The i-REXFO-LIFE business model for food waste reduction through environmental and economical design on the Life Cycle

P. Bartocci[2], M. Zampilli[2], F. Liberti[1], S. Massoli[1], V. Pistolesi[1] and F. Fantozzi[2]

[1]Biomass Research Centre, University of Perugia, Strada Santa Lucia Canetola, 06125 Perugia, Italy
[2] Department of Industrial Engineering, University of Perugia, Via G. Duranti 67, 06125 Perugia, Italy

Keywords: waste, food, co-digestion, biogas, LCA
Presenting author email: francesco.fantozzi@unipg.it

Every year the food produced and wasted consumes a volume of water equal to 250 km requires around 30% of the world agricultural land, and it is responsible for the emission of 3,3 billion tons of greenhouse gases. The direct economic consequences of food waste are ranging around 750 billion dollars per year (FAO source). i-REXFO designs an innovative business model with the objective of reducing significantly the amount of landfilled food waste. The actions are economically sustained by public incentives, tax reductions and private revenues from energy valorization of residual food waste.

Uptaking the good practices from other EU countries (Denmark) the project will develop a tool to design the integrated model, optimize it from a technical, economic and environmental point of view and transfer it to other EU regions. i-REXFO will increase consumer awareness on food waste reduction in retail malls and HORECA while facilitating the sale and donation to charities and food banks of close to expiration and aesthetically not adequate food; it will also remove the barriers that hamper the use of food residues in biogas plants. The actions are economically sustained from energy valorization of food waste in biogas plant that use the digestate as fertilizer, closing the cycle.

i-REXFO will achieve an overall reduction of 17000 tons/year of food waste landfilled during the project duration and in the after life phase. This will correspond to an overall reduction of 41000 tons of CO2 equivalent emissions. i-REXFO is developing an open-source software to design the integrated scenario and optimize it from a technical, economic and environmental point of view (Figure 1): the logistics is optimised using a Vehicle Routing Problem Solver, mass and energy balances of the biogas plant are calculated scaling up Biomethanation Potential Tests performed at laboratory scale (see figure 2).

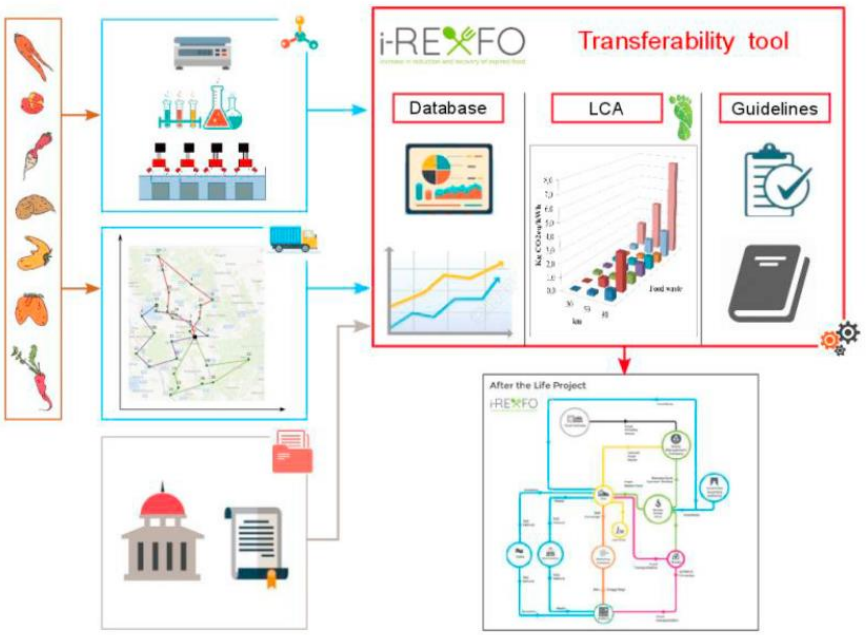

Figure 1 – iREXFO transferability tool for the design of optimization of the circular economy model

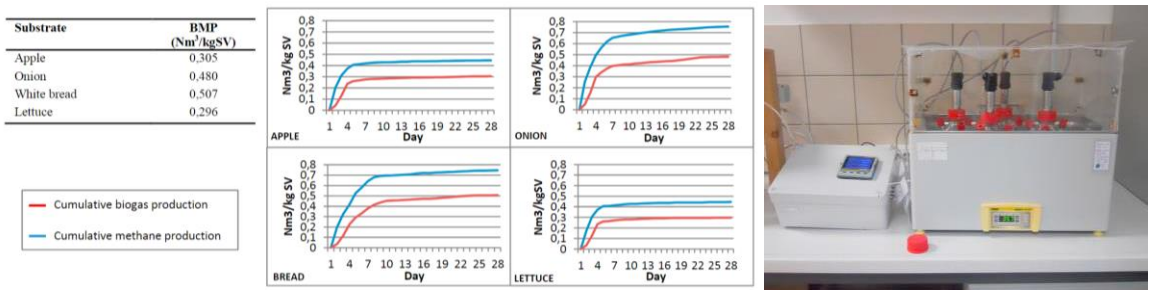

Figure 2 – Waste food BMP experimental database within the iREXFO transferability tool

This paper presents a first application of the transferability tool to assess the environmental benefit in the substitution of energy crops (like maize silage) with food waste in anaerobic digestion. Particular attention is focused on digestate disposal. In fact the digestate obtained using food waste as feedstock presents technical and environmental problems if used as a fertilizer. So both disposal and recycle/reuse processes are compared as end-of-life processes.

Data obtained from food waste transport and anaerobic co-digestion process are used as input for LCA analysis (see figure 3).

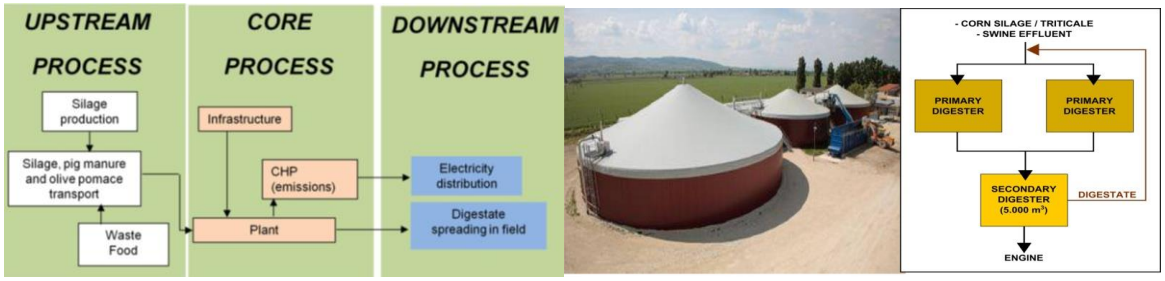

Figure 3: LCA boundaries for real scale biogas plant

The impact categories taken into account are the following: acidification, eutrophication, climate change and photochemical oxidation. The functional unit is set to be 1 kWh of electricity produced from biogas. The results show a reduction of the environmental burden when food waste is used to substitute the energy crop. Particularly favourable results to be the impact on climate change (see figure 4).

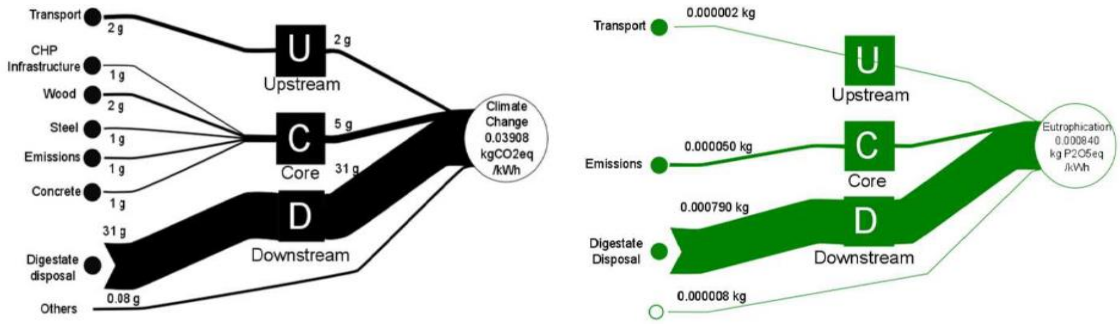

Figure 4: Impact on climate change (left) and eutrophication (right) obtained substituting 100% of maize silage with food waste

Other impacts are not always favourable. In fact the impact on eutrophication can increase when food waste is used, this depends on phosphorus content of food waste and on the content of phoshorus in maize silage. Depending on its composition food waste can contain higher content of phosphorus causing higher impact on eutrophication.