LIFE CYCLE ASSESSMENT OF WASTE PREVENTION

Line K.-S. Brogaard, Postdoc
lksb@env.dtu.dk
Anders Damgaard, Senior Researcher
Thomas F. Astrup, Associate Professor

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Waste prevention is part of the solution towards circular economy and sustainable consumption. Electronic equipment is known for containing scarce resources and the recycling of these is seen as important. Long lifetime of some electronic products leads to energy consumption during use phase being the most important process for the total impacts from the life cycle. By preventing waste and extending the lifetime of electronics, resources are kept in the loop for a longer period saving the extraction and use of virgin resources. It should be considered if, keeping scarce resources in the loop, will lead to keeping products having low energy efficiency in the loop.

A case study was carried out, assessing the environmental impacts from the use and consumption pattern of refrigerators as the electronic product. The study compared two scenarios providing the same functional unit: Cooling of food (5 degrees Celsius) by a 240L refrigerator for 30 years in Denmark during the period 2015-2045. The full lifetime of the refrigerator was assessed including production, use and waste management. The two scenarios assessed were: 1) use of a refrigerator for 10 years and 2) use of a refrigerator with an extended lifetime of 5 years being in total 15 years of use. Both scenarios were assessed for an old refrigerator with a low energy class and a newer refrigerator with a high energy class. Both scenarios were also assessed with substituting the refrigerator in use with one with the same energy class or with one with a more efficient energy class.

The assessment showed that the use phase becomes less important, and the production phase becomes the main contributor to the potential environmental impacts when choosing an electronic product with high energy efficiency. Meaning the extraction and production of materials and the assembling of the refrigerator becomes more important when the energy efficiency during use is high.

During the life time of electronics the sealing of refrigerators gets worn and the compressor becomes less efficient. Thereby increasing energy consumption is seen for all kinds of electronic devices during the lifetime. It is described in literature that refrigerators tends to have larger energy loss over time than other electronic devices. Therefore the change of energy consumption of scenario 2 was assessed for the two scenarios to have equal potential environmental impacts. For an old refrigerator with low energy efficiency the energy consumption should only increase by ~15% over a period of 30 years consumption time. For the newer refrigerator the change should be ~49% for the two scenarios to have equal environmental impacts.

From the assessment it was concluded that it leads to lower potential environmental impacts to replace an old refrigerator with low energy class after 10 years use by a new refrigerator, and again change this to a more energy efficient one after 10 years use (Scenario 1 with substitution to more efficient energy class), than to reuse an old refrigerator with low energy class (Scenario 2 with substitution to same energy class). The study also concludes that it leads to even lower potential environmental impacts to reuse an old refrigerator and replacing it at the end of life with a new one with high energy efficiency, which is also reused to have an extended lifetime (Scenario 2 with substitution to more efficient energy class).

The lowest environmental impacts were found by extending the lifetime of refrigerators (Scenario 2) with high energy efficiency. In this way as less energy as possible is used during the use phase, and resources are kept in the loop for as long as possible.