MAKE IT CIRCULAR – CIRCE2020 PROJECT: RATING METHOD FOR A PROBLEMATIC PLASTIC COMPOSITE TO CHOSE THE BEST CIRCULAR ECONOMY SOLUTION

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Abstract

The European Union's ambitious legislative package was accepted in May 2018 setting many challenges to the member states. One of the potential tools to foster the needed transition in this respect is to applying circular economy solutions. Some material is only just a waste to the company, but another company can utilize it as a secondary raw material. We have to track down these possibilities and need to promote the industrial symbiosis connections in favor also of our environment. Many barriers exist from feasibility to economical interest, but the strongest key factor is the commitment to protecting the environment. CE is not only a waste management law, but it requires new product development methodologies and new business models.

Introduction

The CIRCE2020 – Expansion of the CIRcular Economy concept in the Central Europe local productive districts – Interreg Central Europe project aims to facilitate a larger uptake of integrated environmental management approach in five specific Central European industrial areas by changing patterns from single and sporadic company recycling interventions to an integrated redesign of industrial interactions based on the concept of circular economy (CE). The goal is to introduce innovative cross-value chain waste governance models and transnational analytic tools to improve capacities of concerned waste public-private sector to reduce dependencies from primary natural resources within industrial processing. The project should also provide robust evidences about environmental and economic benefits from shifting to enhanced industrial symbiosis. That is why the main objective of the project is to test and work out a decision supporting tool analyzing the alternative options from different perspectives.

Results and discussion

In the Hungarian pilot area, two relevant waste flows and their amounts were identified by using material flow analysis to target two critical material flows. One of them is a plastic composite from a medical tool producing company containing several types of ingredients, such as polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyvinylchloride (PVC), polyamide (PA), ethylene vinyl acetate (EVA) and some starch. The currently applied waste management technology of the critical amount (yearly 5000 tonnes) of plastic waste is incineration with energy and steam recovery.

The following phase was a detailed research about the possible alternative solutions, technologies and recipient companies. The aim was to change the present waste management system and develop the present treatment choice to a higher and more efficient level or - being a critical material- to produce valuable products from these waste plastics as a secondary raw material. Due to the complexity of the composition and because of the quantity it is quite a challenge to identify producers who can deal with this material. Continuous, long-term and sustainable relation is needed.

During the project a rating system has been developed for identifying the impacts of the currently used and the circular economy based solutions. The following figure shows the essence of the methodology.

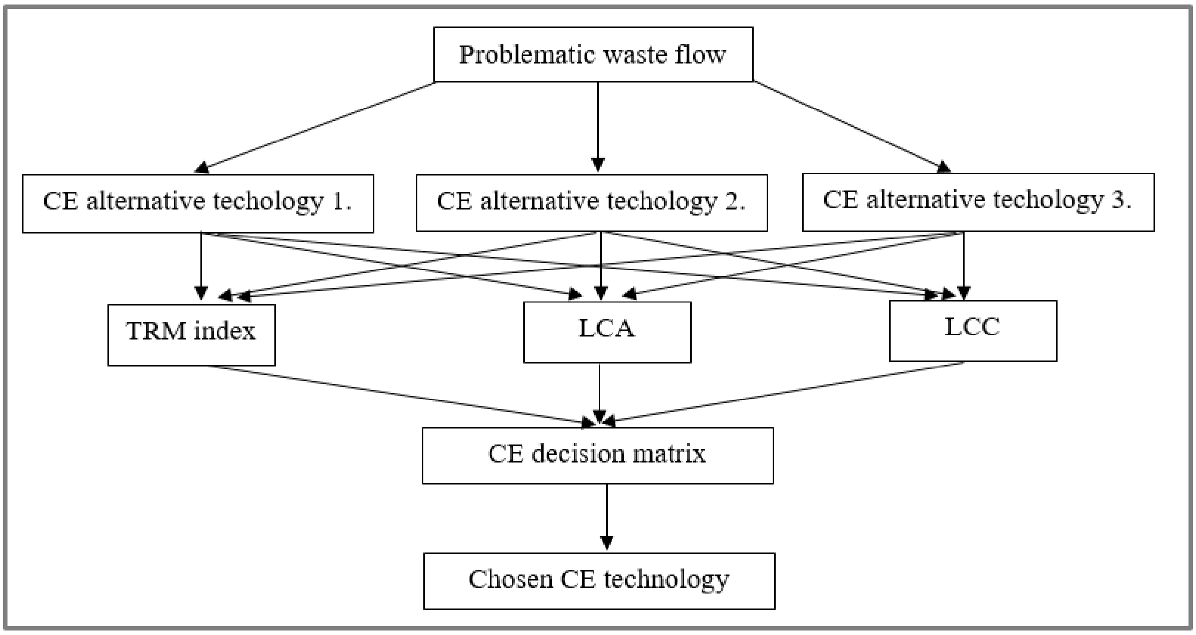

Figure 1. Methodology of the developed rating system

Experts of Bay Zoltán Nonprofit Ltd. for Applied Research developed a special process. Technological Rating Methodology (TRM index) represent an instrument which allows to user to assess the identified circular solution considering the three most significant driver for a circular business: technology, environment and economy.

In the process a weighted evaluation of the following factors was required:

- technology readiness level index;
- references in the market;
- reliability of technology provider;
- circularity level of the technology;
- operational experience;
- technical limitations;
- others.

In the following definition can be seen the calculation of the TRM, where TRM_i is i^{th} specific TRM aspect and W_i is the i^{th} specific weighting factor.

$$\text{TRM} = \sum_{i=0}^{n} TRMi * Wi$$

After the rating method a life cycle assessment (LCA) and life-cycle cost analysis (LCC) were followed. The purpose to applying the tools was to:

1. support decisions among different choices;
2. measure the environmental and economic impact of the changes.

In order to test the environmental sustainability of the pre-selected circular economy cases and quantify the relevant environmental impacts of products, a life cycle assessment was performed based on the latest Environmental Footprint (PEF) methodological requirement. LCA required a detailed and strict rules in connection with the quality and documentation of the collected data, modelling of transportation processes, applied allocation rules and methods of environmental impact assessment. Environmental evaluation focused on the main environmental aspects (soil, air, water) and considering for impact assessment robustness, inventory covery completeness and inventory robustness. Because of that Climate change, Particular matter, Acidification, Eutrophication (terrestrial) and Resource use (minerals and metals) categories had been selected during the process.

General patent or detailed regulated reference are not exist in case of LCC, but it has to be comparable with the LCA-PEF assessment within same system boundaries and functional units.

At the end the CE decision matrix summarizes the main weighted results of the TRM, LCA-PEF and LCC with respect to each circular economy based solutions. According to the TRM, environmental and economical index a qualitative evaluation and a final score were given where we can see that the analyzed technology is „not recommended“, „partly not recommended“, „recommended“ or „highly recommended“.

In the final section the user can summaries the evidences deriving from the analysis of the three main drivers for CE. The last assessment would synthetize all the information, leading to the choise of adopting or discarding the identified solution for the selected flow. It is significant to see the whole picture which contains all the information about advantages, disadvantages and feasibility before chosing the best alternative technology.

Conclusion

In case of plastic composite waste, the chosen technology was to make granulate and after that produce valuable product. It was a big challenge to find partners for that.
According to the preliminary researches the team defined the TRM numbers in each above mentioned category and performed the weighting. The final number belonged to the limited recommended category – since we face many challenges in this respect.
Environmental driver was given by LCA-PEF assessment in the 5 categories. In the present scenario there were some impact categories where the energy recovery had the biggest environment impact, but is case of the other categories the CE stage had bigger effect. Overall it can reach environmental benefit with another/better waste disposal or recycling alternative, because the qualitative evaluation result was highly recommended in case of CE scenario.

Regarding the LCC final score, both scenario produced almost the same result. However, we need to acknowledge that the system boundary of the analysis is only the production of granulates. This could then be transformed into new, more value added products in the market. With this and with long term contracts regarding transportation and treatment, these costs could be decreased. Getting back to the rationale behind the qualitative scores, since with the new CE solution the environmental sustainability could be increased plus the dependency hence the risk of the company could be decreased.

References
[1] CIRCE2020: Shared technology rating methodology (TRM) to check out readiness of new techs and processes
[2] CIRCE2020: Guidelines for adaptation of LCA methodology to estimate environmental impact
[3] Zs. István, B. Sára: Technological, environmental and economical evaluation of circular economy solutions with life cycle approach