GLA Circular Economy Infrastructure Study

Strategic review of London's Circular Economy infrastructure

Greater London Authority

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Quality information

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Aims

The purpose of this report is to determine what types of infrastructure and spatial requirements are needed for London's transition to a low carbon circular economy. The report considers all waste streams – including household, commercial, industrial, construction, as well as specific categories such as food waste, plastics and packaging, and electricals, to ensure a holistic approach to resource management.

The report aims to identify the opportunities and constraints, based on London's unique geography, economy and demographics; and to accelerate the city's transition to a circular economy. This involves exploring different scenarios towards a circular economy in London considering both the physical and digital types of infrastructure that would be needed to implement these scenarios.

The methodology included a mixture of desk-based research, and a workshop attended by representatives of London boroughs and waste disposal authorities, statutory bodies, non-governmental organisations, and academia.

Infrastructure Types

A number of factors influencing circular economy development were identified, both overarching and London-specific, and the potential infrastructure types were categorised into physical and digital types, illustrated in Table 1:

Table 1. Infrastructure types

Physical Infrastructure	Digital Infrastructure
• Dedicated reuse and repair centres	• Smart sorting and tracking systems
• Collection points and takeback programmes	• Digital exchange platforms
• Food redistribution hubs	• Material passports
• Building material banks	• Information and communication platforms
• Cleaning and sanitisation units	
• Libraries of things	
• Remanufacturing and reprocessing centres	
• Reverse logistics hubs	

Scenarios

The following scenarios were developed:

- **Scenario 1: Innovation incubator.** Physical and digital infrastructure needs would focus on providing space and facilities for startups, pilots and proof-of-concept studies. Knowledge dissemination networks would play an important role in educating and informing citizens, businesses, investors, financial institutions and product designers about the benefits and applications of the circular economy, and in attracting funding.

- **Scenario 2: Distributed reuse networks.** The emphasis would be on infrastructure which facilitates localised exchange and reuse of products, thereby keeping them out of the waste management system. Physical infrastructure would focus on a wide network of relatively small-scale facilities for the collection, repair, refurbishment and reuse of products. Digital infrastructure needs would reflect this and would facilitate these local exchanges of materials and products by linking donors and receptors, whilst ensuring transparency of information to build confidence and certainty into these transactions.
- **Scenario 3: Reprocessing hubs.** Economies of scale would be realised by providing physical infrastructure to collect and (where possible) manage this material within London. Physical infrastructure would be required for collection and reprocessing / remanufacture, supported by the digital infrastructure to facilitate effective material collection and separation at scale, as well as to provide the necessary data to allow safe and efficient reprocessing of end-of-life products back into raw materials.

Actions

Suggested priority actions for infrastructure development for each scenario have been developed. The stakeholder engagement and research work for this study suggests an “all of the above” rather than an exclusive focus on a single scenario, with different material types requiring different approaches.

- For Scenario 1 (innovation incubator), short-term priorities would be focused on digital tools and innovation networks: in the medium term, physical infrastructure for research and pilot-scale facilities would be prioritised; whilst in the longer term there would be focus on providing suitable infrastructure for scaling-up of emerging technologies.
- For Scenario 2 (distributed reuse networks), in the short-term the focus would be on supporting new and existing neighbourhood facilities and using digital networks and tools to encourage usage. Medium-term priorities would include considering how to integrate facilities into the existing HWRC network, and how new developments could be required to provide space for reuse/repair hubs. Over the longer-term, the priorities would be to scale up to a comprehensive network of such facilities across London, integrated with the necessary digital tools.
- For Scenario 3 (reprocessing hubs), the short-term priorities would be to identify and where possible safeguard locations for large-scale reprocessing activities; and then in the medium and longer-terms to engage with potential operators of existing and emerging processes to determine their specific requirements and how to support their development.

1. Introduction

1.1 Aims of this document

AECOM was appointed by the Greater London Authority (GLA) to carry out a study to determine what types of infrastructure (both physical and digital) are needed for London's transition to a low carbon circular economy.

The report considers all waste streams – including household, commercial, industrial, construction, as well as specific categories such as food waste, plastics and packaging and electricals, to ensure a holistic approach to resource management.

The report aims to identify the opportunities and constraints for circular economy infrastructure, based on London's unique geography, economy and demographics; and to accelerate London's transition to a circular economy. This involves exploring different scenarios towards a circular economy in London considering both the physical and digital types of infrastructure that would be needed to implement these scenarios.

This report responds to the following research questions posed by the GLA:

- What are the possible scenarios for how a circular economy could continue to develop in London?
- What are the infrastructure requirements for each scenario identified and how do they vary between different scenarios?
- How does London's unique characteristics impact the way the circular economy could develop? What impact might this have on infrastructure requirements?
- What are the benefits and risks associated with the various scenarios?
- What types of infrastructure could be prioritised to ensure London's transition to a circular economy is effective and sustainable?

1.2 Reporting structure

The structure of this study is as follows:

- Section 1 (this section) sets out the aims and scope.
- Section 2 describes the research methodology that has been followed.
- Section 3 discusses the key factors influencing circular economy infrastructure development, both in general and with respect to the London context.
- Section 4 presents a list of infrastructure categories, both physical and digital, which support a circular economy.
- Section 5 identifies and discusses the scenarios that have been developed in response to the factors identified in Section 3 below and the types of infrastructure detailed in Section 4.
- Section 6 analyses how these scenarios are impacted by London's unique characteristics, describes the risks and benefits of each scenario, and suggests a series of priority actions.

- Section 7 draws together the outputs of the preceding sections into a set of conclusions in response to the research questions posed by GLA and set out in Section 1.1 above.

1.3 Scope of this Study

Local authorities (either individually or collectively via the combined waste disposal authorities and partnerships[1]) have a responsibility to plan for the infrastructure that is required to appropriately manage London's waste in accordance with the waste hierarchy. This includes infrastructure for recycling, recovery, and disposal of waste, such as:

- Household waste recycling centres.
- Composting.
- Anaerobic digestion.
- Material recovery (e.g. separation of mixed recyclables into single streams to facilitate recycling).
- Energy-from-waste.
- Deposit to land for recovery.
- Landfill.

The circular economy will seek to divert waste from traditional waste management processes to maximise residual value (i.e. to repair and reuse rather than dispose).The purpose of this study is to identify the infrastructure (physical and digital) which can complement the existing and planned waste infrastructure, to support the transition to a circular economy by minimising the amount of resources that become waste in the first place. It is acknowledged that conventional waste management processes play (and will continue to play) an essential role in managing resources within London. Although the circular economy seeks to divert materials away from this type of waste infrastructure, it is anticipated that there would be continuing need for such facilities during the transition to a circular economy, to deal with those wastes for which circular processes are not technically or commercially feasible, and even in the longer term there may still be some residual waste materials (e.g. food waste unfit for consumption) which require treatment in traditional waste facilities. It is anticipated that over time the quantity of waste requiring management in traditional waste facilities would therefore decline, with the highest rate of decline being for those higher value materials which lend themselves better to circular processes.

This study is not limited to any specific materials or products, but recognises the work that has already been done on priority waste streams within London (e.g. by ReLondon (Ref.1)), and hence the following categories of waste are of particular relevance when considering infrastructure types:

- Food.
- Fashion and textiles.

[1] The relevant combined partnerships/authorities are North London Waste Authority; East London Waste Authority, West London Waste Authority; Western Riverside Waste Authority; South London Waste Partnership

- Plastics and packaging.
- Electricals and electronics.
- Built environment (i.e. waste from construction, demolition and excavation).

Where this report forms part of the evidence base for the next London Plan, the findings and conclusions will inform ongoing policy development, however, the study does not seek to provide specific policy recommendations. The following exclusions to the study should also be noted:

- The study does not identify specific sites or locations for the provision of infrastructure or allocate spatial land use targets.
- The study does not include detailed quantitative London-wide carbon assessments of waste and material flows. The study seeks to qualitatively address infrastructure requirements in relative terms and does not provide quantification of risks and benefits, including capital expenditure (capex) and embodied carbon.

2. Research Methodology

2.1 Overall approach

The methodology is based on the following key steps:

- To identify the general and London-specific factors which will influence the way the circular economy could develop and how these could impact future scenarios.
- To identify the infrastructure types which could be required to support the circular economy in London.
- To develop and evaluate scenarios to support the development of London's circular economy alongside benefits and risks, and identification of supporting infrastructure requirements.

Two key methods of information collection have been used to inform the reporting outcomes: a review of industry information and a stakeholder engagement workshop. Section 2.2 and Section 2.2.1 set out additional detail with respect to the review of industry information and stakeholder engagement processes respectively. Figure 1 provides an overview of the methodological steps undertaken.

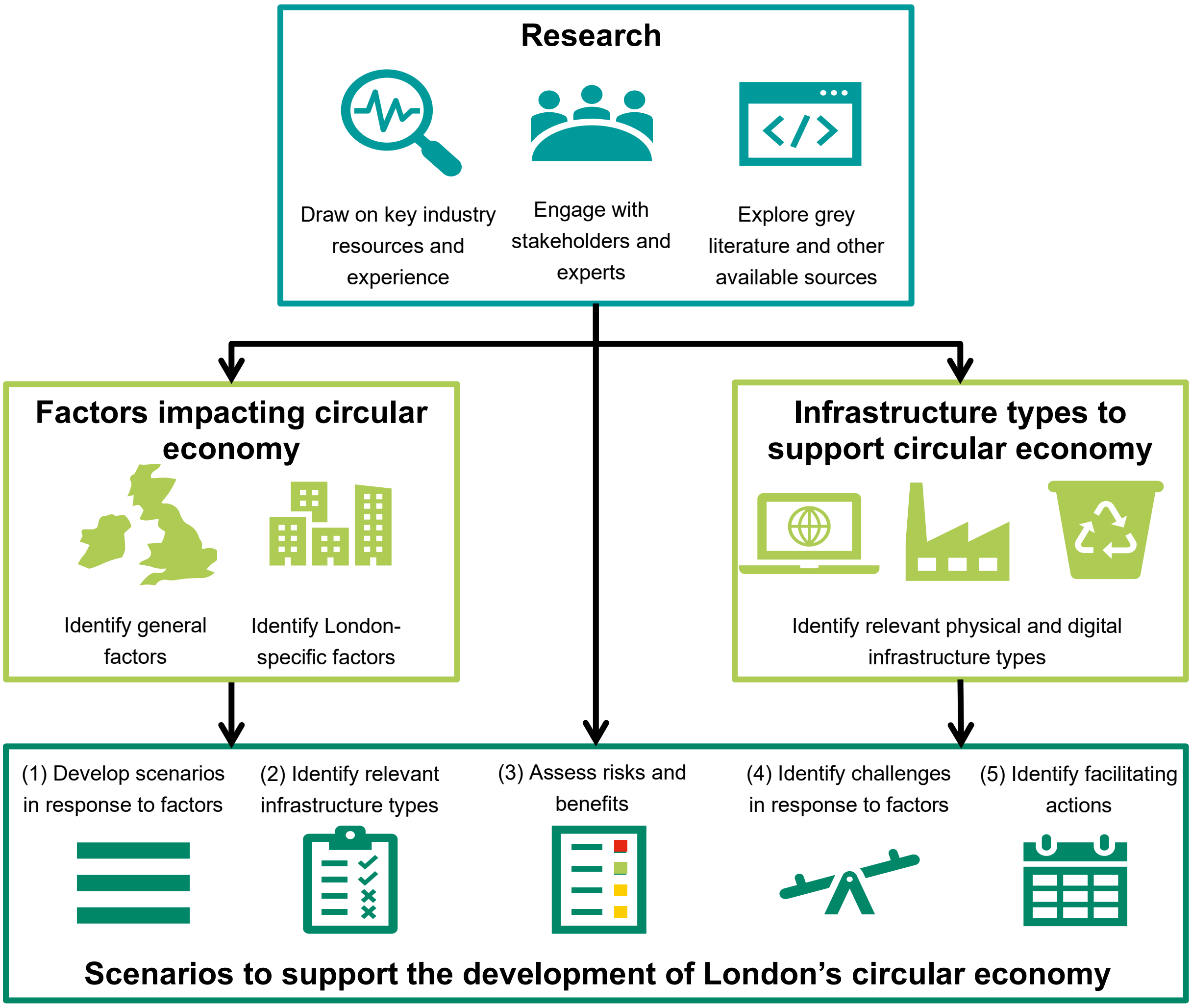

Figure 1. Methodological steps undertaken as part of this study

2.2 Information review

Resources and studies from key industry bodies were drawn upon to inform the initial list of factors and infrastructure types which were refined through stakeholder engagement before going on to inform the scenarios.

Key sources of information which were referred to throughout the development of this study included, but were not limited to:

- Amsterdam Circular 2020-2025 Strategy (Germeente Amsterdam) (Ref. 2)
- Circular Flanders case study information (Ref. 3)
- Circular Cities Declaration Report 2024 (Ref. 4)
- ReLondon studies into priority waste streams:
  - London’s Fashion Footprint (Ref. 5)
  - London’s Food Footprint (Ref. 6)
  - London’s Packaging Footprint (Ref. 7)
  - London’s Electrical Sector (Ref. 8)
- ISO59004 – Circular Economy Principles (Ref. 9)
- ReLondon Insight note – Space to go ‘round’: the case for more circular industrial processes in cities (Ref. 10)
- Ellen MacArthur Foundation Circular Cities Project (Ref. 11).

Following identification of factors and infrastructure types, exploratory web-based research was undertaken to identify grey literature sources. The search was focussed primarily on practical applications or examples of circular economy infrastructure, drawing mainly on examples from other cities and case studies. This included identifying specific examples of infrastructure types which could be used to support the circular economy in London. These are detailed further and referenced in Section 6.Summary of stakeholder engagement

A stakeholder engagement workshop was hosted by the project team on Tuesday 29th April 2025. The aim of the stakeholder engagement workshop was to refine and discuss the initial set of factors, scenarios and infrastructure types identified to support London’s Circular Economy.

The workshop was carried out virtually, using a digital whiteboard for participants to post comments, observations and suggestions, alongside facilitated discussions.

Participants included representatives of:

- London’s combined waste disposal authorities. Those attending were:
  - North London Waste Authority
  - East London Waste Authority
  - West London Waste Authority
- A selection of London boroughs
- Government and statutory bodies:
  - Department for the Environment, Food and Rural Affairs

  - Environment Agency
- Relevant non-governmental organisations and advisory bodies:
  - ReLondon
  - Ellen MacArthur Foundation
  - Waste and Resources Action Programme (WRAP)
- Academic institutions
  - University College London

A pre-read document was issued to attendees for review prior to the workshop to facilitate preparation for the session and provide material ready for discussion. This included a preliminary list of factors and infrastructure types, and an initial outline of the scenarios for consideration.

The workshop was delivered via Microsoft Teams and facilitated using a Mural board. The Mural board was used to facilitate conversations and collaboration between attendees and as a means of recording the inputs of attendees in real time. The Mural board remained accessible to attendees following the session to allow for any final feedback to be captured following the session. Figure 2 provides illustration of the extent of written feedback received from attendees during the workshop session.

Workshop participants were invited to provide verbal feedback upon the questions posed and contribute to the discussion between attendees. This feedback was captured via meeting minutes for future reference and consideration in the study, this is summarised in Section 2.2.1.

Figure 2. Excerpt of the Mural board following the workshop including stakeholder feedback

2.2.1 Summary of stakeholder engagement

The workshop was broken into three key sessions and extensive feedback was received from stakeholders that has informed the subsequent development of this study. A selection of some of the overarching feedback is presented below (noting that many additional more detailed comments were received which have also been taken into consideration).

- **Session 1: What are the locally-relevant circular economy factors?**
  - Stakeholders noted that the significant scale of development in London is both opportunity and constraint:
    - Stakeholder noted that lots of flats being constructed and occupied near to recycling centres are increasing inflow of waste.
    - Density of population in London means there is a greater potential to achieve the level of demand for renting, repair and reuse. Stakeholders referenced that around 1/3 of people are already doing this and another 1/3 would if it was convenient.
    - It was noted that much waste needs to be exported and excess of waste can lead to potential criminality.
  - Stakeholders noted that development of the circular economy in London risks placing significant burden on Local Authorities:
    - Stakeholders noted that the responsibility of boroughs currently ranges anywhere from clothing swap to full circularity hub. Beyond waste and emissions reductions, there is no real financial incentive to Local Authorities, with facilities being expensive to set up and requires a lot of expertise. There is a significant limitation in terms of the available personnel, with perhaps only one person involved at Local Authority level.
    - It was acknowledged that Local Authorities have a very broad range of services. Responsibility would need to be split this down into delegating into small, specific organisations who can engage with the community (e.g. one for furniture, another for large white goods).
  - Stakeholders noted that social factors play a role in how the circular economy can be developed:
    - Stakeholders reported success with neighbourhood level events are particularly successful - e.g. second-hand bike sales, clothing swaps – where these are regular and reliable, in the same location.
    - Stakeholders noted that business improvement districts and peer-to-peer systems have benefit to circular economy and support boroughs in building more resilient local industry.
    - Stakeholders noted that London is a good environment for new circular businesses which are increasingly emerging in the private sector.
  - Stakeholders agreed that availability and affordability of physical space is a key requirement for management of waste which varies across London:
    - It was highlighted that some central boroughs have no physical space to support construction waste exercises and will be limited to development sites themselves or engagement with other boroughs.
    - The exploration of digital infrastructure types was supported, noting that digital just-in-time infrastructure would be significantly space saving, though there are still challenges to using BIM for this, even for new build.
  - Stakeholders acknowledged that London is a hub of available knowledge and information which could be embraced to support the circular economy:

  - Stakeholders noted that some key information is currently held by businesses and manufacturers, limiting wider roll-out of best practice processes. Some businesses are trying to increase the level of transparency and available data however there are digital constraints to the availability of databases where information (such as material passports can be uploaded).
  - It was acknowledged that technical and academic knowledge could support required standardisation to allow for better data collection due to resolution and consistency, such as for pre-demolition audit information. This also has potential to feed into digital material exchange platforms.

- **Session 2: What are the infrastructure scenarios to be taken forward for assessment?**
  - Stakeholders supported suggestions that London be just part of the process rather than full end-to-end circular economy cycle.
  - Stakeholders shared experience that large retail are considering interventions at an international-level rather than London-level, so there is likely to be more opportunity relating to small- / medium-sized businesses, with a balance between the business- and consumer-levels.
  - Stakeholders noted that there needs to be demand in order to drive the Circular Economy. Any physical hubs need to be close to the consumer (i.e. demand) to be successful to overcome limitations (e.g. transportation).
- **Session 3: What are the types of infrastructure to consider?**
  - Stakeholders referenced that various materials and exchange platforms have been explored with focus on construction and fashion. Boroughs noted that material exchange platforms require both physical and digital infrastructure, with feasibility studies undertaken noting significant time required before roll-out.
  - Stakeholders noted that reuse and repair centres are working well at a community scale. However, these are typically driven by individual volunteers, who lack support. Some of these are attached to HWRCs but are very much overused. These need to be accommodated in smaller sites (e.g. shops) with walkable locations.
  - Stakeholders noted that there are limitations to London-wide or cross-borough infrastructure where this would have to located in one borough or another. Boroughs would need to consider whether a fee is in place for visitors out of borough where there is challenge to the borough in terms of bear burden of costs, additional vehicle movements etc.
  - Stakeholders noted that sanitary products (e.g. nappies) are likely to require a different approach and could in themselves drive an element of industry, for reusables and processing. With sanitary products and washing services a behaviour change is required, and a potential challenge is present in ensuring consumers are given the same products back which they send in for cleaning.

2.3 Analysis

The results of the information review were used to set the context and present draft lists of factors, scenarios and infrastructure types for discussion in the stakeholder workshop.

The project team then synthesised the results of the stakeholder engagement and information review together with the teams' own experience of circular economy infrastructure to develop the final set of factors, scenarios and infrastructure types that are presented in the following sections of this report.

3. Key Factors

3.1 Introduction

Transitioning to a circular economy will require changes to many aspects of how we use materials and products. Our use of materials and products is in turn influenced by many factors.

One set of factors is the laws, guidelines and policies set either nationally or locally, and the governance structures by which these are implemented. Some of these are within the control of the GLA (e.g. planning guidelines and policies for London) whereas others are not (e.g. national legislation). This regulatory and policy environment for circular economy at the national level is still emerging and is expected to be strongly influenced by the findings of the Circular Economy Taskforce, and is hence not considered further in this report. However, it will be necessary to review and possibly update this assessment of future infrastructure needs in the light of any new policies or regulations that result from the national Circular Economy Strategy in due course.

Another set of factors relates to other aspects of the socio-economic system that affect our relationship with materials. These are potentially very wide ranging; from the global system of production that extracts material and manufactures products, through to the psychological factors that influence our feelings about our belongings and drive our patterns of consumption.

The following section summarises some of these factors: firstly, outlining general factors that will influence the transition to a circular economy, and secondly looking more specifically at factors as they apply to London. These factors were then used as a basis for discussion during stakeholder engagement, and informed scenario development.

3.2 General Factors

As outlined in Section 2 above, an initial list of general factors was developed based on technical experience and industry context and refined through stakeholder engagement. Table 2 sets out the general factors that the report authors consider will impact the development of the circular economy in London, and what effects these might have on the development of infrastructure.

Table 2: General Factors

Factor	Description	Potential Effects
Waste types	Circular economy infrastructure needs to be tailored to specific materials. The selection of key materials to be considered is based on ReLondon's circular economy work, namely: • Textiles • Electrical and electronic equipment • Plastics and packaging • Food • Construction materials	The priority waste streams already identified by ReLondon should remain the focus for circular infrastructure. Different material types might need managing at different scales (e.g. distributed models may suit certain waste types better than others)

Factor	Description	Potential Effects
Behaviours	A central proposition of circular economy is to change how individuals and organisations manage their use of materials. Behaviours may be influenced by underlying socio-economic factors, as well as cultural factors such as the behaviours of one's friends, neighbours and family; advertising; and the influence of public figures. Corporate behaviours can be influenced by the need to remain competitive in terms of meeting customer's expectations around sustainability.	Some behavioural changes are driven by external regulatory drivers (e.g. legislation, subsidies), but any such changes can be supported by having the right infrastructure in place. Digital tools can also drive behaviour change in terms of increasing accessibility to relevant information and networks. Voluntary behavioural changes (e.g. willingness to use circular economy infrastructure and acceptance of circular economy outputs) are relevant to consideration of the type and distribution of infrastructure.
Material Flows	Material flow is a useful lens through which to consider circularity: London has large flows of finished products into the city and exports waste/recyclable materials for disposal or processing elsewhere.	Geographic and economic factors affect material flows: lack of manufacturing capacity may limit markets for certain types of recovered materials, since manufacturers are in many cases the ultimate customer for recycled or recovered materials. High land costs may limit establishment of infrastructure with high space requirements.
Technical Capacity	Circular economy infrastructure provision needs to have regard to existing and future supply chains for reused and remanufactured products, and the extent to which it is realistic to reinforce or establish this technical capacity within London	Expansion of existing technical capacity may be more feasible than establishing entirely new capacity. There may be synergies or dependencies between different types of technical capacity that influence what types of infrastructure are viable.
Regulatory, Policy and Economic Environment	Current and planned regulations and policy may impact on waste types and material flows, and on how and where circular economy infrastructure is provided.	Planning and permitting requirements will be a constraint on infrastructure development, in terms of driving cost and location. Flexibility required in order to respond to future changes.

3.3 London-specific Factors

Following development of the list of general factors, factors specific to London were similarly developed, based on technical experience and industry context and refined through stakeholder engagement.

Table 3 sets out the London-specific factors that are anticipated to impact to the development of the circular economy in London, and what effects these might have on the development of infrastructure.

Table 3: London-specific Factors

Factor	Description	Potential Effects
Local government structure	Individual boroughs have final responsibility for waste collection and management, although many boroughs have chosen to work together to deliver their waste disposal responsibilities by means of joint Waste Disposal Authorities. The individual boroughs are also responsible for land use planning within their boroughs. Whilst there are London-wide bodies such as ReLondon and the GLA, their role in the planning system and their ability to provide funding for projects are more limited.	Funding for specific infrastructure which is located in one borough but which provides London-wide services may be constrained by the planning and funding model of local government.
Low proportion of industries able to reprocess materials	London has fewer facilities for manufacturing goods compared to other regions. Manufacturing industry accounts for 2% of London's economic output compared to 9.1% across the UK (measured as % gross value added, UK, 2023) *Source: Industries in the UK, Research Briefing 2024 – House of Commons Library Industries in the UK - House of Commons Library*	The relative lack of manufacturing capacity may limit the potential to reprocess and remanufacture products within London, due to lack of both physical capacity and manufacturing skills.
High land costs	Both residential and industrial land values in London are significantly higher than the UK average: • Residential land values (£/ha 2019) – England including London (£6,013,744) – England excluding London (£2,686,981) – London (£35,551,364) • Industrial land values (£/ha, 2019) – England including London (£1,250,337) – England excluding London (£818,635) – London (£5,083,333) *Source: Calculated from VOA_land_values_2019 Land value estimates for policy appraisal 2019 - GOV.UK*	The cost of physical infrastructure is likely to be higher in London than elsewhere in the UK, particularly in terms of large-scale land uses. Storage space in residential development is also limited for this reason.
High population density	London has the highest population density in the UK: • London population density (5,598 residents per km^2) • England population density (434 residents per km^2) • Wales population density (148 residents per km^2) Top 20 most densely populated local authorities across the two nations were all London boroughs *Source: 2021 Census Population and household estimates, England and Wales*	London's high population density means that within a given area there is a high volume of material and products available for circular economy processes; but infrastructure needs to be efficient (in throughput terms) to manage this material.

Factor	Description	Potential Effects
Research and development (R&D) funding	London has the highest overall R&D expenditure of all UK regions (including government, research institutes, higher education, businesses and private non-profits): • Expenditure on R&D by region for London (£13.7 billion) • Total UK expenditure on R&D (£70.7 billion) *Source: Gross domestic expenditure on research and development, UK: 2022- Office for National Statistics*	London has a very strong position in the UK's R&D network, which includes many institutions of higher education attracting global talent – strong culture of innovation, and access to sources of funding from London's financial sector.
Low car ownership level	The proportion of Londoners owning a car or van is below the national average: • England average households with no cars or vans (23.5%) • Wales average households with no cars or vans (19.4%) • England regions, except for London, with no cars or vans (all below 27.6%) • London average households with no cars or vans (42.1%) *Source: 2021 Census Housing, England and Wales - Office for National Statistics*	The relative lack of access to private vehicles is a constraint to any infrastructure which relies on individuals transporting materials to the site, particularly for more bulky products and materials.
High proportion of flatted accommodation	The proportion of Londoners living in flatted accommodation is much higher than the national average: • London average households living in a flat, maisonette, or apartment (54%) • England average households living in a flat, maisonette, or apartment (21.7%) • Wales average households living in a flat, maisonette, or apartment (12.5%) Region examples: • Southeast (21.6%) – highest, except for London • East Midlands (11.4%) – lowest *Source: 2021 Census Housing, England and Wales - Office for National Statistics*	Flatted accommodation tends to have smaller internal and external storage for surplus materials, which may mean residents tend to dispose of them immediately rather than store them pending reuse or recovery; but may also incentivise shared use models where residents do not need to permanently own products but can lease/borrow them only when needed.
Current circular economy infrastructure	There are already examples of CE infrastructure in London (see Section 4 for selected case studies) although the geographic coverage is not comprehensive.	Any new CE infrastructure would have potential synergies with existing infrastructure, either of the type considered in this report or conventional waste infrastructure. Synergies may include positive network effects (e.g. the presence of CE infrastructure catalysing behavioural change by normalising reuse, or stimulating markets for reused materials by providing more security of supply).

4. Infrastructure Types

4.1 Introduction

This section describes the types of circular economy infrastructure that could be required to support London's transition to a circular economy. Subsequent sections then analysis which of these infrastructure types would be required for specific scenarios.

For the purposes of this study, the wide range of potential circular economy infrastructure types has been categorised into a concise framework. Within each type there remains a range of specific infrastructure facilities that could be developed, but the framework aims to group these into categories that share similar functions and have similar requirements in terms of physical space. The sections below describe:

- The types of material that are most likely to be managed using these facilities.
- A summary of the operating concept.
- Typical size requirements and spatial distribution, with spatial distribution relating to the likely catchment area for a facility and discussed at the following levels:
  - Development – serving an individual development.
  - Neighbourhood – serving a neighbourhood (typically within a borough, although potentially operating across borough boundaries).
  - Borough – serving a borough.
  - Regional – serving a cluster of boroughs (e.g. matching those boroughs within a waste disposal authority/partnership).
  - City-wide – serving the whole of London with a single facility.
- Dependencies, in terms of the necessary requirements to enable the infrastructure to function.
- Locational constraints that could limit where the infrastructure is developed.
- Selected case studies of existing examples in operation.

The list below includes both physical and digital infrastructure as distinct categories. However, in practice there is considerable overlap between these such that most physical infrastructure will have a strong reliance on digital presence in terms of attracting both materials and end-users; and digital infrastructure will need to ultimately interact with physical infrastructure in order to have demonstrable physical benefits.

Table 4: Dedicated reuse and repair centres / hubs

Category	Description
Materials	Electronics, textiles, packaging, construction and other materials/products.
Concept	A facility where surplus products can be refurbished or repaired prior to reuse, and where potential users can source reused or refurbished products. They can range in size from small community-led repair cafes/training to commercially operated repair shops, reuse stores and even reuse shopping malls. Also included under this category are premises which offer tools and/or training to motivate people to repair their own belongings.
Size / distribution (see case studies for detail)	**Size:** from small-scale workshops or reuse centres within existing retailers, up to larger scale shopping malls or industrial units. **Distribution:** smaller scale facilities likely to be distributed locally (e.g. at borough or neighbourhood level) whilst larger facilities (e.g. reuse shopping malls) may be regional or city-wide.
Dependencies (material supply and outputs)	Workforce – community-led initiatives require volunteers, whereas larger facilities would require qualified professionals. Investment in tools and equipment required, although overall capex requirements likely to be low and can readily use existing spaces. Needs inputs of end-of-life products which can be repaired or refurbished without need for excessive labour and materials. These are likely to be materials which have not entered the waste management systems (i.e. been discarded into bins) and some level of quality control required over inputs. May be a requirement for certification and testing of outputs (e.g. Portable Appliance Testing (PAT) for electrical and electronic equipment). Potential synergies or competition with existing commercial operators selling refurbished electrical equipment and second-hand clothes (whether via physical shops such as charities, or websites selling refurbished phones and gaming equipment). Potential synergies with Household Waste Recycling Centres as source of products for repair.
Locational constraints	**Site:** The types of repair and refurbishment activities carried out are unlikely to give rise to significant environmental impacts, provided all relevant regulations are followed, and hence may be suitable for land use Class E. **Transience:** Smaller scale community facilities in particular may be temporary in nature (e.g. “pop-up repair centres”) whilst larger commercial facilities are more likely to be permanent. **Accessibility + Infrastructure:** Proximity to public transport required for accessibility.

Category	Description
Case studies	A visit to Millor Que Nou, an inspiring project in Barcelona - The Restart Project (electronics – Barcelona, Spain). Repair training classes, self-repair workshops, repair businesses promotion. Operates 49 hrs/week, 20,000 visits/year, processes 1 tonne goods/month. Renew – Greater Manchester | Donate & Buy Pre-Loved Items | R4GM (multiple materials – Manchester). Accepts items donated at recycling centres for repair and renew at a Renew Hub, ready to be resold. Largest reuse facility in UK, covers 5,000m^2. The Textile Reuse Hub (textiles – London). Offers workshops teaching skills to reuse and repair, with a specialism in textiles. ReTuna Återbruksgalleria (multiple materials – Sweden). Reuse shopping mall with 14 shops. Includes a depot for items to be left by residents, where initial sorting takes place before shops conduct further sorting and repairs. Owned by municipal waste company.

Table 5: Collection points and takeback programmes

Category	Description
Material	Electronics, textiles, packaging, construction and other materials/products.
Concept	Manufacturers, retailers, or government agencies accept used/unwanted (end-of-life) products and divert them from landfills through designated collection points. Items can be sorted based on material composition/condition for recycling, reuse, and correct disposal – recycling and preparing for reuse would take place at locations remote from the collection points. These programmes are distinguished from existing waste and recycling collection carried out by boroughs at present, in that the objective is to collect very specific materials (thus minimising cross-contamination) and prioritising reuse/repair (rather than recycling).
Size / distribution (see case studies for detail)	**Size:** Pop-up collections in retail stores, deposit-return units in public spaces, storage bins in apartment buildings for specific products, marked bins for kerbside collection, depots, permanent facilities such as warehouses or reverse-logistics centres. **Distribution:** Predominantly at neighbourhood or borough scale for "bring" sites (where consumers/producers return items directly). Scale of regional or city-wide for facilities which accept products by post (e.g. small electricals) or which bulk-up products from smaller sites, is likely to limit these to sites in outer boroughs.
Dependencies (material supply and outputs)	Rely on a steady supply of used / unwanted products and willingness of consumers/producers to return items via dedicated takeback routes rather than using the existing waste system. Condition of items affects efficiency of sorting / recycling processes and level of reuse or reprocessing that is achievable. Potential synergies with existing and planned producer responsibility schemes. Potential for dedicated "milk-round" type collection services to incentivise participation and minimise requirement for collection points.
Locational constraints	**Site:** Larger sites storing larger quantities of material may be constrained by limits on traffic movements and/or noise generation and would need to be situated within areas allocated for industrial/distribution uses (i.e. Class B8). **Transience:** Consumer-facing collection points and storage bins could be either permanent or temporary, requiring lower capital. However, these need to be supported by centralised facilities, which are likely to be permanent with greater capital associated. **Accessibility + Infrastructure:** Proximity to public transport required for accessibility for consumers, including access to hubs and postal / courier facilities. Centralised and/or decentralised freight needed for material consolidation.

Category	Description
Case studies	Tech-Takeback - Circular Solutions for Tech Reuse & Recycling - Home (electronics – Brighton). Customers return used/unwanted products to designated collection points. Items are sorted based on material composition and condition. Recyclable materials are dismantled and valuable components extracted for reuse. ecycleNYC - DSNY (electronics – USA). Provides apartment buildings with a secure e-waste collection bin. Clothing, Household Fabrics, & Accessories - DSNY (textiles – USA). Textiles bins at various locations for residents to recycle clean clothing fabrics, accessories. Free textile recycling service for apartment buildings in partnership with non-profit organisation. National Cup Recycling Scheme | Paper Cup Recycling (packaging – UK). Set up by major retailers working together to create a system for collecting and recycling hot and cold paper cups - financially incentivises waste collectors to collect paper cups and provides information about collection points. CHaRM | Live Thrive (construction, electronics, usable clothes - USA). Permanent drop off points for materials (including construction debris), bookable by appointment. Garment Collecting & Recycling (textiles – Europe, China, Japan and India). Scheme run by H&M allowing customers to drop-off textiles from any manufacturer for recycling, in exchange for vouchers. Many other companies offer similar schemes, although some (e.g. Ikea furniture) are restricted to their own products.

Table 6: Food redistribution hubs

Category	Description
Material	Food
Concept	Facilities for collecting, storing and redistributing food that would otherwise become waste. May include publicly accessible refrigerators, in community spaces where individuals/businesses can donate surplus food, which is freely available for others to take, or dedicated facilities. Cold storage required to minimise spoilage.
Size / distribution (see case studies for detail)	**Size:** Hubs can include food markets, school canteens. Size varies from single fridges to larger food storage facilities. **Distribution:** Likely to be largely at neighbourhood or borough level.
Dependencies (material supply and outputs)	Rely on volunteers, community groups, and local businesses that contribute to upkeep and stocking. Requires regular upkeep to prevent hygiene issues and to dispose of expired stock not fit for consumption.
Locational constraints	**Site:** Likely to be similar to food retail in terms of land use class (although smaller community fridges could be accommodated within residential land use classes). **Transience:** May be suitable for temporary land uses as capital requirements are relatively low. **Accessibility + Infrastructure:** Electricity source / power supply required. Need to be close to consumers to ensure efficient last-mile delivery of temperature-sensitive products.
Case studies	Community Fridge Network - Hubbub (UK wide). Fridges are run by community groups in shared spaces such as schools, community centres and shops. There are over 700 fridges across the UK. Fight against waste and food aid - Municipality of Milan (Italy). Facilities to recover edible food waste from large-scale retail outlets in the city, and from some company canteens, in order to redistribute it, through the involvement of third sector entities, to the most vulnerable families. FareShare | Fighting hunger, tackling food waste in the UK (UK-wide). National network for redistributing surplus food to charities, and is developing a network of food hubs (including recently opened facility in South London). The Felix Project - London Charity Fighting Hunger and Food Waste (London). Food redistribution charity which rescues high quality, surplus food that would otherwise go to waste and redistribute it to over 1,200 community organisations across London. Save Good Food From Going To Waste - Too Good To Go – Too Good To Go (Copenhagen). Too Good To Go was founded in 2016 in Copenhagen to fight food waste and has over 100 million registered users and 175,000 active business partners across 19 countries in Europe and North America. Its app connects consumers with businesses which have surplus food available at reduced prices.

Table 7: Building material banks

Category	Description
Material	Construction
Concept	Collect and sell reclaimed architectural elements and other building materials as whole items for reuse (distinct from processing of construction waste for recycling).
Size / distribution (see case studies for detail)	**Size:** Dependent on warehouse sizes but would need to be sufficiently large to accommodate bulky materials at scale, with a mixture of open and covered storage. **Distribution:** Likely to be mainly regional or city-wide in order to maximise sources of materials and markets.
Dependencies (material supply and outputs)	Reliant on a steady supply of materials from old buildings, homes, commercial spaces, transport infrastructure etc. – may require changes in how demolition industry operates to prioritise value retention over speed. Highly reliant on there being consistent market demand for reused products. High quality condition increases ability to resell. Additional benefits in terms of retention and reuse of building elements with cultural heritage value (i.e. architectural salvage). Potential synergies with existing commercial architectural salvage yards and with demolition contractors.
Locational constraints	**Site:** Potential for noise impacts from material handling and deliveries and hence may be B8 land use class (Storage & Distribution). **Transience:** This could include permanent salvage sites or smaller-scale temporary / meanwhile uses on site where demolition is occurring if long-term storage or reprocessing is not required. **Accessibility + Infrastructure:** Will need good transport access to facilitate material logistics, and sufficient space for material storage.
Case studies	Historische Baustoffe bei Berlin | Historische Bauelemente | Jetzt online bestellen! (Germany). Large-scale salvage yard specialising in reclaimed brick, stone, timber, and period fixtures. Suppliers reclaimed materials for restoration and circular construction projects. The Demolition Depot | The Finest in Architectural Ornaments (USA). Salvaging and reselling vintage architectural elements, including mantels, stone, lighting, and hardware. Works with demolition companies to recover high-value materials. Ombygg (Norway). Physical central storage site for reuse of construction materials. Logistics service included as well as digital store.Welcome to the Rebuild Site CIC - The Rebuild Site (UK). Independent body to pilot ways to facilitate reducing construction waste generated through surplus materials by diverting it to shops and community projects, whilst supporting a growing interest in reuse through workshops and information sharing.

Table 8: Cleaning and sanitisation units

Category	Description
Material	Packaging, hygiene products (e.g. nappies)
Concept	Industrial facilities equipped to clean and sanitise reusable items to meet hygiene standards for subsequent reuse cycles.
Size / distribution (see case studies for detail)	**Size:** Units designed to scale and can vary from containerised units up to the size of large industrial units. **Distribution:** Most likely to be regional or city-wide.
Dependencies (material supply and outputs)	Can work on business-to-business (B2B) or business-to-consumer (B2C) model. B2B model requires collaboration with packaging users (e.g. in the food sector) to developed closed-loop distribution models, but likely to attract higher material volumes.
Locational constraints	**Site:** Larger-scale industrial facilities may be B2 land use class with potential for environmental impacts (emissions to air and water from cleaning processes) requiring effective mitigation. **Transience:** Large-scale units are likely to be permanent installations whereas containerised units would offer more flexibility to demand, and could be located as interim uses. **Accessibility + Infrastructure:** Large-scale units are likely to require infrastructure to allow transport of waste to site where these would be decentralised from demand. Infrastructure of this type is likely to require utilities connections to process waste.
Case studies	Reusable Plastic Container and Pallet Washing Service (Europe). Crate washing services including cleaning, disinfection, drying, and delivery to customer. Crates can be used for commercial and logistics purposes. Bold Reuse: Making Reuse Easy (USA). Team collects used products, cleans, and restocks supply. Digital platform to monitor returns, metrics, inventory. Cleancell (LetsUseAgain) (UK). Decentralised network of advanced reusable packaging cleaning facilities (“CleanCells") enable brands to reuse packaging.

Table 9: Libraries of things

Category	Description
Material	Electrical and electronic equipment, tools, parenting accessories (e.g. prams), other goods.
Concept	A facility holding a selection of commonly-used tools or products which can be borrowed and returned, thereby reducing the need to purchase tools or equipment for a single use.
Size / distribution (see case studies for detail)	**Size:** Most examples are relatively small in size, e.g. a shop or small industrial unit, and could potentially be even smaller (e.g. locker-size). **Distribution:** Likely to be at neighbourhood or borough scale to minimise travel distance; although use of on-line ordering could allow for city-wide schemes.
Dependencies (material supply and outputs)	Requires up-front purchase cost for equipment and regular maintenance (although may also utilise donated goods). Potential synergies/competition with commercial tool hire operations, although these tend to focus on larger equipment. Potential synergies with reuse & repair hubs.
Locational constraints	**Site:** Likely to be similar to retail in terms of land use class (although smaller community libraries could be accommodated within residential land use classes). **Transience:** May be suitable for temporary land uses. **Accessibility + Infrastructure:** Require pedestrian or public transport access to pick-up locations or link to delivery networks. Either remote or local internet connection is likely to be required to enable ordering.
Case studies	Welcome to SHARE Oxford - SHARE Oxford (Oxford). A community hiring service, with volunteer support and local sponsorship enabling people to hire things that are normally cheaper to just buy. Library of Things | Borrow useful Things for your home, projects and adventures (London). Social enterprise with 20 locations across London.

Table 10: Remanufacturing and reprocessing centres

Category	Description
Material	All materials
Concept	Facilities for converting end-of-life products and materials into new products and materials. As opposed to repairing, remanufacturing will typically involve a more thorough process of dismantling, replacement or refurbishment of constituent parts, and reassembly/testing back to a "like-new" condition. Reprocessing involves converting waste materials into products that can be used as inputs to other processes.
Size / distribution (see case studies for detail)	**Size:** Medium to large-scale industrial operations requiring process plant and equipment together with supporting logistics. **Distribution:** Economies of scale mean that these facilities would typically operate at city-wide scale or larger (national/international).
Dependencies (material supply and outputs)	Require a suitable waste stream of the target material/product and which meets relevant technical requirements, as well as skilled labour force. Markets for outputs may be national or global in scale.
Locational constraints	**Site:** Potential for environmental impacts and likely to require an Environmental Permit. Likely to be suitable for B2 (General Industrial) land use class only. **Transience:** Likely to be significant start-ups to deliver permanent facilities. **Accessibility + Infrastructure:** Requires good transportation links to facilitate receipt and dispatch of materials.
Case studies	Medsalv - Our Remanufacturing Process (medical devices – Australia & New Zealand). Collects, cleans and remanufactures single-use medical devices. IDC MarketScape: A leader in remanufacturing | News | Brother UK (printer cartridges – global, with facility in UK). Remanufacturing facilities for used printer cartridges. About Us | Autocraft Solutions Group (batteries – global, with facility in UK). Remanufacturing solutions for electric vehicle batteries.

Table 11: Smart sorting and tracking systems

Category	Description
Material	Textiles, packaging
Concept	Digital technologies such as Radio-Frequency Identification (RFID), AI-powered impact recognition, and cloud-based tracking to automate and improve the accuracy of sorting materials (particularly textiles or packaging) by composition/fibre type or condition to enable an efficient reuse or recycling process.
Size / distribution (see case studies for detail)	**Size:** Systems themselves (such as tags or Quick Response, QR codes) do not require space, but sorting facilities themselves may be at a similar scale to material recovery facilities, or make use of existing facilities. **Distribution:** Economies of scale mean most likely to be adopted at regional or city-wide scale; or at the larger national level.
Dependencies (material supply and outputs)	May be integrated with existing material recovery facilities or used in new dedicated sorting facilities for single-stream materials.
Locational constraints	**Site:** Similar constraints to existing material recovery facilities, although facilities receiving uncontaminated single-source material streams (e.g. textiles) are likely to have fewer potential environmental impacts than an existing material recovery facility accepting co-mingled waste. **Transience:** Scale and operational requirements lend this infrastructure type to permanent facilities. **Accessibility + Infrastructure:** As a decentralised infrastructure, adequate support for collection and freight of waste / materials will be required for operation.
Case studies	AI-powered Smart Garment Sorting System automating textile recycling – H&M Foundation (textiles). Smart garment sorting system research project. Post-consumer garments collected, fed into system, validated through visual technology that automatically classifies garment type, composition, and structure. FASHIONSORT.AI (textiles). Uses image recognition and RFID integration to capture and track textiles automatically and efficiently. Discarded textiles are spread out on a conveyor belt, where a state-of-the-art scanner system is used for textile detection and analysis. Site Zero - Svensk Plaståtervinning (packaging). Advanced sorting facility for plastic packaging, enabling the recycling of 12 plastic types - 200,000 tonnes per year of plastic packaging from households, 60,000m^2 plant size. Polytag (packaging). Track individual items of packaging by using an ultraviolet QR code that is detected at sorting facilities.

Table 12: Reverse Logistics Hubs

Category	Description
Material	All materials
Concept	Distribution facilities for temporary storage and bulking of end-of-life materials pending transfer to reprocessing or remanufacturing facilities. They are distinguished from conventional Waste Transfer Stations in that they would manage predominantly single-stream materials (rather than co-mingled waste) and are similar to conventional distribution warehouses, except that instead of distributing goods from producers to consumers, they work in reverse by transferring end-of-life goods back from consumers to remanufacturers or reprocessors.
Size / distribution (see case studies for detail)	**Size:** Likely to vary considerably in scale depending on the types of materials and throughput requirements, from small to large-scale warehouse units. **Distribution:** Smaller units for local collection would be at neighbourhood or borough scale, feeding larger units at the London-wide scale to deliver economies of scale for larger shipments of materials outside the city.
Dependencies (material supply and outputs)	Smaller units may potentially be incorporated into HWRCs. Facilities will need to be served by a distribution network which collects materials from either bring centres (e.g. in HWRCs, retail units or within developments) or directly from consumers; reverse logistics could be integrated into existing distribution facilities.
Locational constraints	**Site:** Most facilities would deal with clean single-stream materials suitable for reprocessing/remanufacturing and hence unlikely to have significant odour impacts. For larger facilities, transport-related noise and air emissions as well as congestion would be locational constraints and such facilities are likely to be located in land allocated for land use class B8 (storage and distribution). **Transience:** Scale and operational requirements lend this infrastructure type to permanent facilities. **Accessibility + Infrastructure:** As a decentralised infrastructure, adequate support for collection and freight of waste / materials will be required for operation.

Category	Description
Case studies	Tailor-made Circular Economy Logistics Hub (A case study by DB Schenker) (electronics). Purpose-built 5,200 square-meter reverse logistics distribution centre in Poland by logistics company DB Schenker for Konica Minolta, a leading provider of advance imaging and business solutions. Saving office furniture from landfill: Deartree (furniture). Reverse logistics solution for office furniture, using a comprehensive digital management solution (the 'Circular Office System' (COS)) to manage the complex furniture reuse supply chain, involving reverse logistics. Seeking solutions to keep clothes in use: Tommy Hilfiger (textiles). To facilitate it's circular economy solutions, Tommy Hilfiger partnered with an external solution provider (the Renewal Workshop) with reverse logistics knowledge and operations. Logistics companies (all materials). Numerous logistics companies offer reverse logistics solutions through their established network of distribution centre.

Table 13: Digital Exchange Platforms

Category	Description
Material	All materials.
Concept	Online marketplaces/platforms to facilitate buying, selling, exchange of textile waste, deadstock, pre-consumer scraps between businesses.
Size / distribution (see case studies for detail)	**Size:** Mobile apps / online platforms **Distribution:** Digital exchange platforms can operate at all scales up to national.
Dependencies (material supply and outputs)	Reliant on scalable digital systems to handle transactions, data management, user interactions. Large and active user base critical for platform success. Consumer-to-consumer platforms are in widespread use (e.g. eBay, Vinted etc.) but business-to-business platforms have been more difficult to commercialise.
Locational constraints	N/A – digital infrastructure.
Case studies	Recovo: Your Platform for Circular Fashion Management (textiles). Businesses buy, sell, reuse surplus fabrics/materials, connecting those with excess stock. Home | Swapush (textiles). Connecting brands and textile suppliers with leftover materials for reuse. Loopfront - Reuse made easy (construction). Digital platform connecting public and private organisations to trade and reuse surplus building materials. reCIRCLE - Reusable system, sustainable takeaway solutions (food packaging). Deposit return and digital rental system with the reCIRCLE app to return/exchange products at any participating partner restaurant. What is a Food Waste Hero? - Olio (food). Community network to collect unsold food from local businesses and redistribute it to the community via the Olio app.

Table 14: Material Passports

Category	Description
Material	All materials – certain sectors (e.g. construction) appear to be moving faster towards adoption.
Concept	Materials and products are provided with an accessible link (e.g. QR code) to an online "material passport" which provides information on composition, recycling routes, environmental impacts etc. This information then allows materials to be reused or recycled with a greater degree of confidence and reduces risks and uncertainty to subsequent users.
Size / distribution (see case studies for detail)	**Size:** Mobile apps / online platforms. **Distribution:** European Union is currently in the process of developing guidelines and regulations for EU-wide adoption of digital product passports. Because they require inputs from material suppliers/manufacturers, this is likely to require adoption at the city-wide scale, if not nationally – and is unlikely to be realistic at the regional or borough level. Potential for promotion at building-level though planning policy.
Dependencies (material supply and outputs)	Reliant on scalable digital systems to handle transactions, data management, user interactions. Requires definitions on data carrier (e.g. RFID tag, QR code etc.) and data content (i.e. what information is included in the passport).
Locational constraints	N/A – digital infrastructure
Case studies	Our platform - Madaster Netherlands (Netherlands). Registers and documents materials used in buildings, creating 'material passports' to facilitate future reuse. Upcyclea Material Passports | UKGBC (UK). Developed 10,000 passports for a variety of materials. Features a robust reuse search engine to correlate supply of materials available for reuse with demand.

Table 15: Information and communication platforms

Category	Description
Material	All materials.
Concept	Digital tools to educate citizens/businesses on source separation guidelines, benefits of reuse, locations of specialised collection points.
Size / distribution (see case studies for detail)	**Size:** Mobile apps / online platforms. **Distribution:** Interactive maps may be limited to location, but otherwise, accessible to all at borough or city-wide level.
Dependencies (material supply and outputs)	Tools will require regular updating and linking to current information on physical facilities, drop-off points etc.
Locational constraints	N/A – digital infrastructure
Case studies	Horizon - Recycling Made Simple (UK - packaging). Mobile app aimed at informing customers about packaging waste and facilitating recycling. Home - Refill - find places to eat, drink and shop with less waste (UK – packaging). Mobile app providing information about locations for refillable and reusable packaging to minimise waste generation. Download the app - Recycle BC (Canada – all materials). Recycling app to find out what recyclable material goes where and find nearest recycling centre location

5. Scenario Development

A number of scenarios were developed to inform assessment of circular infrastructure needs. The scenarios took into account the factors described previously in this report, and considered:

- The opportunities and constraints of London's economy – e.g. the relative lack of manufacturing capacity but high level of research and innovation.
- The balance between an extensive network of distributed facilities and a more centralised network of larger facilities.
- The types of priority wastes identified by ReLondon and the GLA (e.g. in the London Environment Strategy and London's circular economy route map (Ref.1)), and the potential carbon savings associated with a more circular approach to those materials.

The scenarios were further refined based on feedback provided during a workshop attended by representatives of organisations including borough Councils, joint Waste Authorities, and other organisations including the Environment Agency, WRAP, the Ellen MacArthur Foundation and ReLondon.

Each scenario focuses on one potential aspect of the circular economy, and the infrastructure that would be required to support this particular aspect.

The scenarios should not be seen as mutually exclusive. During the workshops, participants generally expressed the view that elements of all scenarios may be required. Nevertheless, the scenarios are a useful way to connect the intended outcomes of a circular London with the types of infrastructure that would be required; and the weight given to each scenario at any point in time will depend on the wider policy and economic environment.

The definition of the scenarios in Sections 5.1 to 5.3, will allow any commonalities in infrastructure requirement to be identified and any facilitating actions to be discussed which can support the development of the circular economy in London.

5.1 Scenario 1: Innovation incubator

London has a world-class position as a hub for innovation and research; but compared with the rest of the UK there is a relative lack of manufacturing capacity within London and high pressures on land supply. This means that London is very well positioned to develop and pilot innovative approaches to circularity; but scale-up of activities such as remanufacturing and reprocessing may be better suited to areas where land and industrial buildings are more readily available.

In this scenario, the focus would be on facilitating innovation in circularity, and providing the necessary infrastructure to support this innovation.

This scenario would not preclude remanufacturing in London altogether, but would play to the relative strengths of London as a centre for innovation and finance. Physical and digital infrastructure needs would focus on providing space and facilities for startups, pilots and proof-of-concept studies. Knowledge dissemination networks would play an important role in educating and informing both citizens, businesses and product designers about the benefits and applications of the circular economy, and in attracting funding. Since most physical processes would be outside London, then enhanced logistics would be required to transfer materials outside London for remanufacturing and reprocessing elsewhere.

Table 16: Scenario 1 – Infrastructure Requirements

Infrastructure Type	Infrastructure Need	Number & distribution
Dedicated reuse and repair centres	-	-
Collection points and takeback programmes	-	-
Food redistribution hubs	-	-
Building material banks	-	-
Cleaning and sanitisation units	Development and piloting, particularly for smaller-scale units which can operate close to point of waste generation.	Number and scale of pilots would be very context-specific.
Libraries of things	-	-
Remanufacturing and reprocessing centres	Development and piloting.	Number and scale of pilots would be very context-specific.
Smart sorting and tracking systems	Scope for developing and piloting, with implementation at existing Materials Recovery Facilities (MRFs).	Number and scale of pilots would be very context-specific.
Reverse logistics hubs	Large network required to handle those materials that, under this scenario, would be exported for reprocessing elsewhere.	Network of facilities at a range of scales, feeding up to city-wide reverse logistics hubs for export of materials, potentially using the existing distribution/warehouse network.
Digital Exchange Platforms	Development and piloting.	Potential for city-wide approach.
Material Passports	Development and piloting.	Potential for city-wide approach.
Information and communication platforms	Platforms to enable communication amongst researchers, innovators and financers.	City-wide circular innovation network to support development of new circular processes.

5.2 Scenario 2: Distributed reuse networks

One of the central tenets of the circular economy is to keep materials and products in circulation for as long as possible at their highest value, and reuse is one of the best ways to achieve this. Reusing products and materials locally brings benefits in terms of reduced transport and storage requirements, as well as providing good opportunities for social enterprises, community engagement, and access to lower-cost products; a distributed approach may also be simpler to implement within London's borough-based governance structure, since under this model there is a closer link between any investments made by the borough and the benefits which accrue to that borough, rather than more widely.

In this scenario, the emphasis would be on infrastructure which facilitates localised exchange and reuse of products, thereby keeping them out of the waste management system. Physical infrastructure would focus on a wide network of relatively small-scale facilities for the collection, repair, refurbishment and reuse of products. Digital infrastructure needs would reflect this, and would facilitate these local exchanges of materials and products by linking donors and receptors, whilst ensuring transparency of information to build confidence and certainty into these transactions.

Table 17: Scenario 2 - Infrastructure Requirements

Infrastructure Type	Infrastructure Need	Number & distribution
Dedicated reuse and repair centres	Widespread adoption across London.	Multiple facilities, each serving a neighbourhood.
Collection points and takeback programmes	Widespread adoption across London.	Multiple facilities at neighbourhood level – scope for integration with reuse & repair centres.
Food redistribution hubs	Widespread adoption across London.	Multiple facilities at scales from building-level to neighbourhood level.
Building material banks	Potential for smaller scale neighbourhood facilities for commonly-used elements.	Multiple facilities at borough level.
Cleaning and sanitisation units	Small-scale modular units may support local reuse. Capex requirements may limit adoption in this scenario.	Potential for integration with local reuse centres where there is a business case.
Libraries of things	Widespread adoption across London.	Multiple facilities, each serving a neighbourhood.
Remanufacturing and reprocessing centres	High capex requirements may limit applicability in this scenario.	-
Smart sorting and tracking systems	Relatively high capex requirements may limit applicability in this scenario.	-
Reverse logistics hubs	Small scale hubs may be required to allow for efficient collection of sufficient materials to allow for efficient reuse networks.	Multiple facilities at the building or neighbourhood level to allow users to drop off materials for reuse.

Infrastructure Type	Infrastructure Need	Number & distribution
Digital Exchange Platforms	Potential for linking with physical reuse/repair centres to bring more materials back into circulation.	Potential for city-wide approach.
Material Passports	May be beneficial in de-risking aspects of the sharing economy, giving end users more confidence in the goods they are using; and providing repair information.	Potential for city-wide approach – may be part of wider national efforts.
Information and communication platforms	Engagement and education of public and businesses.	Potential for city-wide platform with borough and neighbourhood-level information to drive local engagement and action.

5.3 Scenario 3: Reprocessing hubs

London generates large quantities of end-of-life materials (both waste and non-waste); reprocessing and remanufacturing this material within London would retain the value of this material within the capital's economy and provide associated economic and employment benefits. It would reduce the flows of material in and out on London by recirculating more materials internally, potentially reducing overall carbon emissions from waste disposal, virgin material production and transport.

In this scenario, economies of scale would be realised by providing physical infrastructure to collect and (where possible) manage this material within London. Physical infrastructure would be required for collection and reprocessing / remanufacture, supported by the digital infrastructure to facilitate effective material collection and separation at scale, as well as to provide the necessary data to allow safe and efficient reprocessing of end-of-life products back into raw materials.

Table 18: Scenario 3 – Infrastructure Requirements

Infrastructure Type	Infrastructure Need	Number & distribution
Dedicated reuse and repair centres	Not relevant to this scenario.	-
Collection points and takeback programmes	Source of higher-quality end-of-life products and materials as feedstock for reprocessing.	Facilities at neighbourhood or borough level to capture material before entering waste stream – potential for integration with Household Waste Recycling Centres (HWRCs).
Food redistribution hubs	Not relevant to this scenario.	-
Building material banks	Provide materials for remanufacturing, and outlets for sale of remanufactured products.	Small number of larger facilities offering comprehensive range of remanufactured construction products (including mechanical and electrical plant).
Cleaning and sanitisation units	Larger scale cleaning units can produce clean packaging for reuse at scale.	Potential for larger facilities providing city-wide coverage for some packaging materials.
Libraries of things	Not relevant to this scenario.	-
Remanufacturing and reprocessing centres	Network of facilities aimed at key waste streams – e.g. electronics, textiles, plastics etc.	Relatively small number of centralised facilities located in industrial areas.
Smart sorting and tracking systems	Potential for providing higher quality feedstock to reprocessing centres.	Implementation city-wide, integrated with regional sorting facilities to provide good quality feedstock.
Reverse logistics hubs	Network of hubs would be required to transfer material from point of generation to reprocessing hubs.	Likely to require a range of facilities at different scales for different materials, potentially utilising the existing product distribution/warehouse network (for "clean" materials) as well as the network of waste transfer stations.

Infrastructure Type	Infrastructure Need	Number & distribution
Digital Exchange Platforms	Not relevant to this scenario.	-
Material Passports	Provide information on material composition and product type to support remanufacturing process.	Potential for city-wide approach – may be part of wider national efforts.
Information and communication platforms	Useful for informing householders and businesses on options for providing materials for remanufacturing, and purchasing remanufactured goods.	Potential for city-wide platform with borough and neighbourhood-level information to drive local engagement and action.

6. Scenario Analysis

6.1 Approach

This analysis reviews how each scenario addresses the London-specific factors (as described in Section 3); considers the risks and benefits associated with each scenario; and provides a comparative qualitative assessment of the operating expenses (opex) and capex costs for infrastructure development.

The following main risks and benefits are considered:

- **Market volatility** – The business case for circular economy infrastructure can be affected by changes in prices of virgin raw materials – lower materials prices can mean that the costs of sorting and processing end-of-life materials and products becomes uneconomic because the revenue from outputs declines.
- **Carbon savings** – The carbon savings associated with circular economy processes depend on both the embodied carbon within the material that is being recirculated, the scale at which that activity occurs, and the extent of processing required for recirculation (with reuse having lower processing requirements and hence more carbon benefits than recycling). Products such as food, textiles and electronic equipment typically have very high embodied carbon, and hence the carbon savings for reuse (expressed as negative carbon emissions) are correspondingly high, e.g.:
  - Textiles: -14,315 $kgCO_2e$/tonne for closed loop recycling (Ref. 12).
  - WEEE: -1,140 $kgCO_2e$/tonne for reuse (Ref. 13).
  - Food: -5,583 $kgCO_2e$/tonne for donation (weighted average – range -13,792 to -2,494 $kgCO_2e$/tonne) (Ref. 14).
- **Capex** – This includes the cost of establishing an item of infrastructure (whether physical or digital), providing suitable buildings and initial purchase of plant and equipment.
- **Opex** – This includes rental of premises, labour, utilities and maintenance of plant and equipment, as well as (for digital infrastructure) hosting and transaction fees. Facilities using volunteer labour will have reduced labour expenses but will still require some opex.
- **Employment generation** – The circular economy has the potential to support the creation of jobs and to provide training opportunities in areas such as repair and remanufacturing. However, there is a potential trade-off between high employment generation and opex (since a large proportion of opex is likely to be related to wage costs, and higher opex may act as a barrier to infrastructure development).
- **Economic value of outputs** – The value of outputs will depend on the value of the materials or products produced as well as the scale of production. Although a simple approach would just consider the financial value of outputs, a full consideration of economic value would also take into account avoided externalities (such as carbon emissions) and any social benefits provided by the infrastructure (e.g. providing people with access to goods they could not otherwise afford). The value of outputs can vary with market volatility (see above).

- **Environmental, health and safety (EHS) risk** – These risks can be managed by use of proper mitigation measures, but larger and more complex infrastructure may require an environmental permit to operate and hence be subject to a high degree of EHS oversight, commensurate with the higher level of risk.
- **Infrastructure gaps** – this provides a qualitative description of the existing infrastructure provision for each scenario. In order to quantify the infrastructure gaps, further work will be required (in conjunction with on-going waste needs assessments) to better understand current and future flows of materials, existing level of facility provision, and hence the requirements for new infrastructure.

The assessment is presented in Table 19 on the following page.

6.2 Scenario Assessment

Table 19: Scenario Assessment: London-specific Factors and Risks & Benefits

Factors	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Local government structure	May be a constraint if funding is sought from single Borough for projects extending across multiple Boroughs.	May be a constraint on networks which span Borough boundaries, if they are seeking financial support from one Borough but the benefits extend to other Boroughs.	Large-scale reprocessing hubs are more likely to be located in Boroughs having available industrial land, with a risk that the burdens of hosting such facilities are seen as not being fairly distributed.
Low proportion of industries able to reprocess materials	The focus on small-scale pilots under this scenario means that the lack of large-scale reprocessing capacity in London is less likely to be a constraint on innovation – but there would be a requirement for supplementary transport infrastructure to export materials for large-scale reprocessing outside London.	Because this scenario focuses on reuse rather than reprocessing, the lack of industrial capacity is less likely to be an issue – the focus would be on materials that only require relatively minimal intervention to allow for reuse (e.g. repair or minor refurbishment rather than major remanufacturing).	Relative lack of industries able to use reprocessed materials within London may limit the commercial appeal of locating such facilities within London – re-processors may instead prefer to export material for reprocessing elsewhere.
High land costs	High cost of land may limit ability to develop larger-scale pilots; higher office rentals may also be a constraining factor, although since firms are likely to have a small headcount at the earlier stage, this may be less significant.	May pose some constraints, although the relatively low capex requirements for such facilities would allow them to operate on a temporary or “pop-up” basis to take advantage of temporarily available sites.	Provision of larger-scale reprocessing hubs may be difficult due to high land costs within London, and relatively high capex requirements mean they are likely to require permanent sites.
High population density	Unlikely to be a significant factor.	Favourable to distributed reuse networks as the potential user base within a given area is likely to be high such that it is easier to capture a critical mass of material to allow networks to function effectively.	Beneficial in that it allows for high volumes of materials to be collected from a relatively small area.

Factors	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Research and development (R&D) funding	Leverages the high R&D funding within London to drive innovation.	Potential for synergies with the innovation scenario to harness innovation to increase effectiveness of reuse networks.	Potential for synergies with the innovation scenario to develop innovative reprocessing technologies (although high land costs may limit this, as mentioned above).
Low car ownership level	Unlikely to be a significant factor.	Favours a highly distributed network (e.g. at building or neighbourhood level) due to difficulties for people to transport materials using public transport, particularly for heavier materials. This may be addressed through “milk-round” type collections to supplement “bring” sites.	Not relevant – reprocessing hubs are unlikely to be reliant on private transport of materials to the sites.
High proportion of flatted accommodation	Unlikely to be a significant factor.	Relative lack of storage space in flats may be a spur to reuse since it incentivises people to get rid of objects that are surplus to immediate requirements.	Unlikely to be a significant factor.
Current circular economy infrastructure	Many examples of innovation in both academia and business to build on; good supply of feedstock material which could be diverted from existing waste infrastructure.	Established and growing network of small-scale reuse projects within London, but scope for expanding the coverage and increasing usage rates.	May be synergies with existing infrastructure, particular for certain sectors (e.g. construction materials) where there is already a significant amount of reprocessing within London.

Risks and Benefits	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Market volatility	Little exposure to market volatility as large-scale facilities are not prioritised in this scenario.	Small-scale and voluntary reuse networks are less exposed to market volatility than larger commercial enterprises.	Large reprocessing hubs carry significant exposure to market volatility which may undermine their business case.

Risks and Benefits	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Carbon savings	Actual carbon savings negligible during development and piloting, but with potential for significant global savings following scale-up.	Scale of savings per facility would be small, but collectively capable of producing significant savings, particularly if the focus is on reusing materials with high embodied carbon such as food and textiles.	Benefits depend on the extent of reprocessing required and may be less on a product-by-product basis than reuse; but has potential to a) operate at greater scale; and b) reprocess items that can't be reused and would otherwise be disposed.
Employment generation	Good opportunities for researchers and entrepreneurs but less potential for large-scale employment benefits.	Likely to require considerable labour inputs (e.g. for repair activities and managing reuse networks) – scope for training, establishing social enterprises, and providing opportunities for individuals disadvantaged in the wider labour market.	Potential for significant employment at large facilities, although these are increasingly automated.
Opex	Relatively high opex (on a per-tonne throughput basis) due to small-scale nature of pilot facilities.	Potentially high opex associated with large network of physical facilities and high labour inputs. This could be mitigated to some extent by co-location with existing facilities and businesses, and by cooperation with the voluntary sector.	High opex associated with large facilities with high utility demands and labour force.
Capex	Low, since purpose of pilot stage is to minimise capex until concepts are proven. However, some investment required to provide labs and testing facilities to support development process.	Likely to be low as processes are largely labour rather than capital-intensive, although some investment required in repair equipment etc.	High capex requirement to establish.
Economic value of outputs	Relatively small in terms of materials from pilot stage, but potentially large in terms of intellectual property following successful development.	Potentially high in terms of keeping valuable items within circulation, and providing affordable access to reused products to those who may otherwise struggle to afford them.	Potentially high, depending on type of material, but subject to market volatility as described above.

Risks and Benefits	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
EHS risk	Small and manageable provided risks of novel processes are properly assessed and mitigated.	Environmental risks likely to be low. Health and safety risks would require careful consideration to protect both those carrying out repair and preparing items for reuse; and end users of the item. This is likely to include requirements for activities such as PAT testing.	Potential EHS risks, but due to scale of facilities there are various regulatory regimes (including Environmental Permitting Regulations and Health and Safety at Work Act) under which these risks would be controlled.
Infrastructure gaps	As identified in the case studies in this report, there are several examples of innovative circular economy processes being developed and piloted in London, as well as extensive academic research. More work would be required to quantify the current and future needs for physical infrastructure to support such innovation (e.g. small industrial units suitable for pilot facilities) and to understand the constraints whether these relate to physical provision or cost.	There are many examples of distributed reuse networks in London, e.g. food redistribution hubs and community repair centres. Further work would be required to quantify the current number of facilities; their current and potential future throughputs, and hence the level of provision that may be required in future. As part of this work, it would also be useful to assess the level of provision for temporary storage of materials/products for reuse within developments and to consider what level of provision might be required, and how to incorporate this into planning requirements across the city.	Assessment of city-wide material flows together with on-going waste needs assessment work would be required to determine the level of reprocessing provision that may be required. This would draw on the work done by ReLondon on specific priority materials (e.g. for textiles) as well as consideration of the existing recycling capacity within the city and the amounts of end-of-life materials that are current exported for reuse or recycling outside London.

6.3 Potential Actions

As described previously, the outcome of the stakeholder engagement suggested that there is no single scenario that offers a complete solution; and a beneficial approach will be to plan for elements of each scenario with flexibility to respond to the emerging policy and economic landscape.

Whilst digital infrastructure has minimal spatial requirements and limited opex cost, the initial costs of developing and establishing complex systems (particular for items such as material passports) may be high[2], and there is the risk of duplicating both development at national and EU level, and also off-the-shelf commercial tools. From an infrastructure planning perspective, there may be value in encouraging or mandating the use of existing and emerging digital tools in the medium term, rather than developing London-specific ones.

Table 18 outlines facilitating actions for each scenario and their suggested timeframes, where short-term is within the next year, medium term is within the next 3 years, and longer term is longer than 3 years. These timings are of course indicative, and should not preclude earlier action if there is a strong environmental and strategic case to do so. The priorities have been informed by consideration of the benefits and risks associated with each scenario, as well as the likely timeframes required for investment, and for scaling up facilities across London.

Table 20: Facilitating Actions

Scenario	Short term (1 year)	Medium term (1-3 years)	Longer term (3+ years)
Scenario 1 – Innovation incubator	• Develop and encourage digital innovation networks for circularity, including researchers, entrepreneurs and financiers. • Encourage use of digital tools for enhancing circularity.	• Encourage availability of space for research laboratories and pilot facilities.	• Identify potential for scale-up of innovations within London, in conjunction with Scenario 3.

[2] Costs may be high due to the work necessary to agree on common data requirements, data carriers, security considerations etc. – for example, the proposed EU-wide digital passport programme has had a lengthy development period requiring very extensive stakeholder engagement and technical development.

Scenario	Short term (1 year)	Medium term (1-3 years)	Longer term (3+ years)
Scenario 2: Distributed reuse networks	• Consider what kind of support can be made available to existing and new neighbourhood-scale facilities such as repair hubs, community fridges and libraries of things. • Support greater use of digital networks to spread awareness of facilities and encourage their use, e.g. interactive mapping app.	• Consider space provision for reuse/repair hubs as part of new developments. • Encourage integration of repair & reuse with existing HWRC network.	• Support the scale-up of facilities to provide reuse comprehensive network across London. • Integrate with existing and emerging digital tools to reduce the friction of using the network.
Scenario 3: Reprocessing hubs	• Identify and where possible safeguard suitable locations for larger-scale reprocessing and remanufacturing.	• Identify which materials/products are best suited for reprocessing within London rather than export, and engage with potential operators to determine facility requirements.	• Identify emerging processes from Scenario 1 with potential for scale-up within London.

7. Conclusions

This section discusses the findings with respect to each of the research questions (as stated in Section 1.1) based on the exploration through the previous sections:

- **What are the possible scenarios for how a circular economy could continue to develop in London?**

  This study has developed three scenarios for the continued development of the circular economy in London, recognising that they are not mutually exclusive and elements of each scenario are likely to be required in order to transition to a circular economy. The scenarios are presented in Section 5 and summarised as follows:

  – **Scenario 1: Innovation incubator**

    This scenario leverages London's world-class position as a hub for innovation and research, with a focus on developing and piloting innovative approaches to circularity; with most remanufacturing and reprocessing being carried out outside London, with enhanced logistics to transfer materials to these remanufacturing and reprocessing facilities.

  – **Scenario 2: Distributed reuse networks**

    In this scenario, the emphasis would be on infrastructure which facilitates localised exchange and reuse of products, thereby keeping them out of the conventional waste management system. Physical infrastructure would focus on a wide network of relatively small-scale facilities for the collection, repair, refurbishment and reuse of products. Digital infrastructure needs would reflect this and would facilitate these local exchanges of materials and products by linking donors and receptors, whilst ensuring transparency of information to build confidence and certainty into these transactions.

  – **Scenario 3: Reprocessing hubs**

    In this scenario, reprocessing and remanufacturing of end-of-life material within London would retain the value of this material within the capital's economy and provide associated economic and employment benefits, and would reduce the flows of material in and out on London by recirculating more materials internally, potentially reducing overall carbon emissions from waste disposal, virgin material production and transport.

- **What are the infrastructure requirements for each scenario identified and how do they vary between different scenarios?**

  A general classification scheme for circular economy infrastructure is presented in Section 4, and Section 5 maps the requirements for each scenario. These requirements are summarised below. Scenario 1 (innovation incubator) focuses on smaller scale facilities for piloting new technologies, although it would also require logistics facilities to export materials for reprocessing outside London. Scenario 2 (distributed reuse hubs) focuses on a widespread network of facilities at a local level to support the sharing economy; whilst Scenario 3 (reprocessing hubs) focuses on larger-scale reprocessing facilities that would predominantly be located in land zoned for industrial use.

The following infrastructure types have been identified as relevant to all scenarios as they potentially play an important enabling role under all scenarios:

- Cleaning and sanitisation units,
- Remanufacturing and reprocessing centres,
- Reverse logistics hubs,
- Smart sorting and tracking systems,
- Material passports, and
- Information and communication platforms.

Table 21: Summary of Scenario Infrastructure Requirements

Infrastructure Type	Scenario 1	Scenario 2	Scenario 3
Dedicated reuse and repair centres	Not relevant to this scenario.	Widespread adoption across London.	Not relevant to this scenario.
Collection points and takeback programmes	Not relevant to this scenario.	Widespread adoption across London.	Source of higher-quality end-of-life products and materials as feedstock for reprocessing.
Food redistribution hubs	Not relevant to this scenario.	Widespread adoption across London.	Not relevant to this scenario.
Building material banks	Not relevant to this scenario.	Potential for smaller scale neighbourhood facilities for commonly-used elements.	Provide materials for remanufacturing, and outlets for sale of remanufactured products.
Cleaning and sanitisation units	Development and piloting, particularly for smaller-scale units which can operate close to point of waste generation.	Small-scale modular units may support local reuse. Capex requirements may limit adoption in this scenario.	Larger scale cleaning units can produce clean packaging for reuse at scale.
Libraries of things	Not relevant to this scenario.	Widespread adoption across London.	Not relevant to this scenario.
Remanufacturing and reprocessing centres	Development and piloting.	High capex requirements may limit applicability in this scenario.	Network of facilities aimed at key waste streams – e.g. electronics, textiles, plastics etc.
Reverse logistics hubs	Large network required to handle those materials that, under this scenario, would be exported for reprocessing elsewhere.	Small scale hubs may be required to allow for efficient collection of sufficient materials to allow for efficient reuse networks.	Network of hubs would be required to transfer material from point of generation to reprocessing hubs.
Smart sorting and tracking systems	Scope for developing and piloting, with implementation at existing Materials Recovery Facilities (MRFs).	Relatively high capex requirements may limit applicability in this scenario.	Potential for providing higher quality feedstock to reprocessing centres.
Digital Exchange Platforms	Development and piloting.	Potential for linking with physical reuse/repair centres to bring more materials back into circulation.	Not relevant to this scenario.

Infrastructure Type	Scenario 1	Scenario 2	Scenario 3
Material Passports	Development and piloting.	May be beneficial in de-risking aspects of the sharing economy, giving end users more confidence in the goods they are using; and providing repair information.	Provide information on material composition and product type to support remanufacturing process.
Information and communication platforms	Platforms to enable communication amongst researchers, innovators and financers.	Engagement and education of public and businesses.	Useful for informing householders and businesses on options for providing materials for remanufacturing, and purchasing remanufactured goods.

- **How does London's unique characteristics impact the way the circular economy could develop? What impact might this have on infrastructure requirements?**

  The London-specific factors impacting circular economy development and the impact on infrastructure requirements is presented in Section 3 and summarised below.

  – **Local government structure:** the split of responsibilities for circular economy activities and associated planning and strategy between individual boroughs, joint Waste Disposal Authorities, and London-wide bodies such as ReLondon and the GLA may mean that infrastructure development could be constrained by the planning and funding model of local government.

  – **Low proportion of industries able to reprocess materials:** the relative lack of manufacturing capacity in London may limit the potential to reprocess and remanufacture products within the city.

  – **High land costs:** the cost of physical infrastructure is likely to be higher in London than elsewhere in the UK due to higher land costs, which may also limit storage space in residential development.

  – **High population density:** London's high population density means that within a given area there is a high volume of material and products available for circular economy processes; but infrastructure needs to be efficient (in throughput terms) to manage this material.

  – **Research and development (R&D) funding:** London's strong position in the UK's R&D network fosters a strong culture of innovation, and access to sources of funding from London's financial sector.

  – **Low car ownership level:** The relative lack of access to private vehicles is a constraint to any infrastructure which relies on individuals transporting materials to the site.

  – **High proportion of flatted accommodation:** A higher proportion of Londoners living in flatted accommodation compared to the national average: storage for surplus materials is likely to be more limited, which may mean residents tend to dispose of them immediately; but may also incentivise shared use models.

– **Current circular economy infrastructure**: Any new CE infrastructure would have potential synergies with existing infrastructure, either of the type considered in this report or conventional waste infrastructure.

- **What are the benefits and risks associated with the various scenarios?**

  Benefits and risks of the three scenarios are presented in Section 6.2 and summarised below.

Table 22: Scenario Risks and Benefits

	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Market volatility	Little exposure to market volatility as large-scale facilities are not prioritised in this scenario.	Small-scale and voluntary reuse networks are less exposed to market volatility than larger commercial enterprises.	Large reprocessing hubs carry significant exposure to market volatility which may undermine their business case.
Carbon savings	Actual carbon savings negligible during development and piloting, but with potential for significant global savings following scale-up.	Scale of savings per facility would be small, but collectively capable of producing significant savings, particularly if the focus is on reusing materials with high embodied carbon such as food and textiles.	Benefits depend on the extent of reprocessing required and may be less on a product-by-product basis than reuse; but has potential to a) operate at greater scale; and b) reprocess items that can't be reused and would otherwise be disposed.
Employment generation	Good opportunities for researchers and entrepreneurs but less potential for large-scale employment benefits within London.	Likely to require considerable labour inputs (e.g. for repair activities and managing reuse networks) – scope for training, establishing social enterprises, and providing opportunities for individuals disadvantaged in the wider labour market.	Potential for significant employment at large facilities, although these are increasingly automated.
Opex	Relatively high opex (on a per-tonne throughput basis) due to small-scale nature of pilot facilities.	Potentially high opex associated with large network of physical facilities and high labour inputs. This could be mitigated to some extent by co-location with existing facilities and businesses, and by cooperation with the voluntary sector.	High opex associated with large facilities with high utility demands and labour force.
Capex	Low, since purpose of pilot stage is to minimise capex until concepts are proven. However, some investment required to provide labs and testing facilities to support development process.	Likely to be low as processes are largely labour rather than capital-intensive, although some investment required in repair equipment etc.	High capex requirement to establish.

	Scenario 1: Innovation incubator	Scenario 2: Distributed reuse networks	Scenario 3: Reprocessing hubs
Economic value of outputs	Relatively small in terms of materials from pilot stage, but potentially large in terms of intellectual property following successful development.	Potentially high in terms of keeping valuable items within circulation, and providing affordable access to reused products to those who may otherwise struggle to afford them.	Potentially high, depending on type of material, but subject to market volatility as described above.
EHS risk	Small and manageable provided risks of novel processes are properly assessed and mitigated.	Environmental risks likely to be low. Health and safety risks would require careful consideration to protect both those carrying out repair and preparing items for reuse; and end users of the item. This is likely to include requirements for activities such as PAT testing.	Potential EHS risks, but due to scale of facilities there are various regulatory regimes (including Environmental Permitting Regulations and Health and Safety at Work Act) under which these risks would be controlled.

- **What types of infrastructure could be prioritised to ensure London's transition to a circular economy is effective and sustainable?**

  Suggested priority actions for infrastructure development for each scenario are presented in Section 6.3 and summarised below. The stakeholder engagement and research work for this study suggests an "all of the above" rather than an exclusive focus on a single scenario, with different material types requiring different approaches.

  - For Scenario 1 (innovation incubator), short-term priorities would be focused on digital tools and innovation networks: in the medium term, physical infrastructure for research and pilot-scale facilities would be prioritised; whilst in the longer term there would be focus on providing suitable infrastructure for scaling-up of emerging technologies.
  - For Scenario 2 (distributed reuse networks), in the short-term the focus would be on supporting new and existing neighbourhood facilities, and using digital networks and tools to encourage usage. Medium-term priorities would include considering how to integrate facilities into the existing HWRC network, and how new developments could be required to provide space for reuse/repair hubs. Over the longer-term, the priorities would be to scale up to a comprehensive network of such facilities across London, integrated with the necessary digital tools.
  - For Scenario 3 (reprocessing hubs), the short-term priorities would be to identify and where possible safeguard locations for large-scale reprocessing activities; and then in the medium and longer-terms to engage with potential operators of existing and emerging processes to determine their specific requirements and how to support their development.

Appendix A : Bibliography

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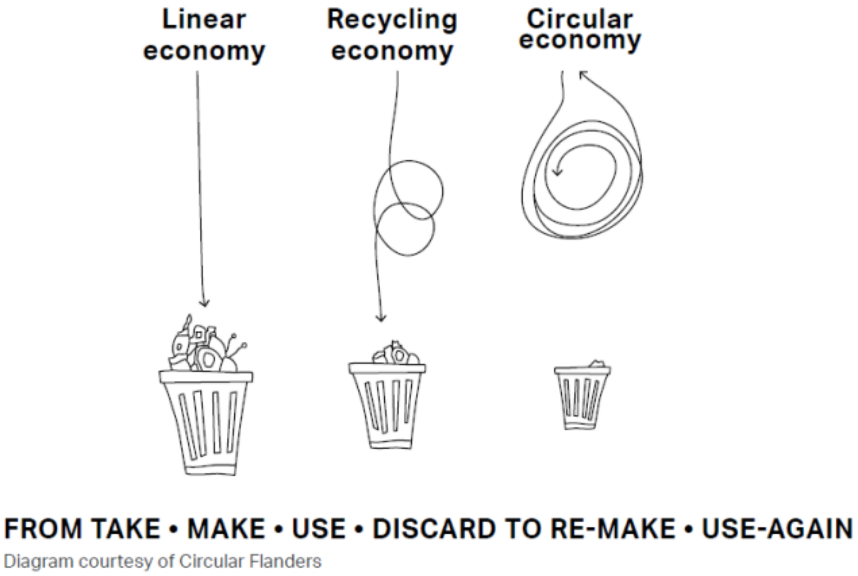
Appendix B : Context

7.1 Definition of a Circular Economy

London Plan Policy SI 7 defines a circular economy as '…one where materials are retained in use at their highest value for as long as possible and are then reused or recycled, leaving a minimum of residual waste.' It is a move away from the current linear economic model, where materials are mined, manufactured, used and thrown away, as illustrated in Figure 3.

Figure 3: Circular Economy compared to linear and recycling economies



7.2 National Context

The government is committed to transitioning the UK to a circular economy. To support the Government in achieving this goal, a Circular Economy Taskforce ('the Taskforce') was established in late 2024 bringing together industry, academic and policy experts with central and local government to develop an evidence-driven and actionable Circular Economy Strategy for England ('the Strategy'). The Strategy will be underpinned by a series of roadmaps for reform in different sectors of the economy and their supply chains.

At the time this report was prepared (mid-2025), the Taskforce work is on-going and the national Strategy has yet to be developed.

7.3 London Context

The Mayor's London Plan includes policies to support the Mayor's waste and circular economy ambitions. Policy SI7 'Reducing waste and supporting the circular economy', focuses on reducing waste, increasing recycling, and promoting resource efficiency across all sectors. Policies SI8 'Waste capacity and net self-sufficiency' and SI9 'Safeguarded waste sites' aim to ensure that London has sufficient waste management capacity to achieve net self-sufficiency, minimise waste, promote recycling, and manage waste sustainably within the city. Policy GG5 "Growing a good economy" aims to recognise and promote the benefits of a transition to a low carbon circular economy to strengthen London's economic success.

The Mayor is undertaking a review of the London Plan and aims to publish the next London Plan by 2027 and this study is intended to form part of the evidence for the circular economy policy and inform the waste policies in the London Plan.

Chapter 7 of the Mayor's London Environment Strategy (LES) sets out the GLA's policies and proposals for reducing the amount of municipal waste produced, increasing the amount of waste reused, recycled or composted, and generating low carbon energy from waste remaining. This chapter includes household and commercial waste (as per the European definition of municipal waste).

The Mayor's objectives for waste as defined in the London Environment Strategy are to:

- Drive resource efficiency
- Maximise recycling rates
- Reduce the environmental impact of waste activities
- Maximise local waste sites and ensure London has the infrastructure to manage all the waste it produces.

Chapter 10 of the LES sets out the GLA's policies and proposals for of the Mayor's objective of:

- Enabling the transition to a low carbon circular economy

Local authorities within London are required to prepare Reduction and Recycling Plans (RRPs) which contribute to achieving the London-wide targets:

- To cut food waste and associated packaging waste by 50 per cent per person by 2030.
- To achieve a 65 per cent municipal waste recycling rate by 2030, including a 50 per cent recycling rate for local authority collected waste (LACW) by 2025.
- To send zero biodegradable or recyclable waste to landfill by 2026.
- London to manage net 100 per cent of all the waste it produces by 2026.

Local authorities are encouraged in their RRP to include plans to adopt circular economy approaches to reduce waste such as repair, reuse or rental schemes, or other projects which aim to keep materials in use at their highest value for as long as possible.

Appendix C : Equalities Impact Assessment

This study is not expected to have a direct impact on any of the groups identified under equality considerations. It does however identify certain factors (both general and London-specific) that would need to be taken into account when planning circular economy infrastructure which are related to these considerations, and in particular socio-economic disadvantage. A review of the potential impacts of the findings and recommendations of the study on key protected characteristic groups, is presented in Table 23.

Table 23: Equalities Impact Assessment

Protected Characteristics	Impacts Identified	Mitigations / Justifications Considered
Age	Constraints may be faced by groups with mobility challenges (e.g. elderly and disabled) and those with limited IT skills or access may not be able to benefit from public-facing digital infrastructure.	Whilst noting these constraints, there is insufficient information to quantify them at this stage, but they warrant further consideration as part of the future planning process.
Gender	No impacts identified.	n/a
Race	No impacts identified.	n/a
Disability	Consumer focussed infrastructure types where Londoners are required to transport products / materials themselves require a physical ability to handle this material and transport them to site, unless an alternative is provided.	Proximity to public transport and potential collection or assisted delivery services may warrant further consideration.
Religion and Belief (including non-belief)	No impacts identified.	n/a
Sexual Orientation	No impacts identified.	n/a
Gender Reassignment	No impacts identified.	n/a
Pregnancy and Maternity	Some types of consumer-facing infrastructure may be unsafe for Londoners to visit with young children, e.g. HWRCs. Some aspects (e.g. reuse hubs for childcare equipment, nappy reuse) may have particular benefits to this category.	Potential collection or assisted delivery services may warrant further consideration, as may the potential benefits of wider uptake of the sharing economy for childcare equipment.
Marriage and Civil Partnership	No impacts identified.	n/a

Protected Characteristics	Impacts Identified	Mitigations / Justifications Considered
Does the evidence address socio-economic disadvantage (including those with lower income or carers, ex-offenders and armed forces veterans)? Does the evidence address structural inequality?	There may be positive impacts from certain types of infrastructure in terms of providing employment benefits and skills (e.g. in repair), and in some cases infrastructure could be provided in collaboration with the voluntary sector to target such benefits at disadvantaged groups. The study notes that socio-economically disadvantaged groups may face constraints in their ability to participate in circular economy activities or access circular economy infrastructure due to factors such as limited internal storage space and lack of access to private transport; and this should be considered when looking in more detail at specific infrastructure types.	Concepts of operations and infrastructure design for both physical and digital infrastructure should take into account issues of accessibility for disadvantaged groups, as well as the benefits to these groups. This study has identified some mitigation measures such as promoting sites which are accessible by public transport, and/or distributed networks of sites which are accessible at the local level rather than requiring long journeys or use of private transport. Collection schemes may also be beneficial in mitigating these impacts.