

Industry Symbiosis and Waste Glass Upgrading: A Feasibility Study in Liverpool Towards Circular Economy

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Abstract : Glass is widely used in everyday life, from glass bottles for beverages to architectural glass for various forms of glazing. Although the mainstream of used glass is recycled in the UK, the single-use and then recycling procedure results in a lot of waste as it incorporates intact glass with smashing, re-melting, and remanufacturing. These processes bring massive energy consumption with a huge loss of high embodied energy and economic value, compared to re-use, which's towards a 'zero carbon' target. As a tourism city, Liverpool has more glass bottle consumption than most less leisure-focused cities. It's therefore vital for Liverpool to find an upgrading approach for the single-use glass bottles with low carbon output. This project aims to assess the feasibility of industrial symbiosis and upgrading the framework of glass and to investigate the ways of achieving them. It is significant to Liverpool's future industrial strategy since it provides an opportunity to target economic recovery for post-COVID by industry symbiosis and up-grading waste management in Liverpool to respond to the climate emergency. In addition, it will influence the local government policy for glass bottle reuse and recycling in North West England and as a good practice to be further recommended to other areas of the UK. First, a critical literature review of glass waste strategies has been conducted in the UK and worldwide industrial symbiosis practices. Second, mapping, data collection, and analysis have shown the current life cycle chain and the strong links of glass reuse and upgrading potentials via site visits to 16 local waste recycling centres. The results of this research have demonstrated the understanding of the influence of key factors on the development of a circular industrial symbiosis business model for beverage glass bottles. The current waste management procedures of the glass bottle industry, its business model, supply chain, and material flow have been reviewed. The various potential opportunities for glass bottle up-valuing have been investigated towards an industrial symbiosis in Liverpool. Finally, an up-valuing business model has been developed for an industrial symbiosis framework of glass in Liverpool. For glass bottles, there are two possibilities 1) focus on upgrading processes towards re-use rather than single-use and recycling and 2) focus on 'smart' re-use and recycling, leading to optimised values in other sectors to create a wider industry symbiosis for a multi-level and circular economy.

Keywords : glass bottles, industry symbiosis, smart re-use, waste upgrading

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