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CARBON FOOTPRINT OF A PALE LAGER

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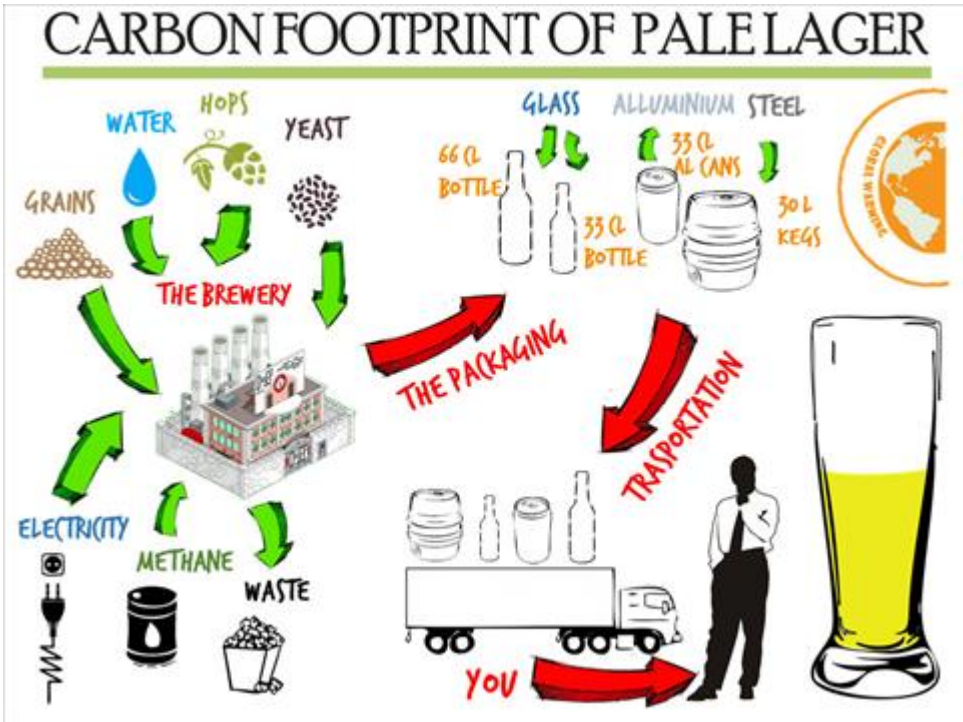

Energy and water consumption, waste generation, and emissions to air are the main environmental issues of the brewing industry. Thus, the beverage sector has started implementing strategies to reduce its impact on the global climate, as focused for instance by the Beverage Industry Environmental Roundtable on the basis of the sensitivity of the beer Global Warming Potential (GWP) to variations in material or process practice aspects (such as packaging material selection, distribution logistics, recycling rates, etc.) in either Europe or North America.

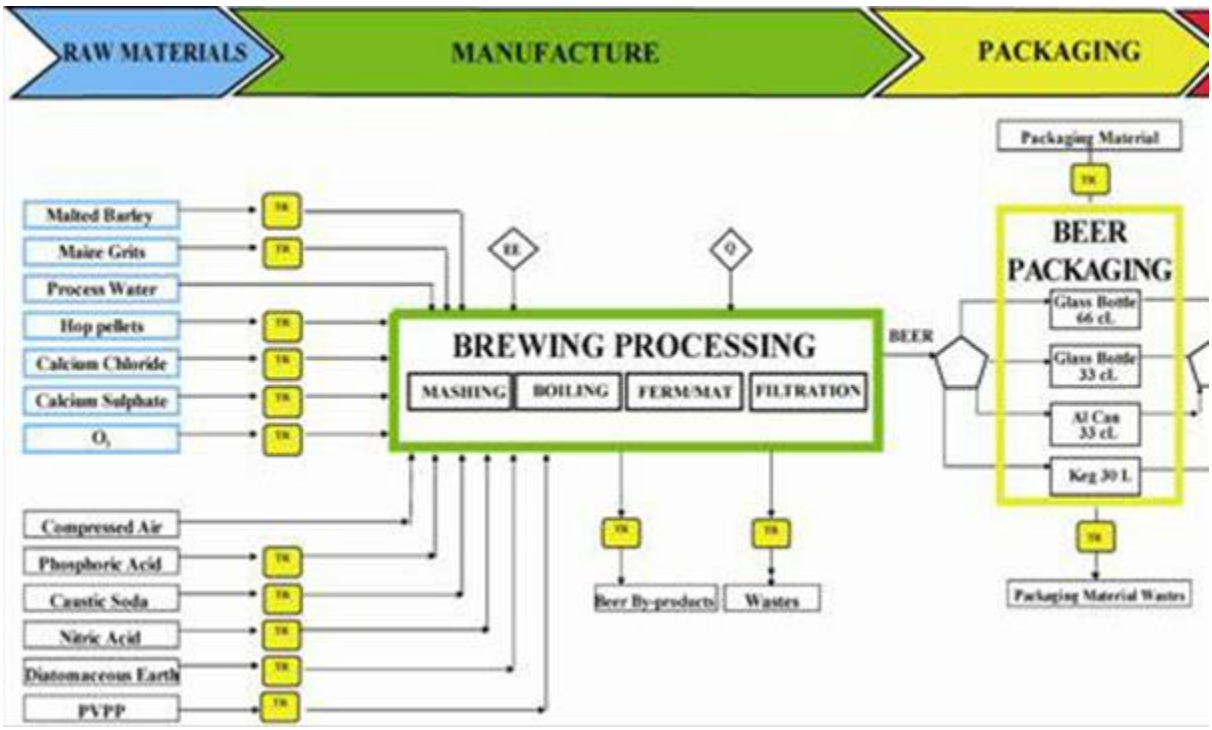

Fig. 1 : Beer system boundary (TR = transport)

As shown in Fig. 1, the system boundary was not restricted to the brewing process. It was extended from the agricultural processes of barley, corn, and hop cultivation to the production of malt, maize grits, and beer, as well as the packaging and auxiliary materials, by including the transport of raw, process, and packaging materials from their production sites to the brewery gate, and the transport of packaged beer to the distribution centers, the disposal of packaging material waste generated in the brewery, the treatment of wastewaters, the production of methane by anaerobic digestion, and the production of heat, as well as electricity utilization from the Italian grid.

In compliance with the Publicly Available Specification 2050 standard method, the environmental impact of the industrial production and distribution of 1 hL of a pale lager was found to be very dependent on the package formats used. More specifically, in the case of the lager beer produced by the Italian brewery Birra Peroni Srl (Rome, Italy) over the period April 2012-March 2013, the estimated carbon footprint (CF) of 1 hL of lager beer packaged in 66-cL glass bottles, 33-cL glass bottles assembled in cardboards or cluster packs, 33-cL aluminum cans, or 30-L steel kegs was of the order of 57, 67, 74, 69, or 25 kg CO_2e, respectively. Such a difference in the overall carbon footprint values was due to the diverse contributions of packaging materials and transportation. In particular, the impact of packaging materials was minimum in the case of kegs, in virtue of the high reuse coefficient, and maximum in the case of the 33-cL glass bottle cluster packs.

Such estimated carbon footprint values were considerably lower than those reported in the most recent literature, probably because of the large production scale and short distribution chain of *Birra Peroni* brewery, utilization of beer co-products as feed and anaerobic

digestion of liquid wastewaters.

Moreover, the sensitivity analysis of CF revealed that two promising strategies might be applied to reduce further the overall greenhouse gas emissions. Firstly, it was suggested to replace glass bottles and steel kegs with novel PET bottles and drums enriched with nanoclays; and, secondly, to use organic barley grown locally. Both these strategies might be generally applied, being not specifically related to the brewery production scale examined here.

Contrary to the quite numerous environmental assessment exercises openly available in the technical literature, in this work it was chosen to resort to wholly transparent data to allow the present CF model to be reproduced by any researcher, this being one of the main principles of the scientific method, as well as to be re-used as soon as better quality data are available (Cimini and Moresi 2015 Journal of Cleaner Production, http://dx.doi.org/10.1016/j.jclepro.2015.06.063).

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