MUO - E8007 ECO-AUDITING WITH CES-EDUPACK PROJECT REPORT.

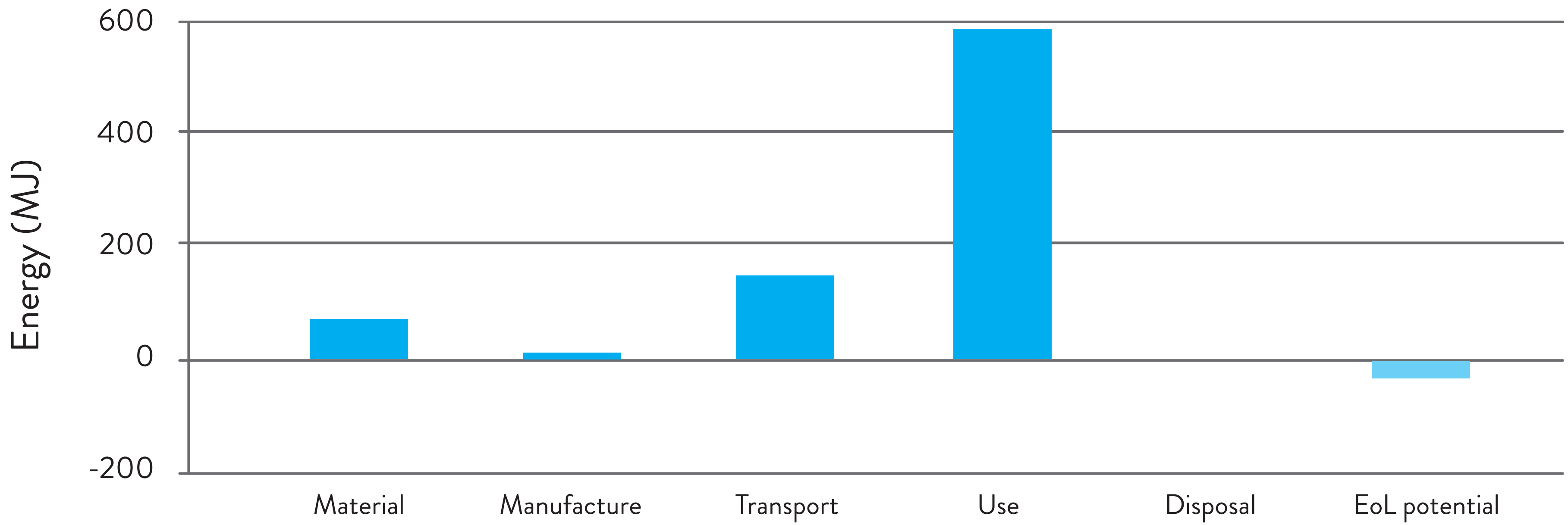
[redacted]

In the context of both our CES Eco-Audit course, and Sustainable Product and Service Design, my aim with the assessment was to combine both courses, especially after working with Vattenfall in the Energy Watch, to get a deeper understanding not only on the life cycle and material aspects of a certain product, but on the energy consumption as well. In order to do this, a water kettle was taken as an example, since it is one of the most energy hungry home appliances, running at 1350 Watts.

According to the International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, there are guidelines in terms of: a) import cleaner energy forms, b) reduce energy loss, c) improve user notifications.
However, when it comes to Optimize Individual Runs/Processes to Outcomes, new guidelines should be approached, and old ones should be re-designed.
I chose the particular example of the Capresso H20 Plus, as it is one of the only models in the market that has a glass body (borosilicate glass, developed in Germany by Schott), and is highly energy efficient (84% with overheating, 85% without it), reaching boiling point faster than most kettles.

To make the material life cycle assessment of the Capresso H20 Plus, certain assumptions had to be made, as there is not full report available on the construction processes and materials available. Therefore, I was forced to take a classic kettle model, and replace the materials for the ones that were available to me on the producer's website and from users' reports.

Energy and CO2 Footprint Summary



Previous to running the LCA, it was already clear that in the energy and C02 footprint summary, the use of the kettle would be the defining factor, way over materials, manufacturing process and transport. In terms of energy usage, the use phase accounted for 72% of the total energy.

This meant different things for the product development and LCA to take into consideration. When compared to other electric kettles made of plastic or steel, the use of glass, even when the manufacturing process ended up being more energy hungry than the ones made of steel or plastic, the properties of the glass and it's efficiency in terms of boiling speed, overheating time, and the centered position of the heating elements, resulted in an impressive decrease of overall energy footprint.

Moreover, the properties of the borosilicate glass, coupled with the shape of the kettle, were other factors that contributed to its energy efficiency.

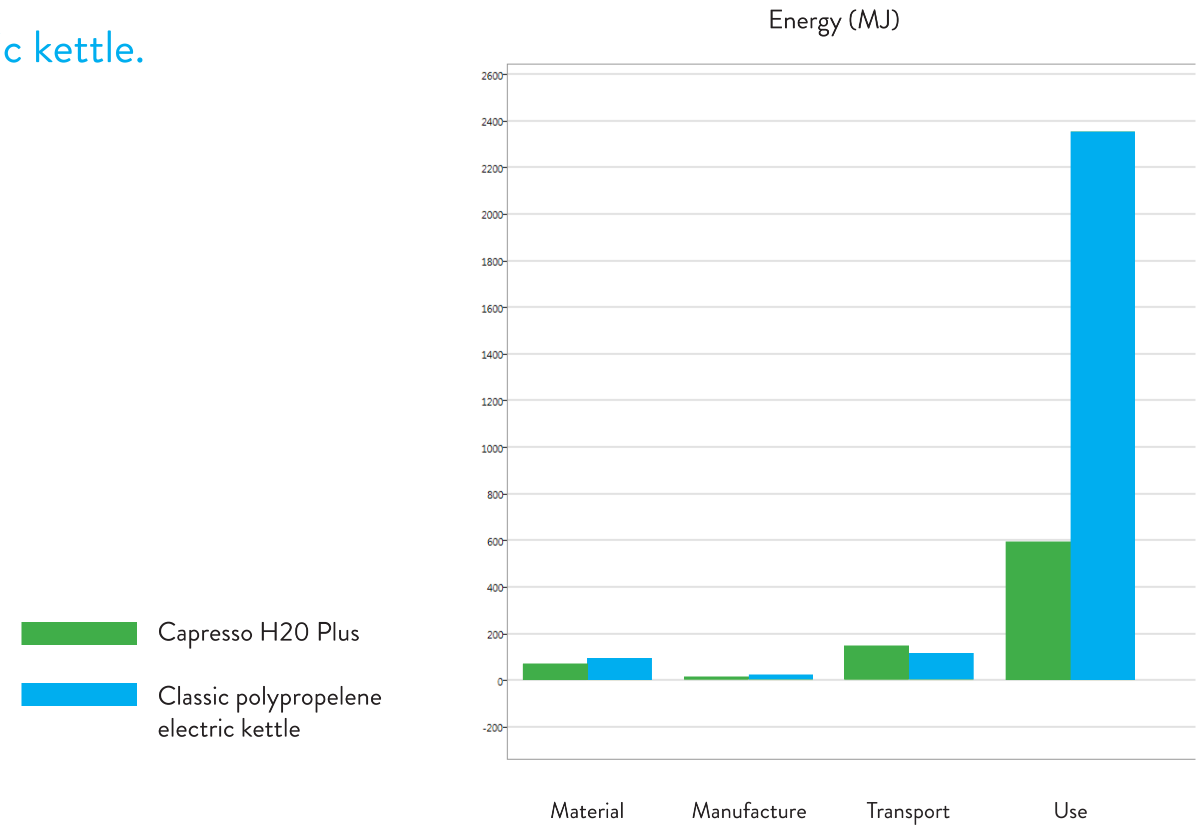
The kettle was personally tested, and several videos made by users were used to analyze the boiling point, speed and accuracy.

Thermal properties Borosilicate the Glass

Glass temperature	450 - 602 (°C)
Maximum service temprature	230 - 460 (°C)
Specific heat capacity	760 - 800 (J/kg. °C)
Thermal expansion coefficient	3,2 - 4 (ustrain/ °C)

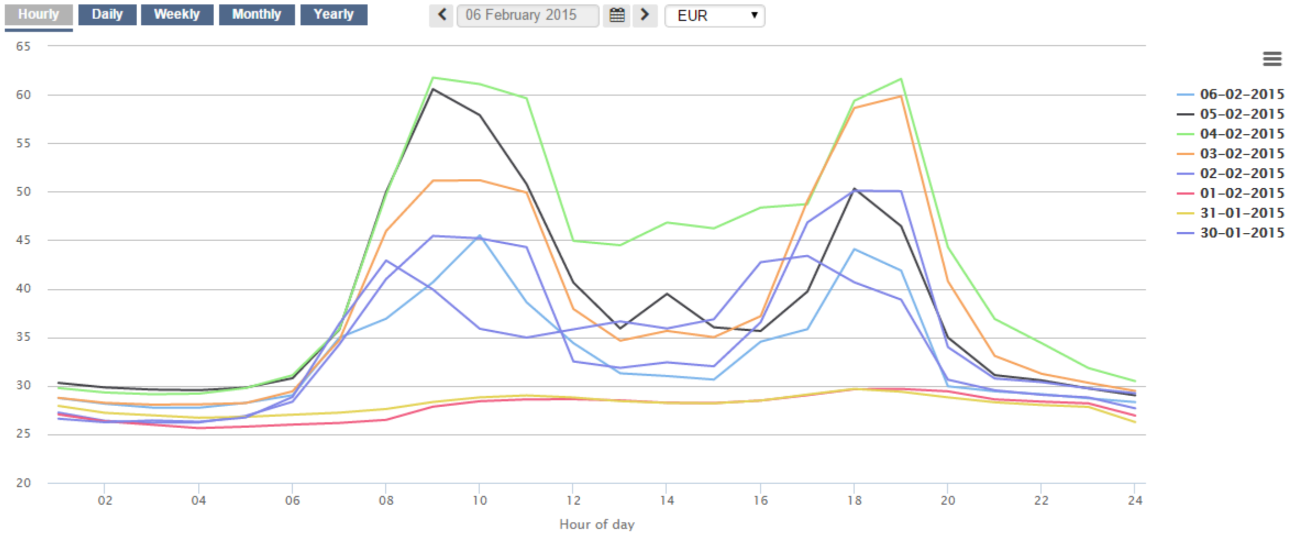
The borosilicate glass is very resistant to thermal shock, which makes for the perfect material to resist sudden changes in temperature. Even when polypropylene tends to be a good material for kettle bodies, because it can resists high temperatures and it's Bisphenol A free, other plastics such as Polycarbonate can be dangerous when used in water kettles, since they contain Bisphenol A. The U.S. National Toxicology Program has expressed the following, concerning BPA "some concern for effects on brain, behavior, and prostate gland in fetuses, infants and children at current exposure levels to Bisphenol A." Glass in this regard is a safe choice, easier to clean, and moreover, it allows the user to visualize the boiling water; something very important if we consider that a lot of energy is wasted in overheating, by users who trust the kettle to stop functioning at the right time. Some kettles can even overheat for more than 50 seconds. As stated before, the Capresso H20 Plus overheats for around 16 seconds.

Comparison to a classic plastic kettle.



When comparing energy footprint performance between a polypropylene body electric kettle and the H20 Plus, we can see a massive different in terms of energy usage in the “use” phase.
Why is there such a considerable difference? Base on the LCA I ran, and also on literature on the subject, one of the key aspects is the time it takes for the H20 Plus to reach boiling point. Another, is how fast it stops when the water reaches 95 degrees, accounting for a very small time of overheating. And lastly, it should also be mentioned that even though it has an average of 1300 watts, which doesn’t make it the most energy efficient, the combination between the speed and a still very decent energy efficiency make the H20 a much better choice than the plastic counterpart.

Energy prices and usage.



http://www.nordpoolspot.com/Market-data1/Elspot/Area-Prices/FI/Hourly/?view=chart
(Hourly price of electricity in Finland)

Considering the price of energy in Finland (average of 14 cents / kWh), it is possible to calculate the yearly average of consumption of the Capresso water kettle, and on top of that, we can also assume if consumption could be lowered when certain information is available to the public.
The yearly energy usage of the H20 Plus is 273 megajoule. Translated into kWh, that leaves us with 75 kWh a year. If the price is 14 cents per kWh, then the total energy cost of the kettle in euros is 10.4 € a year. On the other hand, the classic plastic kettle consumes a total of around 40 € per year. Furthermore, in the context of a smart grid such as the one Vattenfall is developing and researching, small changes in the daily routine can make a big impact.
If a consumer would boil water earlier, and have a good kettle that keeps the water warm, this could account for 20-40% reduction of the first daily use. Moreover, the second use of the day, when done around 8:30pm instead of 19:30pm, can have a 25-40% reduction.

Reflection

Phase	Energy (MJ)	Energy (%)	CO2 (kg)	CO2 (%)
Material	70,2	8,5	3,92	26,5
Manufacture	13,6	1,7	1,07	7,2
Transport	145	17,7	9,73	65,7
Use	591	72,0	0	0,0
Disposal	1,1	0,1	0,0768	0,5
Total (for first life)	**821**	**100**	**14,8**	**100**
End of life potential	-33,7		-1,15	

Energy and C02 footprint summary

To conclude, what I saw in this LCA, and analysis of the usage of the product itself, was that a lot of things were to be taken in consideration when designing such products. The selection of the materials is of course important, but there has to be a holistic approach to such energy hungry appliances. One example being that the selection of glass, is not only based on the thermal properties, but also it allows the user to control the boiling point of the water, and therefore save energy.

This particular model does not have a fixed temperature dial, but it has been studied that this also would further decrease the energy consumption. Moreover, the property of the material to construct the body, should consider the amount of time it allows for the water to be kept warm. This reduces the usage per day as well.
On a final note, smart grids and energy informed users would also be able to reduce the energy footprint when given the correct tools.

References

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http://www.capresso.com/h2o-plus.html

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