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Gateways to Revalorisation in Future Circular Cities: A Vision for Closed-Loop Resource Flows.

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Fast-Moving Consumer Goods (FMCGs) are repeatedly purchased and consumed to temporarily and conveniently satisfy continuous needs. Their intense use and disposal cause finite resource- depletion and waste issues globally, while the value of resources is routinely lost. In a Circular Economy the objective is to retain resource value. To achieve and optimise closed-loop resource flows, it is suggested to 'think in systems'. Among others, systems have been designed to (re)capture and revalorise resources for successive cycles. Consumers access such systems through a variety of *gateways*, i.e. entry points where resources are collected for transit to the next system. Despite the existence of these systems, recovery rates of obsolete resources are poor, e.g. only 2% of global plastic packaging exists in closed-loop systems.

Poor recovery rates are to large extent caused by low collection rates that are susceptible to consumer-engagement. The design of today's collection systems increasingly saddles consumers with specific logistic activities. Engagement with these activities is all but self-evident. First, because increasing environmental awareness does not guarantee pro-environmental behaviour. Second, it is predicted that by 2050, 68% of the global population will live in small costly living spaces in urban areas, which limit the ability to sort and store waste. Third, as cities grow, commuting times are likely to increase and FMCGs will be conveniently consumed and disposed on-the-go, regardless of gateways. Finally, digitisation is disrupting FMCGs' purchase and consumption patterns⁹, which in turn can disrupt existing gateways.

This research aims to identify factors that influence collection rates of obsolete FMCGs, by studying the activities that consumers need to undertake to use different gateways. The results of this work are used to outline requirements for the design of future gateways. We have used customer journey mapping to analyse the activities that consumers undertake to access three common gateways: *kerbside collection of recyclables* through analysis of 'Recycle now' protocols of 10 London Boroughs; *revalorisation services for FMCGs in take-back schemes* through analysis of 18 case studies; *on-the-go recycling* based on the analysis of recycling possibilities along 5 of London's home-work commutes.

We identified four key activities common to all gateways: 'to clean' and 'to stock' resources, 'to prepare' resources for their transit and disposal, and 'to transit' them to the gateways. The activities differ per gateway in the means required to undertake them (e.g. time, space) and provided by the system to facilitate collection (e.g. collection products, services, incentives). The means are subject to socioeconomic variables and the exact impact on collection rates is still to be studied. Nevertheless, the likelihood of consumers undertaking the activities greatly depends on the availability of and access to these means. This is dependent on who the consumer is, and when and where the activities take place. Based on insights into future consumers, we outline the following requirements for gateways to improve collection rates in future cities: *facilitate reuse of obsoletes* to allow consumers to revalorise locally; *reduce stock volume and complexity* to align with consumers' ability and willingness to dedicate space to stock obsolete resources; *ease and facilitate cleaning activities* by providing instructions and facilities on location; *improve localisation of gateways* to incentivise their use; and *keep lean and connected stock* to minimise stock volumes, optimise collection logistics and facilitate the consumer in the organisation and planning of resource movement. This work contributes to the development of effective revalorisation services, circular resource infrastructure and business models for a sustainable future.