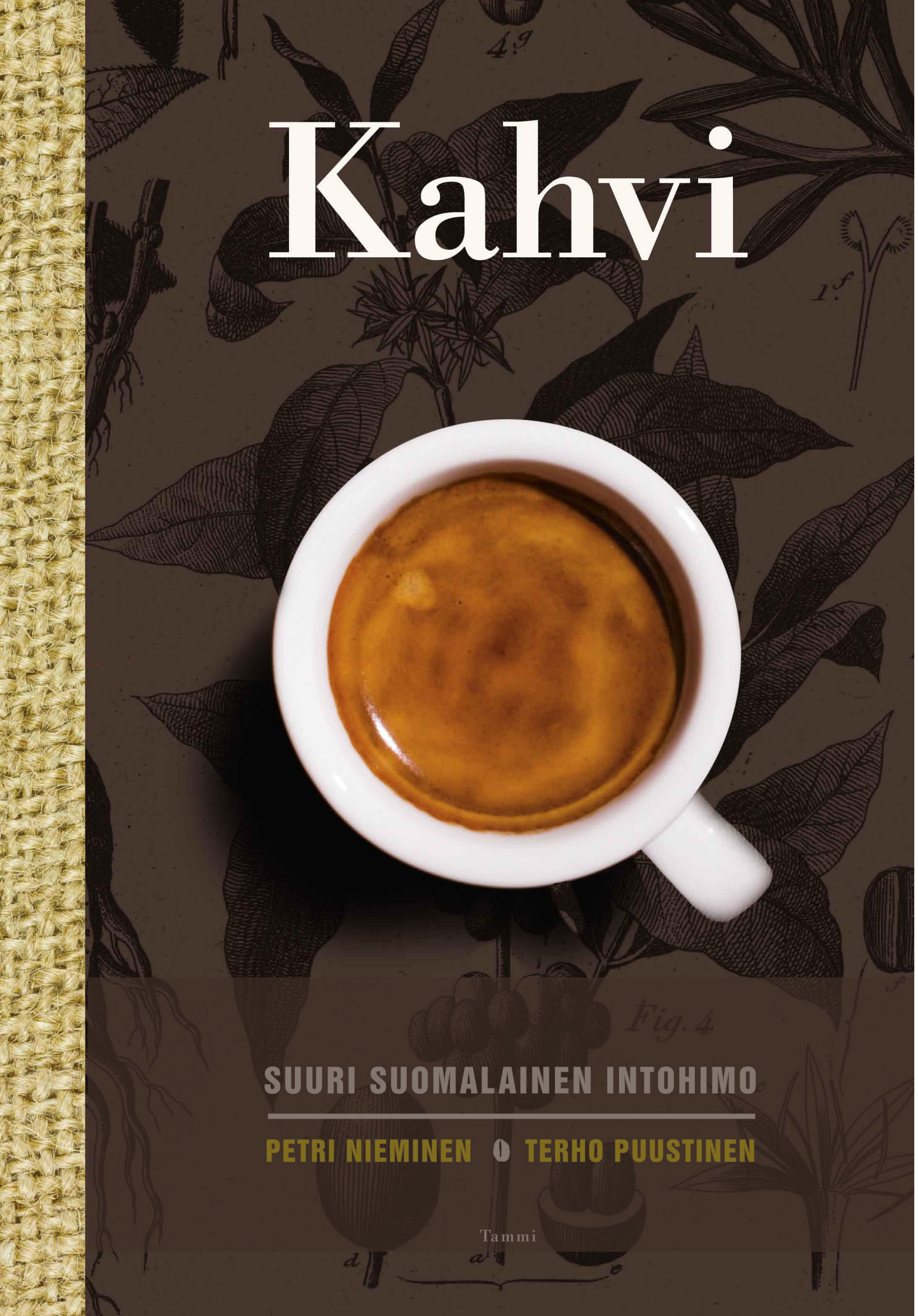

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A STUDY OF COFFEE DRINKING

Finns are the people with the highest consumption of coffee in the world, at 12 kilo per person per year. Even as a foreigner, my coffee consumption increased around 4 times since I moved to Helsinki.

The cheap price of coffee is one of the factors of increasing consumption. Finns pay a bit less than 80 euro a year or 5.75 cents for the coffee they drink at home.

While not scientifically proven, I can suspect coffee consumption of University students is quite high as well. In student cafeteria, a price of normal coffee varies from 0.90 cents to 1.5 euros (slightly more expensive in Robert's coffee).

However, the side effect of the massive increase of coffee consumption around the world is 4 billion paper cups that are left in a landfill. Many alternatives are available including reusable mugs and vacuum flasks. While lasting longer, production of ceramic cups or steel mugs are very energy and resource intensive.

Through this study, I want to compare the production of various coffee drinking cups that can be used on campus. To make the comparison, I assumed the amount of 500 paper cups against one ceramic cup and one Thermos vacuum flask.

Huhtamaki paper cups

Paper cups used at Aalto University campuses are produced by Huhtamaki, a global food packaging specialist, headquartered in Espoo, Finland. Its primary outputs include paper and plastic disposable tableware, such as cups, plates and containers. For hot beverages, the company offers double-wall (Impresso and Air smooth), single-wall (heavy-board and Heat Barrier), classic handle cups, and Bioware compostable single-wall hot cups, as well as hot sip lids.

According to Töölö campus cafeteria staff, 130-150 paper cups are used every day, which results in over 30,000 cups per year in this student cafeteria only. The cups offered are single wall hot cups - either heavy board or Heat barrier.

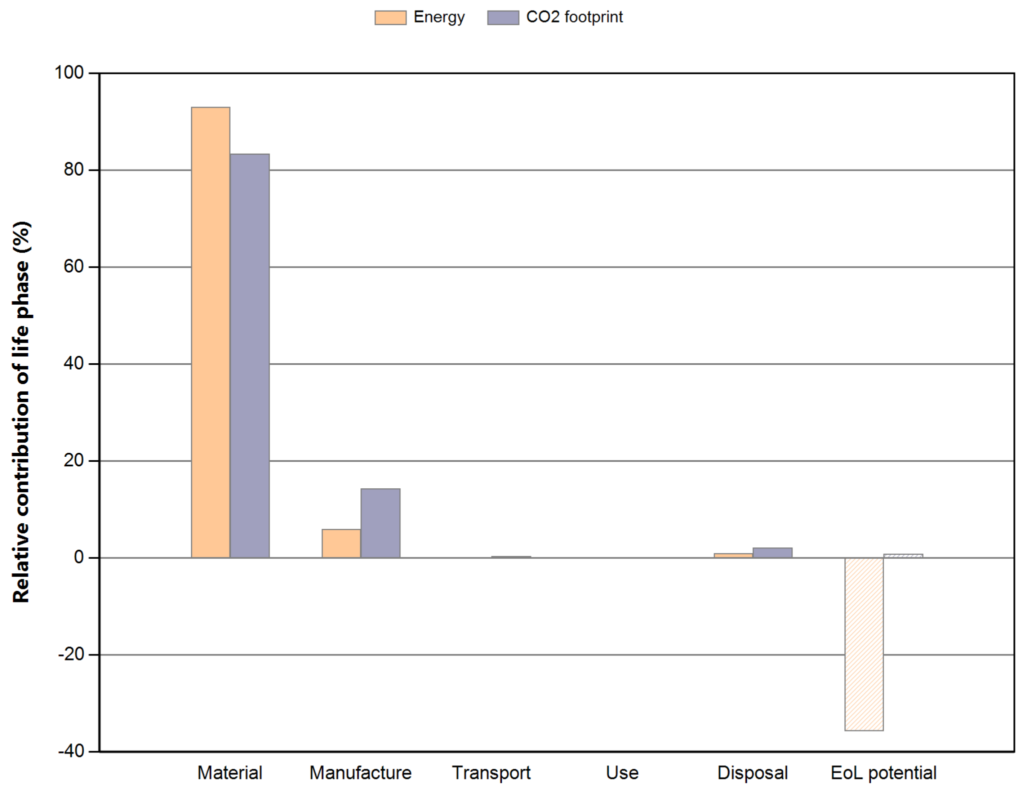
As Huhtamaki has a production facility in Hämeenlinna, it is assumed that the product will be delivered directly by truck.

It is also assumed that paper cups have no recycled content but can be recycled afterwards (paper). However, it is difficult to separate paper from polyethene cover in disposable cups, reducing chances of recycling.

Materials (paper cup with lid):

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass (kg)	Energy (MJ)	%
Paper	Paper and cardboard	Virgin (0%)	0,012	500	6	3,1e+02	67,4
Polyethylene	Polyethylene (PE)	Virgin (0%)	0,0001	500	0,05	4	0,9
Cup Lid	Polystyrene (PS)	Virgin (0%)	0,003	500	1,5	1,5e+02	31,8
Total				**1500**	**7,6**	**4,6e+02**	**100**

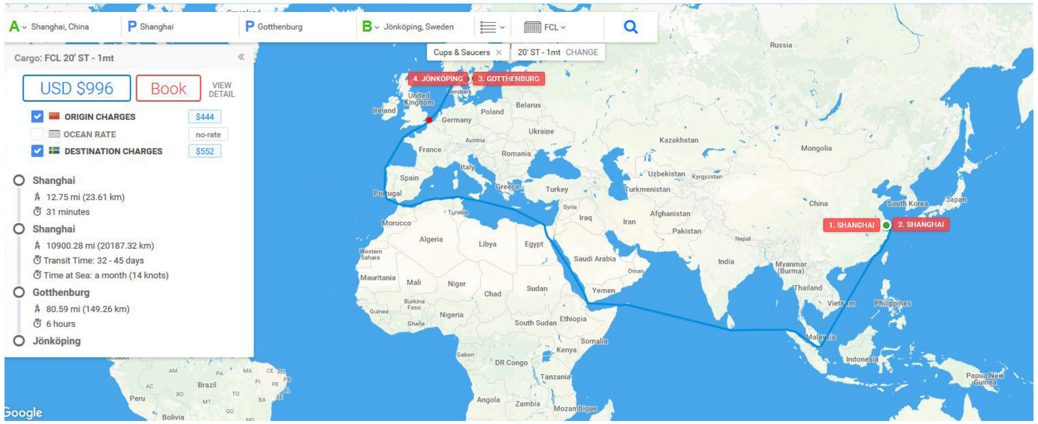
Eco-audit (Energy and CO2):



Phase	Energy (MJ)	Energy (%)	CO2 footprint (kg)	CO2 footprint (%)
Material	458	93,0	12,8	83,4
Manufacture	29,3	6,0	2,2	14,3
Transport	0,642	0,1	0,0456	0,3
Use	0	0,0	0	0,0
Disposal	4,51	0,9	0,316	2,0
Total (for first life)	**492**	**100**	**15,4**	**100**
End of life potential	-176		0,12	

IKEA ceramic mug

IKEA ceramic mug is often offered in cafeterias as an alternative for paper cups. Sustainability of ceramic mugs is quite doubtful as a production process requires much more energy. There are different studies, according to which ceramic mugs need to be used 100 to 1000 times to be more energy-efficient than polystyrene cups. Beside actual production, mugs need water to be washed (and washing detergent could be harmful to environment). In large kitchens with water/ energy-efficient equipment, washing process should be more efficient than hand washing at home.

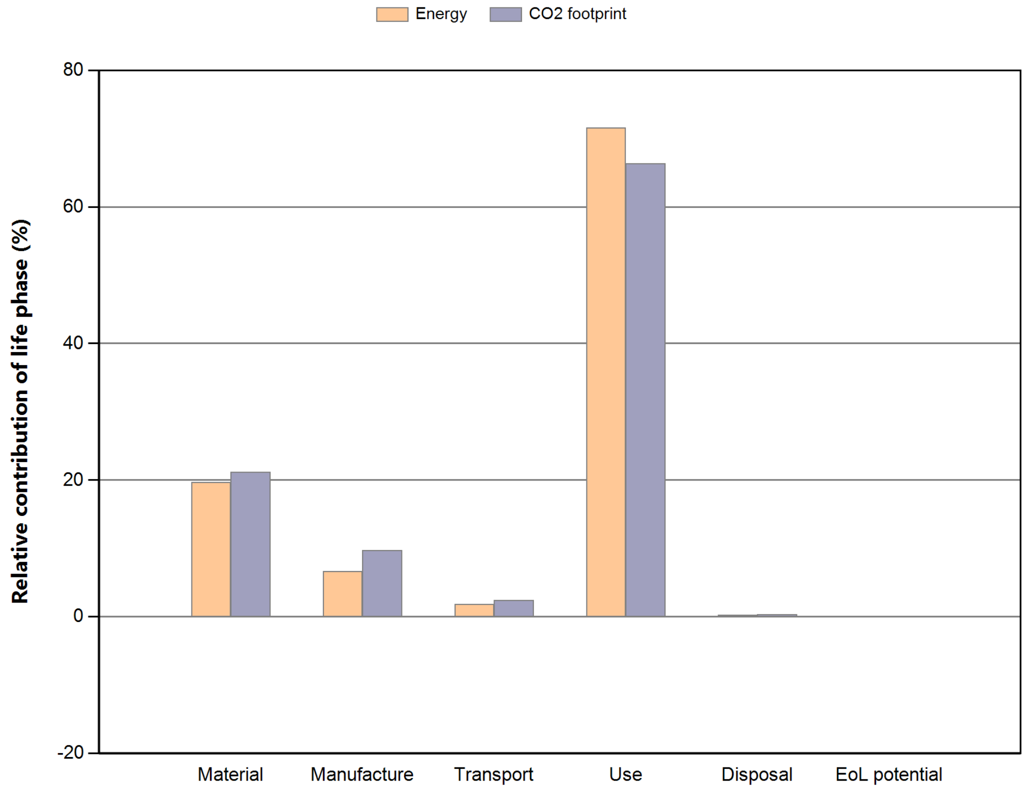


Those are complicated factors that were not noted during this simplified audit. Nevertheless, I tried to calculate transportation distance, assuming IKEA cups are produced in China and transported by water from Shanghai to Gothenburg. From there, mugs can travel by truck to IKEA distribution warehouses (for Nordic countries) in Jönköping, and eventually reach Helsinki.

Materials (paper cup with lid):

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass (kg)	Energy (MJ)	%
Ceramic	Glass ceramic	Virgin (0%)	0,24	1	0,24	9,5	100,0
Total				1	0,24	9,5	100

Eco-audit (Energy and CO2):



Phase	Energy (MJ)	Energy (%)	CO2 footprint (kg)	CO2 footprint (%)
Material	9,47	19,7	0,555	21,2
Manufacture	3,2	6,6	0,256	9,7
Transport	0,901	1,9	0,064	2,4
Use	34,5	71,6	1,74	66,3
Disposal	0,12	0,2	0,0084	0,3
Total (for first life)	48,1	100	2,62	100
End of life potential	-0,024		-0,00168	

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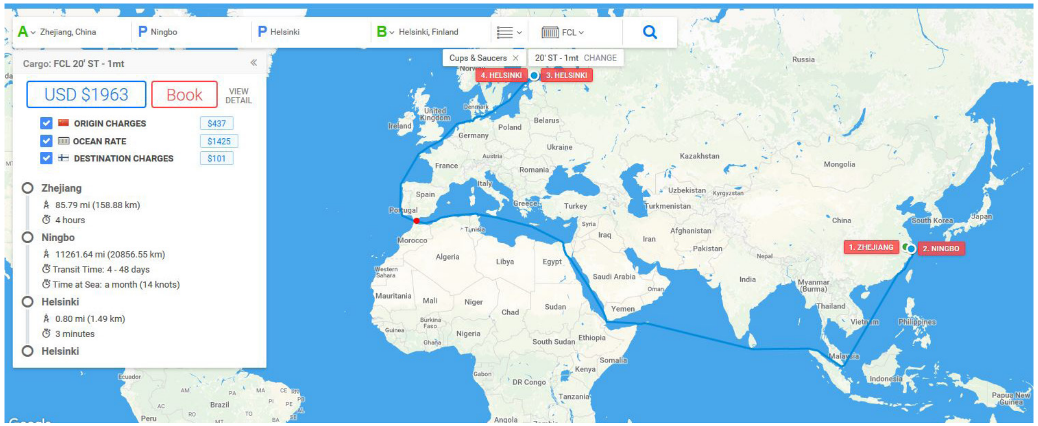
Thermos flask

Vacuum flasks require even more energy and valuable material (stainless steel) to be produced. However, in comparison with paper cups or ceramic mugs, flasks have the longest potential life-span. For example, Thermos offers 5 years limited warranty, while competitors like Stanley promise lifetime warranty. However, similar to mugs flasks require washing and can be more uncomfortable to carry around.

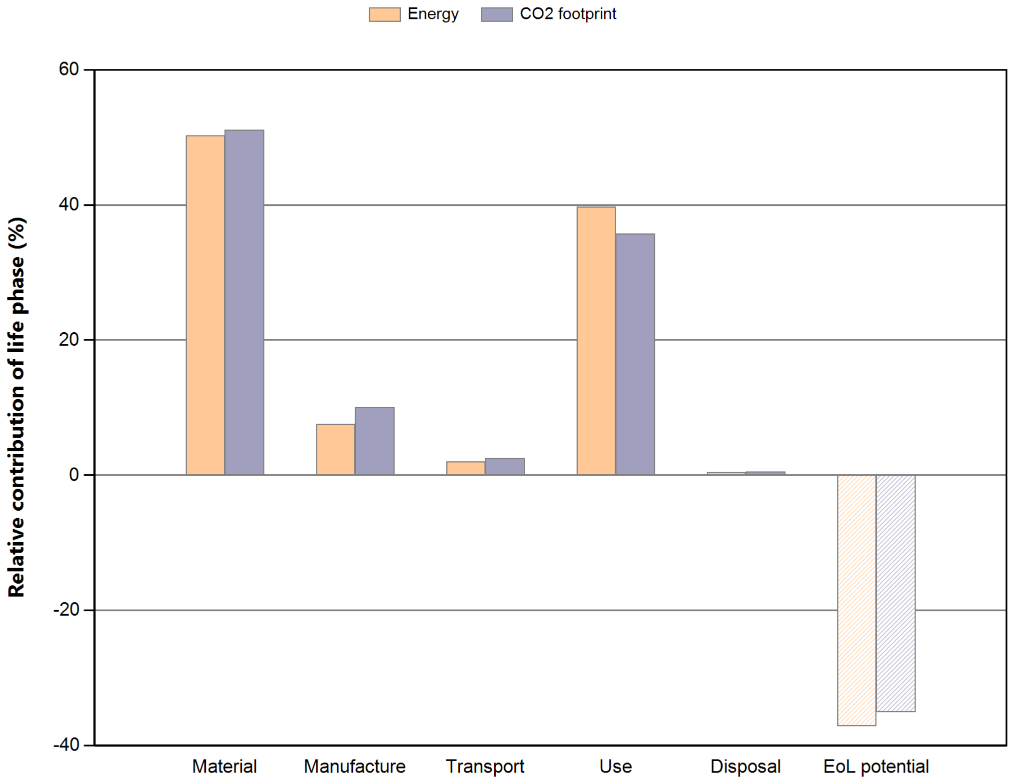


Based on the internet search, I assumed that flasks are produced in China and transported to Helsinki by water. However, no detailed information was provided by Thermos customer support. The materials and weight are based on 0.7 litres Thermos bottle for camping.

Materials (paper cup with lid):

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass (kg)	Energy (MJ)	%
Stopper	Polyester	Virgin (0%)	0,038	1	0,038	2,7	6,8
Cup	Stainless steel	Virgin (0%)	0,081	1	0,081	6,8	17,1
Bottle	Stainless steel	Virgin (0%)	0,36	1	0,36	30	76,1
Total				**3**	**0,48**	**40**	**100**

Eco-audit (Energy and CO2):



Phase	Energy (MJ)	Energy (%)	CO2 footprint (kg)	CO2 footprint (%)
Material	39,9	50,3	2,31	51,1
Manufacture	6,01	7,6	0,456	10,1
Transport	1,61	2,0	0,114	2,5
Use	31,6	39,7	1,61	35,7
Disposal	0,328	0,4	0,0229	0,5
Total (for first life)	**79,4**	**100**	**4,51**	**100**
End of life potential	-29,4		-1,58	

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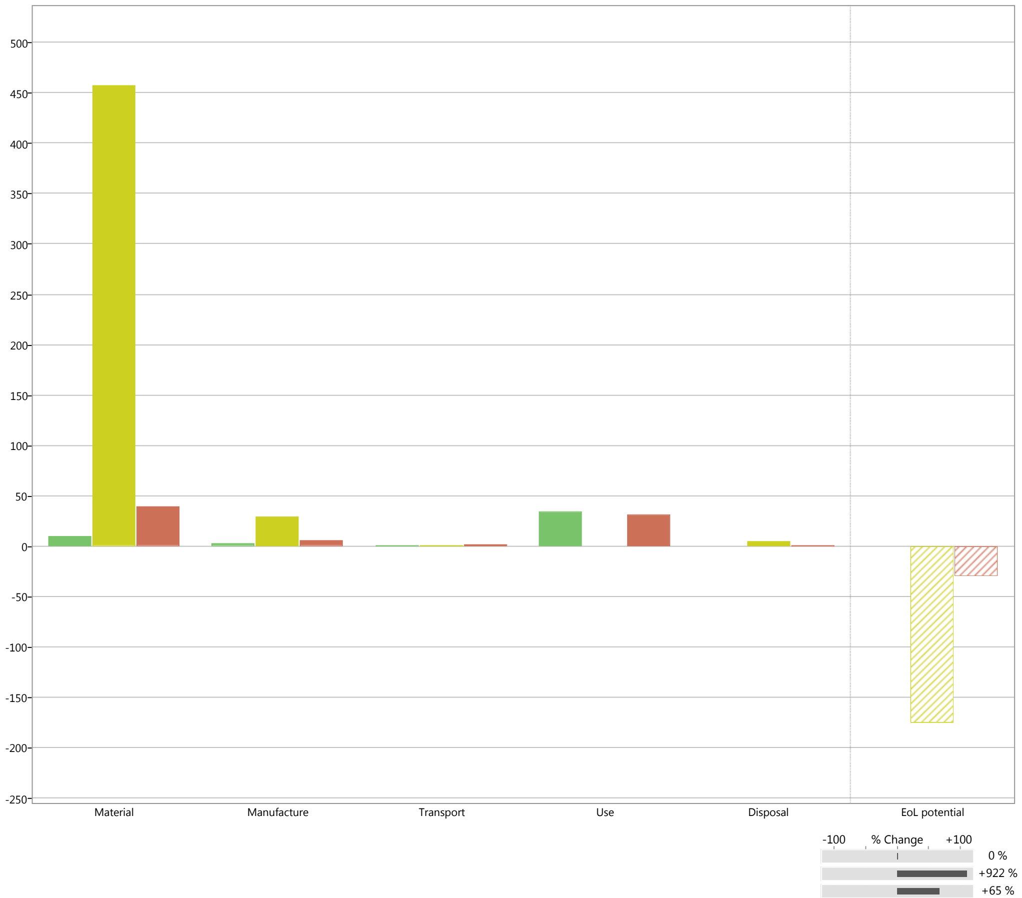
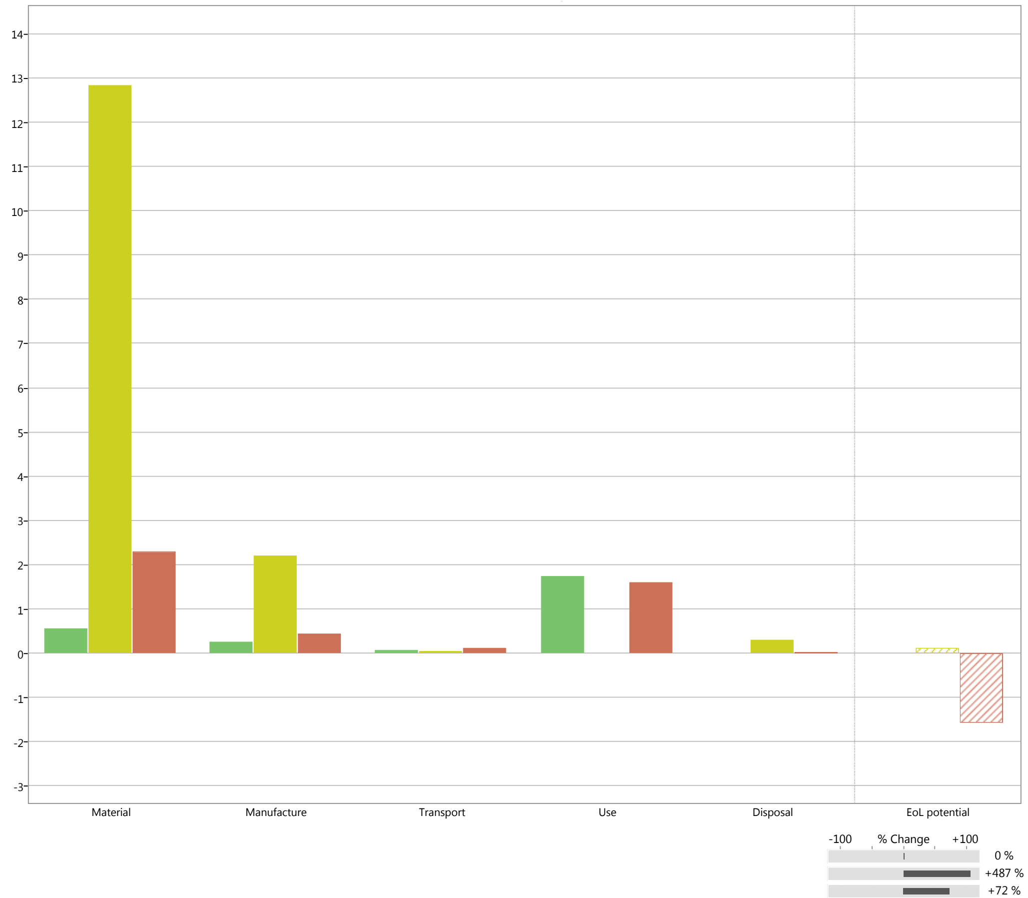
Life-cycle comparison

Energy (MJ)



CO2 footprint (kg)



- Ceramic IKEA mug
- Huhtamaki Paper Cup
- Vacuum Flask (Thermos)

Conclusion

84% of Finnish population (4.4 million people) qualify as potential coffee consumers. As I couldn't find exact statistics, based on simple math and assumption that 80% of those 4.4million people use 1 paper cup per day, Finland could be using around **1.3 billion paper cups per year**. Customers in UK and Germany use around 2.5 billion cups per year.

Based on the Energy and CO2 footprint auditing, it seems that Huhtamaki paper cups are the least desirable choice. However, it is worth noting that items involved in auditing have quite different weights due to the difference in quantity.

500 paper cups ~ around 6kg (with lids)
1 ceramic mug - 240g
1 Thermos flask - 480g

As earlier stated, the assumption was made that a mug or a flask can be used around 500 times. Changes in transportation methods/ routes don't have enough impact to improve efficiency. Therefore, the efficiency could fluctuate dramatically if:

1) paper cups will be used more than 1 time;
2) a mug or a flask will be disposed of or not used within less period;
3) production process and materials increase/ decrease in efficiency. For example, biodegradable PLA cups can replace plastic cups.

Polylactic acid (PLA), a plastic substitute made from fermented plant starch (usually corn) is considered as an alternative to plastic cups. However, there are many drawbacks: PLA biodegrade very slowly and should be kept separate and recycled from regular plastic in a different composting facility.

It is quite disputable to call a mug or a flask to be more eco-friendly than disposable cups. Ultimately, consumer behaviour is an important factor. Therefore, to target the problem of increasing disposable cup waste it is crucial to both improve eco-efficiency of alternatives and promote more meaningful and sustainable coffee drinking habits.

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