

Building a circular economy

How a new approach to infrastructure can put an end to waste

“green alliance...”



Building a circular economy

How infrastructure can support resource efficiency

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Green Alliance

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creative commons

Executive summary

Infrastructure is central to all our lives. It shapes the way we travel, work and spend leisure time. It is the framework of systems that allows the economy to function.

The creation of the National Infrastructure Commission was recognition that decisions on infrastructure need to be strategic and timely because they determine the success of the economy and its ability to respond to future challenges.

Infrastructure has a major influence on whether resources can be preserved to use again or whether they are lost forever. For the most part, it has been designed for, and has perpetuated, the linear economy, the system of ‘take, make, use, throw’. It is holding back the circular economy that all the major political parties have said they want to develop for the future, for the good of the environment and the economy at large.

Strategic planning of new infrastructure is needed to ensure the development of an economy which minimises resource use and waste, by lowering demand for new goods, through reuse, repurposing and the remanufacture of products.

Working with academics from the University of Leeds, we outline three scenarios for England with varying degrees of circularity. We have analysed what infrastructure would be required under each of these scenarios for three common, high impact material streams from household waste: plastic, textiles and electrical equipment.

The scenarios are:

Business as usual: England's resource management system has a low level of circularity. An increasing share of material collected is sent to energy from waste (EfW) facilities after its first life, removing resources and their value in use from the system altogether, while also generating carbon emissions. Under this scenario, we assume that the current pattern of investment will continue and up to 80 per cent of plastics, textiles and electronic goods would continue to go to landfill, incineration or low quality recycling.

High recycling: If continued investment in EfW and other systemic problems do not undermine existing recycling targets, the country will move towards a more circular economy driven by planned higher recycling targets. This would mean more infrastructure designed to collect material for recycling only. If consumption levels stay the same, we estimate the amount of residual waste generated would be double that of the 'transformation' scenario described below. Some recycled materials would return to the economy, but often for lower value uses.

Transformation: In a truly circular economy, recycling would still be a prominent activity, but only once resource value has been maximised by other means. Industrial processes would 'put less in' to products in the first place, and better products and new businesses models would allow consumers to 'get more out' of fewer resources. Overall material use and waste would be halved.

The transformation scenario is best for the environment. It would cut carbon emissions and pollution and reduce the impacts of resource extraction. By preserving value and creating new businesses around a modernised resource management industry, it is also best for the economy: reuse and repair activities

in the UK already support nearly four times more jobs than waste management.

Investment in transformation needs to refocus on upstream activities, business models and data and logistic systems targeted at reducing resource consumption rather than just on recycling and EfW. Much greater knowledge of current infrastructure and material flows is needed to support this shift. We recommend an immediate and comprehensive infrastructure stocktake, looking beyond residual waste treatment, and fast tracking the proposed National Materials Datahub.

We also suggest setting up a £400 million fund, dedicated to kickstarting new circular economy infrastructure development and business models.

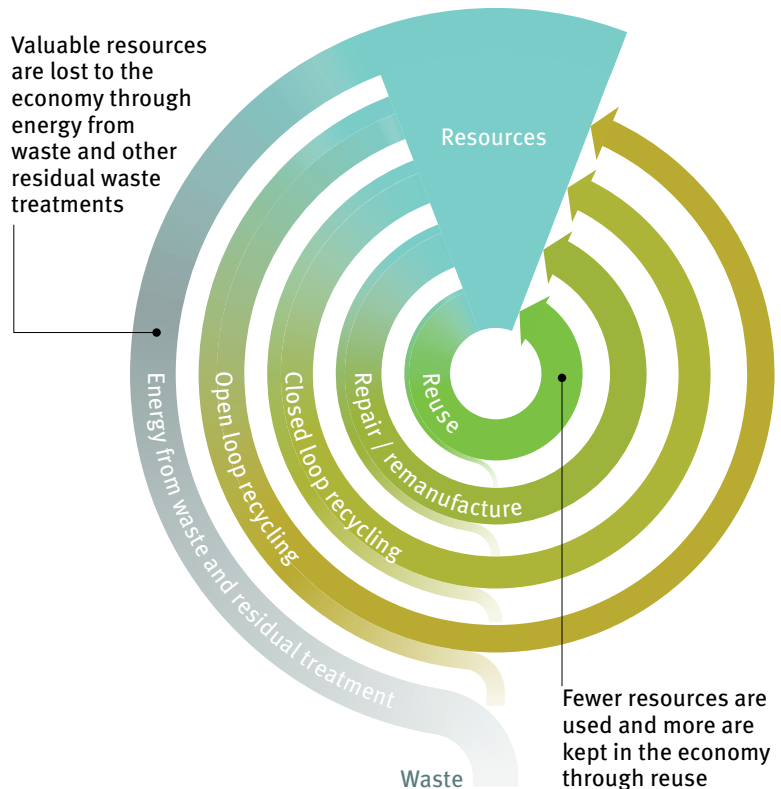
It is vital that the next government sets the strategy now to put in place the systems and infrastructure needed for a successful transition to a circular economy.

Introduction

The UK has promised to tackle its unsustainable use of resources. Setting out the rationale for a new Environment Bill, Theresa May's government explained: "The traditional 'linear' economic model of 'take, make, use, throw' has led to needless waste piling up, and has caused significant environmental damage."¹

The idea that a circular economy is crucial to achieving change is gaining traction. It involves using resources much more wisely: designing products that require fewer resources to make and use, that last longer and can be remanufactured once they are finished with. And also recovering the materials to use again at the very end of a product's life. It is generally visualised as a series of concentric loops, where opportunities for the greatest conservation of resources and value are located in the tighter loops closest to the centre.

Where resource value is kept and lost in a circular economy



The overarching aim of England's resources and waste strategy "is to move to a more circular economy which keeps resources in use for longer" by reducing, reusing and recycling more. This will, it says, benefit the environment, the economy and society alike.² However, there are limited signs of any new policy or investment in the infrastructure that is needed to meet these aims.

The UK lacks circular economy infrastructure

Debates around whether the country has the right amount of landfill or energy from waste (EfW) infrastructure have been going on for years. These focus on whether a shortfall in the amount of infrastructure needed to deal with residual waste would mean the country is unable to handle the waste it produces, or whether over capacity would make it impossible to meet recycling targets because of the amount of material necessary to feed large incinerators.³ Recently, there has been some discussion about the capacity of the UK’s recycling infrastructure, following the publication of the resources and waste strategy and since China banned the import of ‘foreign waste’ for recycling.⁴

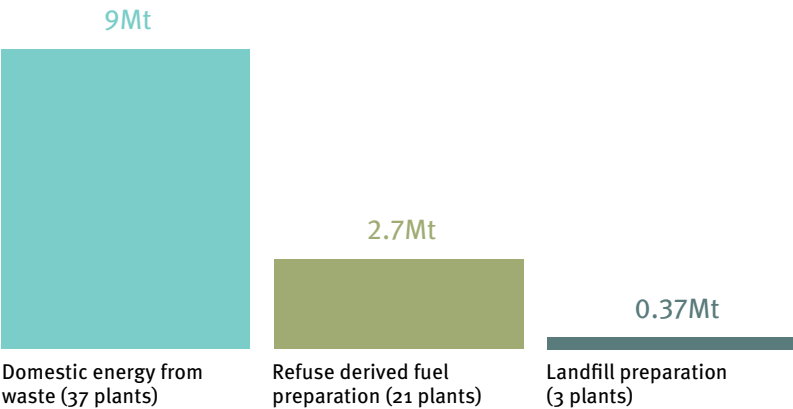
However, very little has been said about the capacity of infrastructure for the activities needed to reduce resource use and support a circular economy in addition to recycling, ie for reuse, refurbishment and reduced consumption.

Investment is perpetuating the linear economy

Most analysis assumes that waste from households and the commercial and industrial sectors will continue to grow, at least in line with population growth and frequently above it.⁵ But most waste is not inevitable; much of it is caused by a failure of the economic system.

The highest proportion of public and private infrastructure investment has been in EfW facilities which, by burning valuable materials, perpetuate the linear model. The Department for Environment, Food and Rural Affairs’ (Defra’s) main infrastructure investment fund, the Waste Infrastructure Delivery Programme, through which £3 billion has been committed by government and industry to 2042, is dedicated to residual waste treatment, predominately generating energy from waste. There is no major government funding source for recycling infrastructure, and support for resource efficiency and the circular economy focuses on research, rather than infrastructure provision.⁶

Public and private investments tracked through Defra’s Waste Infrastructure Delivery Programme capacity⁷

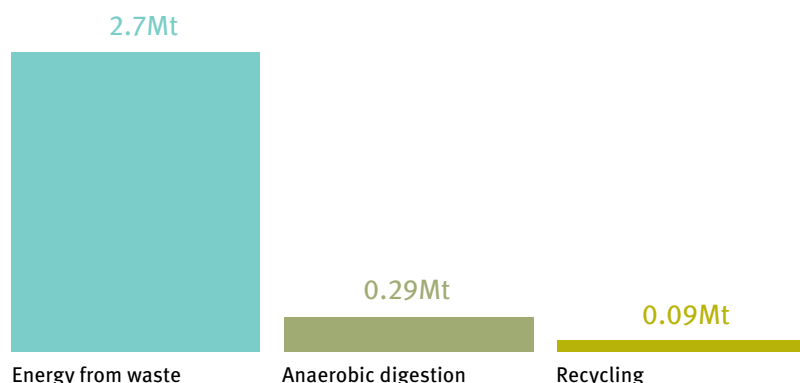


“Most waste is not inevitable; much of it is caused by a failure of the economic system.”

The Green Investment Bank, when it was government owned prior to 2017, also dedicated the vast majority of funds in resources and waste to end of life treatment; this is despite the government’s claim that the bank would address “market failures which are constraining the flow of finance”, and calls from the Environmental Audit Committee for it to “finance innovative technologies to support a circular economy”.^{8,9}

Rather than targeting infrastructure that would help to grow a circular economy, nearly all its investments in this area, went towards residual waste treatment. Companies offering solutions to avoid waste, such as disruptive design, new business models and reuse, received no funding at all.

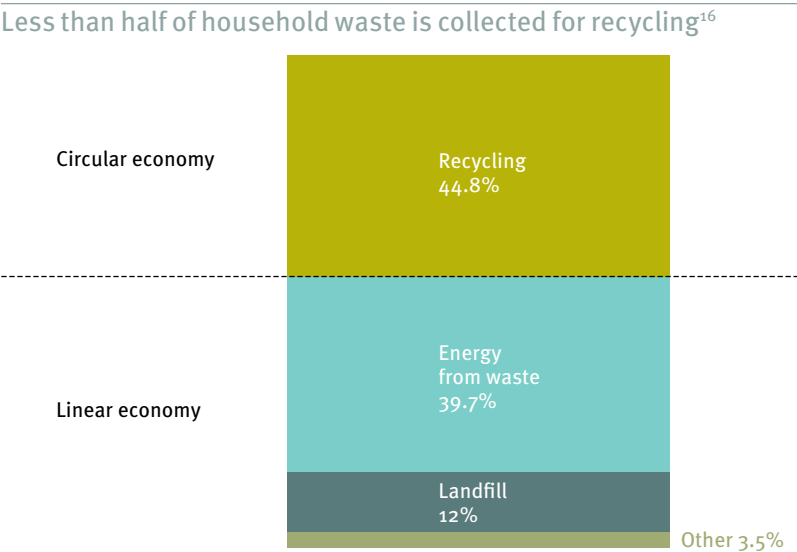
Infrastructure investments by the government owned Green Investment Bank, 2012-2017 (by capacity)¹⁰



Private sector infrastructure funding has also concentrated on waste disposal, in the absence of policy to drive investment towards circular solutions.¹¹ Since it was privatised in 2017, the Green Investment Bank, now the Green Investment Group, has made four investments in the waste and resources sector. All of them have been for large scale EfW facilities. The most recent three, announced between December 2017 and March 2019, were made in partnership with Covanta, one of the world’s largest incineration companies.¹²

Consequently, recycling in England has plateaued, after a rapid increase from under ten per cent at the turn of the century to more than 40 per cent by 2010.¹³ Today, the overall proportion of household waste that goes to recycling is 45 per cent, well below the 50 per cent recycling target for 2020. And this headline figure hides very low rates for some individual household waste streams, including food waste (12 per cent), textiles (20 per cent) and plastics (22 per cent).¹⁴ Moreover, a large proportion of what is counted as recycled, including over half of the packaging collected, is sent abroad, with few guarantees that it is actually recycled.¹⁵

“A lack of knowledge makes it difficult to plan for the future of the circular economy.”



Circular economy infrastructure is not tracked

The Waste Infrastructure Delivery Programme tracks both public and merchant facilities for residual waste and the government regularly releases information on the numbers and capacities of final treatment facilities: incinerators, EfW plants and landfills.¹⁷ But there is no equivalent, comprehensive list of facilities for recycling, repair, remanufacturing or reuse. A lack of knowledge makes it difficult to plan for the future of the circular economy that the resources and waste strategy said England wants to develop.¹⁸

Current strategy will not lead to a circular economy

Two recent opportunities were missed to analyse existing circular economy infrastructure and assess future needs: the national infrastructure assessment (NIA), released by the National Infrastructure Commission in June 2018, and the resources and waste strategy, published in December 2018.

National infrastructure assessment

Waste and recycling – if not the circular economy – is one of the NIA’s priority areas. The document describes the importance of knowing existing infrastructure and what is needed: “Decision making can be improved through robust analysis of the performance of existing infrastructure and recognising the value of good design”.¹⁹

However, beyond an observation that making food waste collections universal would avoid the need to build between one and three EfW plants in England, it does not comment on either existing or required infrastructure for a more circular economy. The report’s recommendations for the sector, while sensible, only tangentially relate to infrastructure. It focuses on increasing recycling targets, clearly labelling material for recyclability, restricting hard to recycle plastics and improving commercial and industrial waste data reporting.

In future, the task of the commission should be to specify exactly what is needed in terms of investment and infrastructure to meet its aim to “incinerate less and recycle more”, as part of a wider move towards a circular economy.

Resources and waste strategy

In the resources and waste strategy, sustainable production is given theoretical prominence in its first chapter, which recognises the role resource efficient business models can play in creating a circular economy. But an outline of the concrete steps needed to promote better production and business models is largely lacking and there is no assessment of the kinds of infrastructure and systems needed for such businesses to succeed.

“Initial strategy consultations were a missed opportunity to move towards the whole lifecycle approach that is required in a circular economy.”

The strategy has more to say about end of life treatment. It states, “We cannot increase resource efficiency without the right waste infrastructure”, again focusing only on the end of the material cycle. Where circular economy infrastructure is discussed, it largely relates to incentives for the private sector to invest in recycling infrastructure, but it fails to include a timeline of policy reforms, or details of the capacity of current recycling and reuse facilities, future material composition and quality, or the impact of the UK leaving the European Union.

The initial strategy consultations were also a missed opportunity to move towards the whole lifecycle approach that is required in a circular economy. The proposed interpretation of extended producer responsibility (EPR) for packaging – the first of several sectors that could be addressed with the same overarching framework – will only hold producers responsible for end of life costs, with a narrow focus on promoting recycling and reducing litter. This is at odds with the original concept of EPR, in which it was described as “a policy principle to promote total life cycle environmental improvements of product systems”.²⁰ It is also out of line with the EU’s stance, which gives prominence to reuse and prevention, as well as to improving design and encouraging products that are “suitable for multiple use” and which are “technically durable”.²¹ The UK’s more narrow interpretation limits the effectiveness of this potentially powerful policy mechanism.

How will England manage resources in 2030?

The resources and waste strategy is a high level vision, but not a plan. Given that all the major political parties have promised to make the UK more circular, it would be sensible for the next government to back it up with concrete action, not least in the forthcoming update of the 2013 waste prevention programme.²²

Working with academics from the Resource Recovery from Waste programme at the University of Leeds, we have outlined three possible scenarios for a future circular economy, focusing on the type of infrastructure needed to deliver each of them.²³ As waste is a devolved matter and Scotland, Wales and Northern Ireland have their own strategies for resource use, we have limited this analysis to England.

Our first two scenarios describe limited circular economy development, based on enhancements to the current system, while the third outlines a transformational shift that makes resource efficiency an objective of all economic activity. Our three scenarios:

Business as usual: continued focus on end of life

The current resource management system has a low level of circularity. The UK is off track to reach even its 2020 50 per cent household recycling target. In this scenario, most waste disposal is focused on energy recovery which does not fit a circular economy model because burning destroys most materials.²⁴ But, as the government plan includes incineration with energy recovery, the private sector is following suit.²⁵ The accounting firm Grant Thornton, which tracks investment deals in the waste and resources sector, noted in its 2018 report: “There are 40 new proposed energy from waste facilities in varying stages of pre-contract development throughout the UK.”²⁶ Our business as usual scenario assumes that this pattern of investment will continue, based on existing policy. Some limited additional recycling infrastructure might come online for plastics, as discussed in the next section.

High recycling: achieving existing targets

Assuming that greater investment in EfW does not suppress efforts to achieve existing recycling targets, in this scenario the country would move towards a circular economy based on recycling. This would mean more infrastructure designed to tackle the outer, lower value material loops of a circular economy, and the country aiming for a 65 per cent municipal recycling rate by 2035.²⁷

New policy for extended producer responsibility for packaging, a deposit return scheme for drinks containers and consistent collections would increase the collection of source separated material suitable for recycling.²⁸ The resources and waste strategy states that this will “significantly increase UK [recycling] capacity by both increasing investors’ confidence and improving the competitiveness of UK reprocessing”.²⁹

There is some evidence the private sector is already preparing to increase recycling facilities: the volume of mergers and acquisitions in the recycling sector in 2017 increased by 50 per cent compared to 2016, according to Grant Thornton.³⁰ While these will not necessarily result in new infrastructure, the report concludes that the investment activity “stems from a recognition that the UK has the scope, opportunity and incentive to develop its recycling capability.”

Following the considerable attention recently given to plastic, there have also been a number of recent announcements on new recycling infrastructure designed to end plastic pollution. According to WRAP, since the start of 2019, plans to build over 250 kilotonnes of plastic recycling capacity have been announced.³¹ This includes the UK’s biggest multi-polymer plant, being developed by Viridor near Bristol.³²

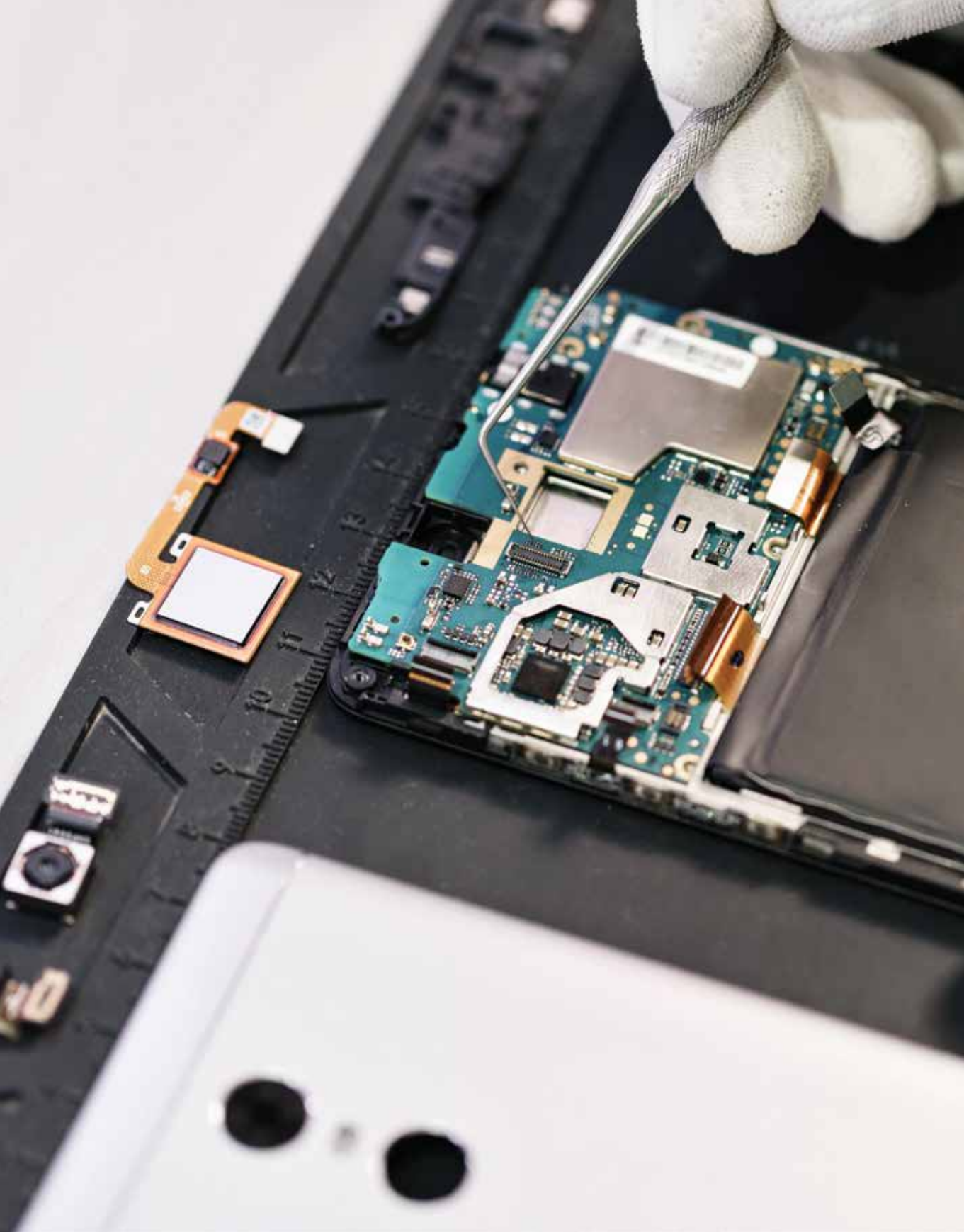
Transformation: a truly circular economy

Achieving a truly circular economy will require much more besides energy recovery and recycling. The resources and waste strategy promise to “prolong the lives of the materials and goods that we use, and move society away from the inefficient ‘linear’ economic model of ‘take, make, use, throw’” necessitates a completely different approach.

In this scenario, recycling would still be a prominent activity, but only after other options to improve resource value have been maximised by other means. Change would start with production and consumption, which would be overhauled in a way that benefits both progressive businesses and consumers. Instead of focusing on how to make the most of waste as the first step, attention would be on industrial resource productivity: ‘putting less in’ to the production process and ‘getting more out’ at the other end to drastically reduce material use. Alternative business models could help, including sharing and servitisation, by which people pay for the services provided by a product rather than for the product itself. People would get the affordable, better designed, longer lasting products they are demanding, helping them embrace better – but significantly less – material consumption.³³

In the following section we consider three common, high impact material streams from households: plastics, textiles and waste electronics, and what the future might be for each under these scenarios.

An annex outlining the main characteristics, actors involved and infrastructure requirements for these three scenarios is on page 31.



2030 scenarios for three common waste materials

Plastic, textiles, and electrical equipment are all associated with high environmental and human costs. They are consumed and wasted in very high quantities as a result of inadequate infrastructure and treatment systems and have been prioritised in the resources and waste strategy.

We estimate the household waste arisings of these materials, and show the infrastructure that would be needed under our three circular economy scenarios.



Plastics

Estimates suggest that English households currently produce around 2.1 million tonnes of plastic each year.³⁴ Less than a third of this is collected for recycling, and two thirds is sent abroad. The remainder either goes to landfill or incineration.³⁵

Business as usual

Continuing to focus on end of life would see waste generation remain high and about two thirds of household plastic waste being treated in EfW plants in 2030.³⁶ Of the 500 kilotonnes collected for recycling, half would be recycled in domestic infrastructure, though this could increase slightly if planned infrastructure comes online. The rest would be sent abroad.³⁷

High recycling

If England meets the 70 per cent recycling and composting target in the UK Plastics Pact, by 2030 the amount of household plastic collected for recycling would increase over three fold.³⁸ Recycling this plastic in the UK would require between 54 and 62 new closed loop recycling plants in the next decade depending on whether planned infrastructure is delivered. The alternative would be to export the collected material, potentially to countries that have limited capacity to recycle plastic safely.³⁹

Transformation: a circular system for plastics

Our modelling assumes that a more circular economy could cut plastic waste arisings from households by half compared to the 'high recycling' scenario, while increasing the amount of plastic collected by nearly 60 per cent compared to business as usual.

Based on these much lower waste arisings, we estimate that between 21 and 31 new closed loop plastics recycling plants would be needed across England, along with additional infrastructure and systems, including:

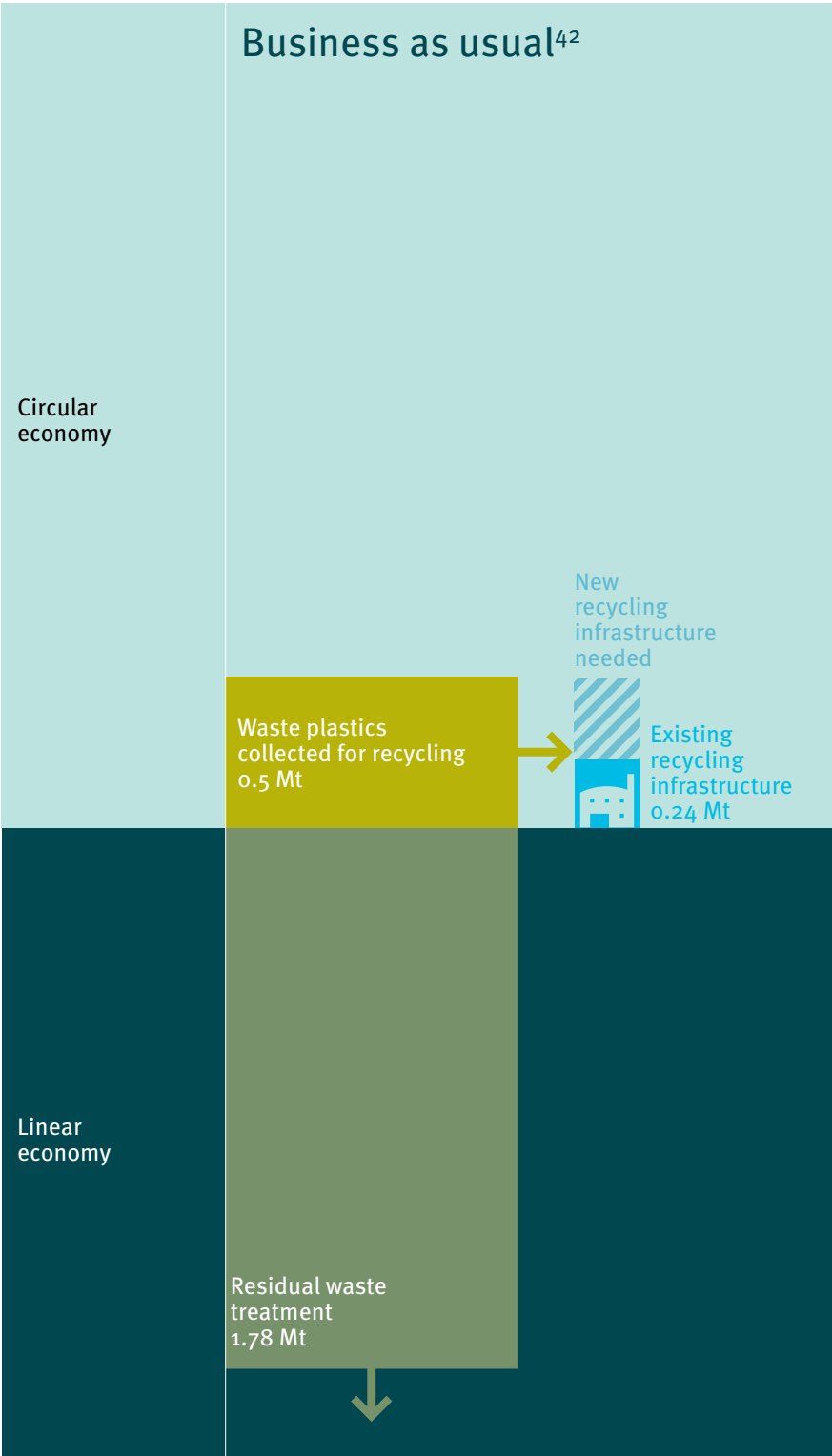
Reorientation of the proposed deposit return scheme to support the return of beverage containers for refill rather than recycling.

A standardised, source separated collection system, to ensure that better quality plastic material enters the recycling system. While the resources and waste strategy promised a harmonised system, there is still uncertainty about when local authorities will have to implement changes, and how alike systems should be across the country.⁴⁰

Standards and labelling for reusable plastics, as well as for the share of recycled content and for recyclability.

Infrastructure and logistics for refilling containers, to encourage less consumption of packaging. Examples of this approach range from drinking water fountains to 'bring your own' container refill services for products like pasta, cereals and coffee, as has been successfully trialled by the supermarket chain Waitrose.⁴¹

Household plastic waste
England's infrastructure
requirements for a circular
economy in three scenarios



High recycling

Transformation

Waste plastics
collected for recycling
1.6 Mt

New
recycling
infrastructure
needed

Existing
recycling
infrastructure
0.24 Mt

Residual waste
treatment
0.67 Mt

Reduced
plastic
consumption
1.14 Mt

New
infrastructure
needed
(including
information,
logistics, standards
and labelling)

Waste plastics
collected for recycling
0.8 Mt

New
recycling
infrastructure
needed

Existing
recycling
infrastructure
0.24 Mt

Residual waste
treatment
0.34 Mt



Textiles

The consumption of clothing per person in the UK is higher than any other country in Europe and is rising quickly. Currently, it equals 26.7kg per person, compared to 14kg in the Netherlands and 12.6kg in Sweden.⁴³ Reuse is more common than in other sectors, perhaps as high as 33 per cent, although the vast majority is exported to markets that are becoming saturated.⁴⁴ Around 300,000 tonnes of household clothing is incinerated or landfilled each year.⁴⁵

Business as usual

If current trends continue, in another ten years' time only a fifth of end of life textiles from households will be able to be collected for recycling. Current domestic infrastructure would handle less than half of that and, assuming limited innovation, downcycling of textile fibres would dominate.⁴⁶ About two thirds of household textile waste would be sent to EfW plants.

High recycling

If collection rates rise to 65 per cent (in line with the EU's targets for 2035), an additional 340 kilotonnes of textiles would be collected for recycling in 2030. In addition to existing treatment infrastructure, England would need to build 17 recycling plants by 2030, of which nine smaller scale plants would specialise in closed loop recycling for particular types of fibres, while the remaining facilities would downcycle the majority of textiles collected. Large amounts of clothing would continue to accumulate unused in people's wardrobes, in line with recent trends. In 2012, WRAP estimated that nearly a third of clothes in the UK – worth £30 billion – had not been worn in the previous year.⁴⁷ By 2016, the amount of clothes purchased had increased by nearly 20 per cent and sales have continued to rise.⁴⁸

Transformation: a circular system for textiles

By bringing the consumption of textiles per person in line with that of other European countries, England could cut the amount entering the waste system by half, to just over 300 kilotonnes in 2030. The amount collected for recycling would increase to just under 200 kilotonnes per year. England would require 15 new closed loop recycling plants by 2030, adopting innovative processes that enable 'clothing to clothing' recycling across a wide spectrum of fibres.

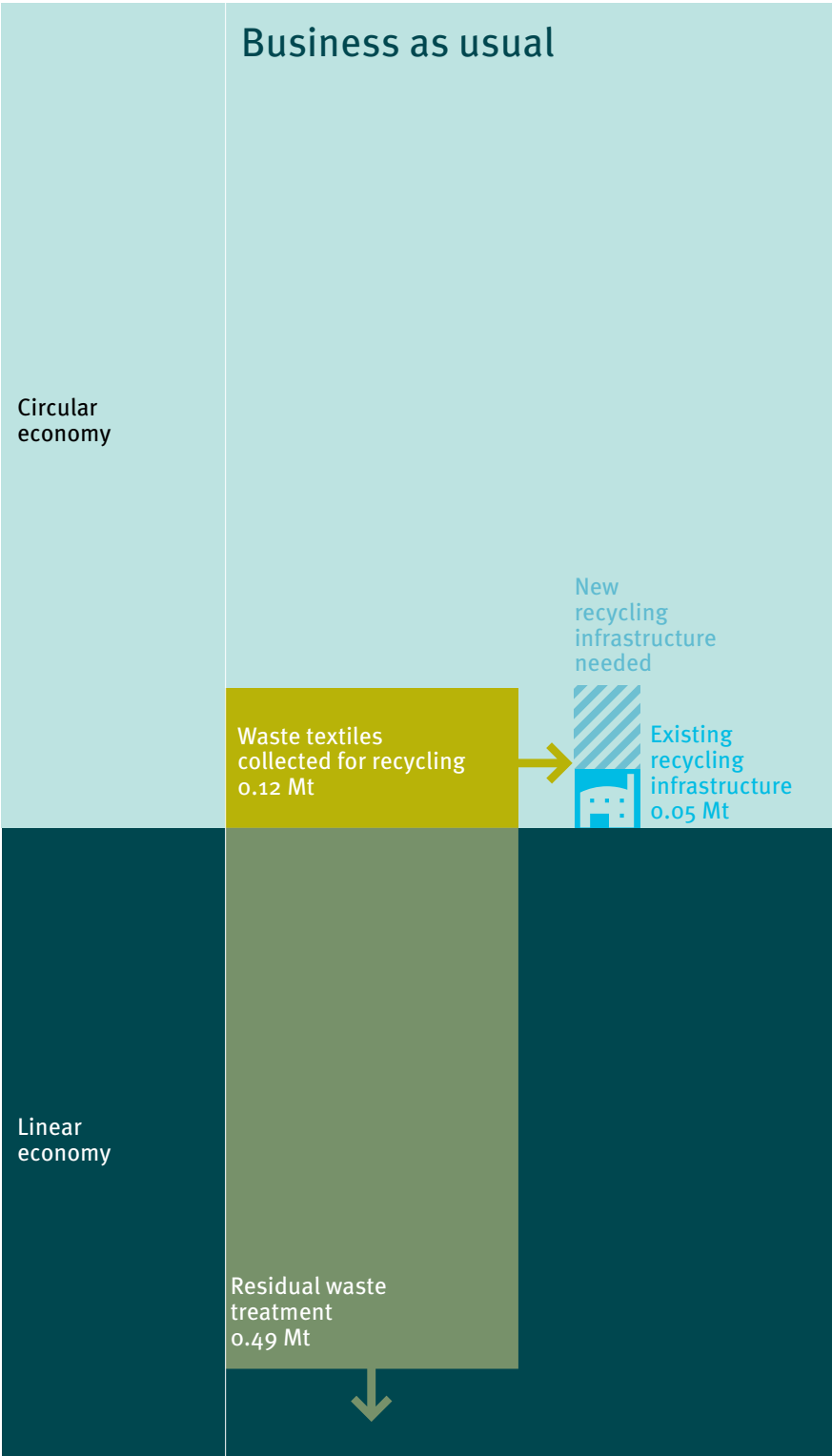
New infrastructure and systems needed include:

Information and education, including labelling for durability, recyclability and the presence or absence of substances of concern.⁴⁹

Reuse facilities and leasing, for longer, more intensive use of clothing. This will require expanding existing facilities and making these business models more attractive to consumers by, for instance, improving cleaning, maintenance and quality monitoring; widening access to second hand clothing through resale alongside new sales; and increasing leasing options, currently being trialled by some companies.⁵⁰

Take back centres and specialist logistics, to support lower cost, shared operations for leasing and to expand clothing recovery schemes.⁵¹ Product tags that are scanned on collection, like those being trialled by Danish baby clothing company Vigga, could also improve tracking, sorting and inventory management.⁵²

Household textile waste
England's infrastructure
requirements for a circular
economy in three scenarios



High recycling

Transformation



Residual waste treatment
0.22 Mt

An arrow points from the bottom of the yellow block in the 'High recycling' scenario to a grey block representing residual waste treatment at 0.22 Mt.





Electrical equipment

Electrical equipment use has been increasing in recent years, with two million tonnes placed on the market each year. WRAP expects a further rise of 19 per cent between 2015 and 2020.⁵³ At the end of life, most of this is treated through low quality recycling that relies on shredding, which loses highly valuable critical raw materials. About ten per cent of electronics are reused at the end of their first life, often through informal channels, but there has been little effort to design products for greater durability or repair.⁵⁴

Business as usual

In this scenario, England's reprocessing capacity for waste electrical and electronic equipment (WEEE) from households would continue to focus on low value recycling, which relies on shredding.⁵⁵ As a result, while most waste electronics and appliances that households eventually discard would be collected for recycling, the use of shredding would continue to lose valuable materials and prevent closed loop recycling.⁵⁶

High recycling

If the UK were to meet the EU's recycling collection target of 85 per cent for electronics, 150 kilotonnes of additional WEEE would be collected in 2030. To process this domestically, England would need two general WEEE recycling facilities and four specialist reprocessors for specific appliances, in addition to existing reprocessing infrastructure.

Transformation: a circular system for electrical equipment

Our modelling assumes that, by moving to a circular economy, England could halve the amount of WEEE entering the household waste stream by 2030. Most waste collected would be sent to specialist recyclers capable of high quality disassembly, parts harvesting and closed loop recycling. England could support 17 recycling reprocessors specialising in particular appliances, which would require either investment in new plants or the repurposing of existing facilities.

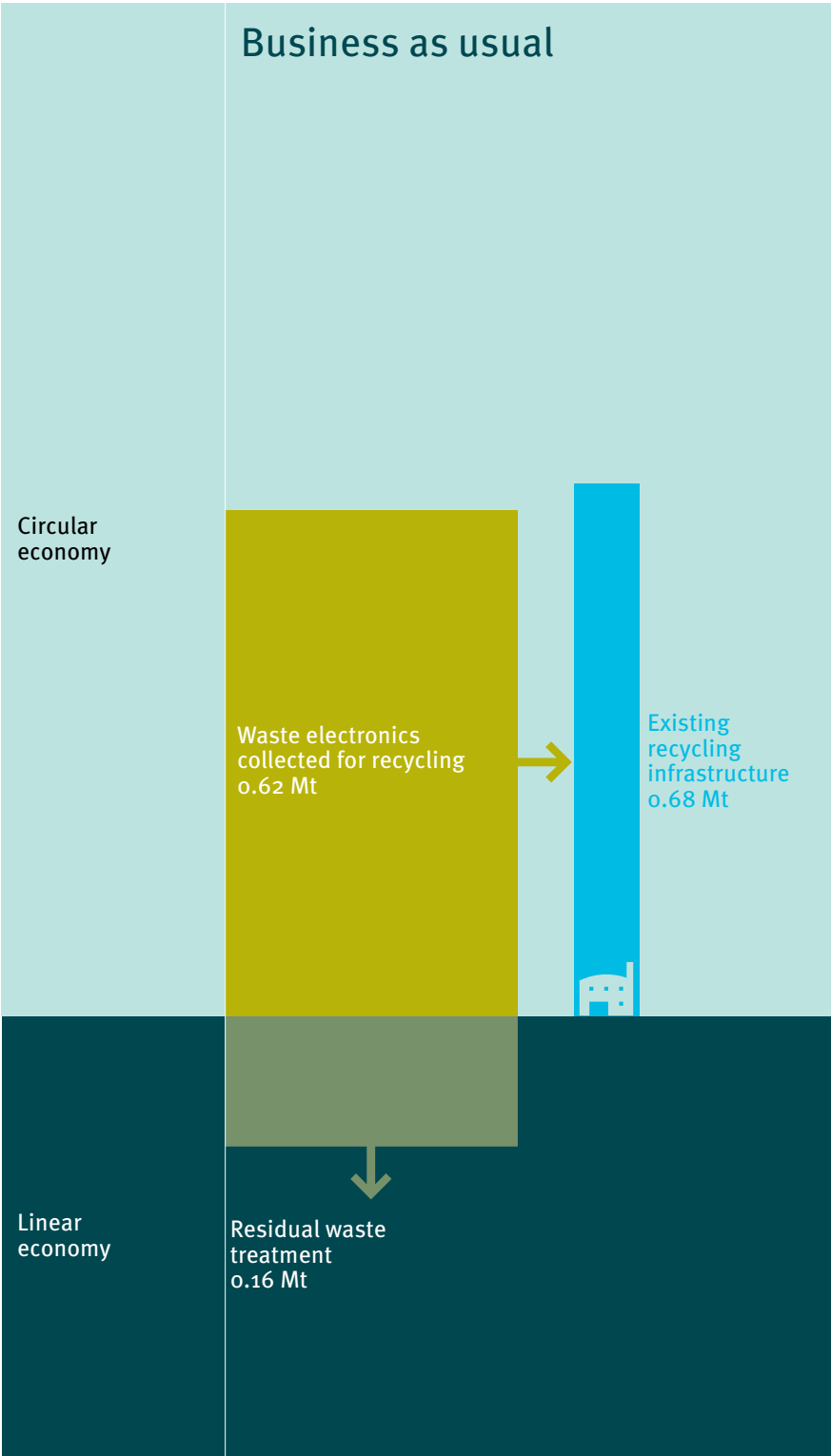
New infrastructure and systems needed to prevent waste include:

Information, guidelines and education systems that ensure better product design and use. This could include making ecodesign central to design courses, setting standards that designers are encouraged to exceed and making sure that repair information and components are easily available.⁵⁷

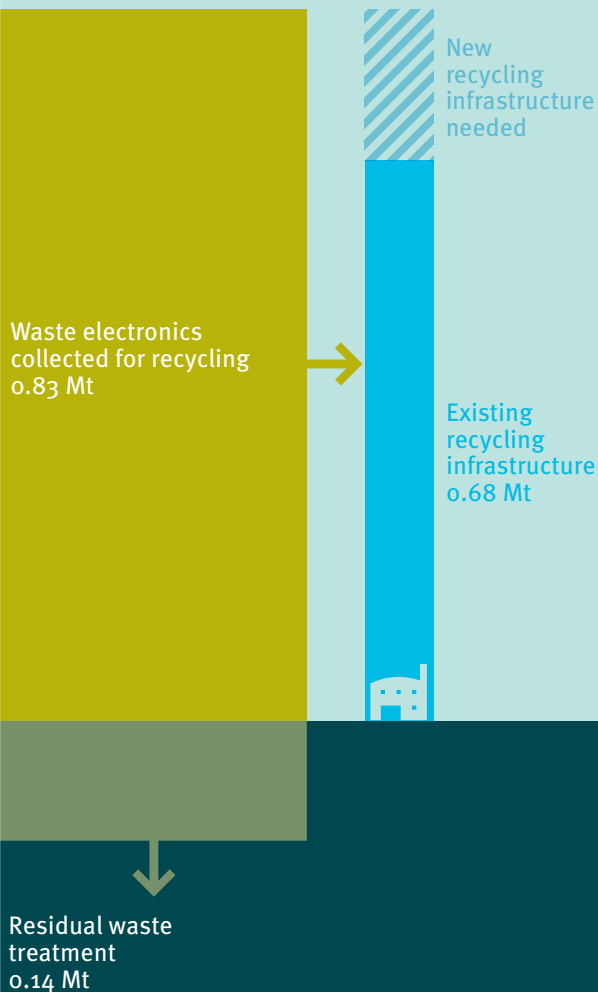
Take back centres and specialist logistics to encourage the return of items and enable collection and transportation to centres for data wiping and assessment for reuse. To avoid damage to items, the system needs to facilitate careful handling.⁵⁸ This would also allow better sorting and the recovery of smaller items that currently end up in residual waste.

Reuse, repair and remanufacturing centres to sort electrical equipment, identify opportunities for repair or remanufacturing and to return secondhand devices to the market. This can build on existing initiatives for business-to-business applications.⁵⁹

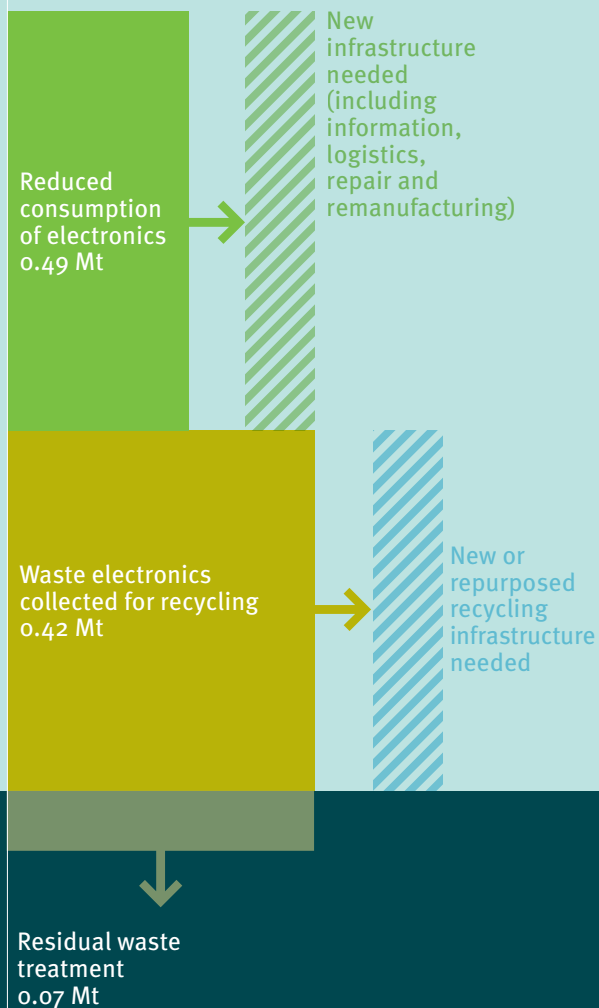
Household electronics waste
England's infrastructure
requirements for a circular
economy in three scenarios



High recycling



Transformation



Why England should choose a transformational circular economy

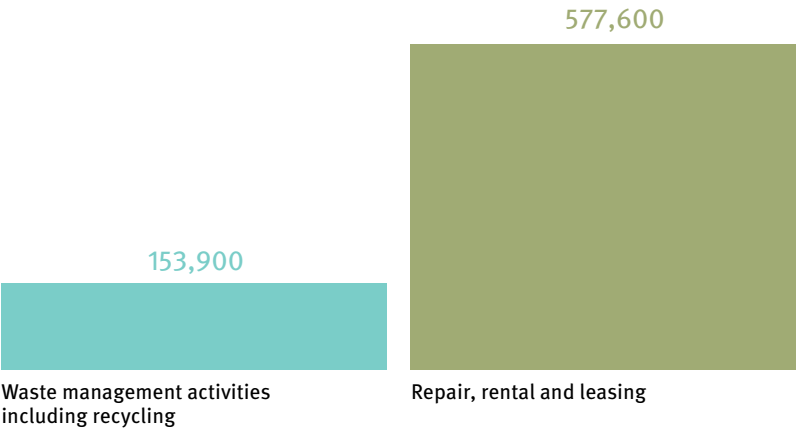
Redesigning the system for a transformational circular economy for all materials and sectors would not only end the unsustainable use of resources, but offer other considerable benefits, including new, high quality jobs, carbon reduction and opportunities for economic development.

Jobs

There are many more jobs in materials recycling, repair and reuse than in waste treatment and disposal. For every thousand tonnes of material there are two jobs in recycling as opposed to 0.1 job in waste treatment and disposal.⁶⁰ Reuse and remanufacturing generate many more jobs while creating greater value for the economy.

Even now, with little government intervention to create a circular economy, the number of people employed in repair, remanufacturing and leasing in the UK dwarfs those employed in dealing with waste and recycling. Employment figures suggest there are already four times as many people employed on these activities, in large part due to the repairing and leasing of vehicles and industrial machinery.

UK employment in waste related and circular economy activities, 2017⁶¹



Green Alliance’s previous research, in collaboration with WRAP, has shown that a transformative approach to a circular economy could drive growth, creating over half a million new jobs in Britain, with over a fifth of these being net jobs. This would help to revive employment prospects in declining manufacturing regions, with new jobs in recycling, biorefining, repair and remanufacturing, reuse, and servitisation. Crucially, these jobs come at all skill levels, from low skilled to professional. Our research shows that opportunities for this new employment is most likely to be in areas like the North East and the West Midlands, where unemployment is highest.⁶²

“Better use of resources could yield £10 billion in additional profits to the manufacturing sector.”

Carbon reduction

Work by Green Alliance, with the Centre for Industrial Energy, Materials and Products, has shown that resource efficiency offers considerable potential to cut carbon. In fact, the benefits are so great that we labelled it the UK’s missing climate policy. Using and losing fewer resources in production processes and getting more out of products in just five key sectors (construction, vehicles, electrical equipment, clothing and textiles, and food) could reduce emissions by nearly 200 MtCO₂e by 2032. This would help the UK to meet its long term carbon reduction targets.⁶³

Economic benefits

The average UK manufacturer now spends five times more on resource inputs than they do on labour.⁶⁴ The Institute for Manufacturing has conservatively estimated that better use of resources could yield £10 billion in additional profits to the manufacturing sector.⁶⁵ This would have the effect of raising productivity, particularly in regions that are currently lagging behind.⁶⁶

A circular economy would also reduce exposure to volatile markets in critical raw materials. Low carbon technologies, such as renewables and electric vehicles, rely on imported cobalt and rare earth elements. Extraction of these materials is associated with substantial human and environmental costs, potentially exposing UK businesses to supply chain risks. A circular economy can lower these risks and increase business resilience in two ways: reducing the need for the materials and providing a domestic source of reprocessed material to meet some of the demand.⁶⁷

Recommendations

Having accepted the need to create a more circular economy, the next government must now shift focus upstream, so that materials are captured and repurposed before they become waste.

To do this, a new approach is required. A range of incentives will be needed to help businesses to make the transition and establish the new infrastructure necessary for a circular economy.

Three actions taken now would set the wheels in motion:

Carry out an infrastructure stocktake

To inform decision makers about what infrastructure is needed, the government should urgently survey the existing and planned infrastructure for all materials and waste streams. The three material streams we have examined above should be priorities, but a comprehensive stocktake should take into account other materials.

Given that the Infrastructure and Projects Authority (IPA) already tracks waste infrastructure through the National Infrastructure Delivery Plan, it would make sense for it to lead this stocktake. Its 2016-21 plan mentioned the government's "ambition to move towards a 'circular economy' where material resources are valued and kept in circulation" in passing, but it only assessed the ability of infrastructure to meet landfill diversion targets, not to create a circular economy.⁶⁸

Future assessments should concentrate on the country's current and planned capacity for reuse, repair and remanufacturing, and recycling. It should also assess end of life treatment facilities. This should be publicly available and regularly updated. It should be created in close co-operation with the National Infrastructure Commission, which is charged with addressing "the lack of a long term infrastructure strategy, siloed decision making in infrastructure sectors, fragile political consensus and short termism".⁶⁹ These two bodies should work with priority departments, including Defra, the Department for Business, Energy and Industrial Strategy, the Ministry of Housing, Communities and Local Government and the Treasury, as well as the Office of National Statistics (ONS).

Set up a materials database within five years

Better resource management requires much better data on material and product stocks and flows.⁷⁰ The resources and waste strategy recognises that the sector's information deficit "hampers the proper functioning of market incentives and stifles those trying to become more resource efficient. If you can't measure it, you can't manage it – and this lack of basic data prevents us from reaping the benefits of resource efficiency."⁷¹

To correct this, it has said it will be supporting the ONS to develop a pilot and business case for a National Materials Datahub. The aim is to provide a near real time materials tracking system, including “comprehensive data on the availability of raw and secondary materials, including chemicals, across the economy to industry and the public sector, and by modelling scenarios around material availability.”

It is anticipated that this datahub would ultimately require investment of hundreds of millions of pounds, although this will not all have to be government expenditure. Resource Recovery from Waste reasons that this “would be far outstripped by significant benefits for economic growth, business opportunities, job creation, low carbon targets, natural capital, resource productivity, and material supply security.”⁷²

However, it is not yet confirmed whether the initial £5 million two year pilot project will go ahead and, if it does, under current plans it would take ten years for the complete datahub to be fully up and running.⁷³ Given the widespread recognition of the urgent need for better data, and its role in planning and creating a more circular economy, the next government should not only confirm the go ahead but fast track its development, committing to it being fully functional for at least two sectors within five years.

Create a £400 million circular economy starter fund

Instead of focusing on waste treatment, which continues to attract relatively high levels of private investment, the government should be investing in upstream activities. These are crucial to a circular economy but they have so far struggled to attract private funding to get off the ground.

The previous government showed it was willing to invest in helping businesses move to a low carbon future, for example through the £315 million Industrial Energy Transformation Fund (IETF) and the £66 million Transforming Foundation Industries fund, arising from the Industrial Strategy.⁷⁴ While efforts to improve industrial resource efficiency could benefit from this funding, the focus is likely to be split between energy efficiency and production processes in energy intensive industries and manufacturing. Focusing solely on these industries could limit opportunities for resource efficiency throughout supply chains. This, and the fact that funding is only expected to be available until 2024, may prevent businesses from innovating.⁷⁵

Little government funding has gone into realising the considerable potential of the circular economy, beyond research and pilot projects. The government should also dedicate a similar level of funding – at least £400 million – over the next five years for upstream circular economy projects that deliver carbon savings through better design, durability, reuse, refurbishment and high quality recycling. The government should also commit to renew funding support for projects at the end of the five year period, building on lessons from the first wave.

This new support should build on ongoing research and innovation, and the successful National Industrial Symbiosis Programme (NISP) and the Resource Efficient Business (REBus) pilot projects. Between 2005 and 2013 more than £27 million of public funding was invested in NISP for England, to help redirect surplus resources from one industrial process for use in different processes. The programme led to significant benefits, including 10,000 jobs as well as 8.4 million tonnes of carbon savings and £1 billion cost savings.⁷⁶ And, with €3.1 million from EU funds, REBus projects – many of which took part in the UK between 2013 and 2017 – resulted in more than €5.6 million in financial benefits while saving more than 60,000 tonnes of material.⁷⁷

A vision and strategy for transformation will help to take the circular economy beyond simply recycling to embed a full lifecycle approach, including reuse, repair, remanufacturing and servitisation. Everyone, from extractors and processors to producers, designers and consumers, should be involved and encouraged to play their part in this economic transformation.

Annex 1

More detail on our three circular economy scenarios⁷⁸

Scenario	Characteristics	Actors involved	Main infrastructure requirements
Business as usual	<p>'Closing the loop' through energy recovery (not generally accepted as part of a circular economy)</p> <p>Production and consumption system maintained</p> <p>Focus on end of pipe treatment options</p>	<p>Public and private waste collectors</p> <p>Waste treatment operators</p>	<p>Material collection systems</p> <p>Waste treatment and recovery systems</p>
High recycling	<p>'Closing the loop' through material recovery</p> <p>Production and consumption system largely maintained</p> <p>Limited adjustments to production and focus on material collection</p>	<p>Public and private waste and resource collectors</p> <p>Waste and secondary resource treatment operators</p> <p>Producers</p> <p>To some extent, government, local authorities and consumers</p>	<p>Material collection systems</p> <p>Waste treatment and recovery systems</p> <p>Production and limited logistics to use secondary resources</p>
Transformation	<p>'Closing the loop' through maximising resource use and minimising waste</p> <p>Production and consumption overhauled through lowering demand for new products and bringing in new business models and greater reuse, repair, sharing and servitisation</p> <p>Focus on all aspects of material use with recycling as the last resort</p>	<p>Government</p> <p>Raw material suppliers</p> <p>Designers</p> <p>Manufacturers</p> <p>Retailers</p> <p>Service businesses</p> <p>Public and consumers</p> <p>Public and private resource collectors</p> <p>Secondary resource and product treatment operators</p>	<p>Design and manufacturing</p> <p>Logistics: tracking data, product and material collection and redistribution</p> <p>Systems for sharing, leasing and servitisation</p> <p>Repair, remanufacture and reuse</p> <p>Public education and skills</p>

Endnotes

A full methodology for our analysis of the different scenarios for plastics, textiles and electronics can be found online at www.green-alliance.org.uk/resources/circular_economy_infrastructure_methodology

- ¹ HM Government, July 2019, 'Environment Bill summer policy statement'
- ² HM Government, 2017, *Our waste, our resources: a strategy for England*
- ³ See, for instance: *Resource*, 30 November 2017, 'Residual waste infrastructure: heated debate continues as ESA weighs up different arguments'. The government has examined whether or not there will be enough treatment infrastructure, given current levels of waste generation and suggests that there could be overcapacity of 2Mt by 2035. It adds: "if energy recovery continues to provide a better environmental alternative to landfill, more investment to reduce tonnages of MSW to landfill further would deliver environmental benefits". See: HM Government, December 2018, *Our waste our resources: a strategy for England: evidence annex*
- ⁴ China's National Sword programme initially banned 24 grades of "foreign garbage" including unsorted paper and all plastics in 2018. Since then, the list of banned materials has increased, and some other countries – including Indonesia, Thailand and Vietnam – have also implemented restrictions.
- ⁵ A 2017 review from Tolvik Consultancy for the ESA showed that of seven reports on incineration capacity, only one projected that household waste growth would not at least keep pace with population growth and all suggested that commercial and industrial waste was likely to grow faster than population (although one report included a low growth scenario that was lower at 0.2 per cent). See: ESA, November 2017, *UK residual waste: 2030 market review*
- ⁶ Resource efficiency and the circular economy are priority areas for research in the strategy. In line with this, in September 2019, UK Research and Innovation (UKRI) announced a £30 million Interdisciplinary Circular Economy programme.
- ⁷ Defra, 29 March 2019, 'Waste Infrastructure Delivery Programme residual waste treatment infrastructure project list'. The project list predominantly tracks infrastructure funded through public private partnership and private finance initiatives, as well as some merchant facilities. In addition to the operational facilities, it lists a further 25 energy from waste plants (with capacity of 6.1 Mtpa) and three plants producing refuse derived fuel (with a capacity of 0.6 Mtpa) in construction or consented.
- ⁸ HM Government, 2011, *Update on the design of the Green Investment Bank*
- ⁹ EAC, July 2014, *Growing a circular economy: ending the throwaway society*
- ¹⁰ Based on analysis of Green Investment Bank announcements between 2012 and 2017. The figures exclude investments in combined heat and power plants running on waste wood.
- ¹¹ This is set out as a government preference in multiple documents. The 2016 *National infrastructure delivery plan* noted that the government had no plans to invest in any waste infrastructure, as there was sufficient capacity to meet 2020 landfill diversion targets. No infrastructure requirements for a move to a circular economy were identified.
- ¹² The investments will go to a 545,000 tonne per annum waste to energy facility in Bedfordshire (GIG press release, 22 March 2019, 'Green Investment Group supports decarbonisation of Scottish economy by energising Grangemouth's local industry'), a 216,000 per annum waste to energy plan in Grangemouth, Scotland (GIG press release, 18 December 2018, 'Green Investment Group supports decarbonisation of Scottish economy by energising Grangemouth's local industry') and a 600,000 tonne per annum waste to energy facility in Dublin (GIG press release, 18 December 2017, 'Green Investment Group invests in Covanta's Dublin facility as first step in partnership to co-develop waste-to-energy projects in UK and Ireland')
- ¹³ SUEZ, 2015, *At this rate: exploring England's recycling challenges*

- ¹⁴ Based on analysis of household waste arisings and destinations in England for 2017-18 by material type calculated from collection.
- ¹⁵ The Environment Agency, for instance, publishes information on household and commercial and industrial packaging material that is treated domestically or exported, including for aluminium, paper and board, plastic, steel and glass that is sent for re-melt. In 2018, 2.9 Mt of these types of packaging were treated domestically while 3.7 Mt were exported for reprocessing. See Environment Agency, 29 March 2019, '2018 Q1, Q2 & Q3 & Q4 packaging recycling & recovery data'
- ¹⁶ Based on analysis of waste arisings and destinations in England for 2017-18
- ¹⁷ See, for example: Defra, May 2018, *Digest of waste and resource statistics – 2018 edition*
- ¹⁸ P Purnell, 2017, 'On a voyage of recovery: a review of the UK's resource recovery from waste infrastructure', in *Sustainable and resilient infrastructure*
- ¹⁹ National Infrastructure Commission, July 2018, *National infrastructure assessment*
- ²⁰ Thomas Lindhqvist, 2000, *Extended producer responsibility in cleaner production: policy principle to promote environmental improvements of product systems*
- ²¹ European Union, 2008, *Waste Framework Directive*. The idea that extended producer responsibility should cover the full lifecycle is also included in the Circular Economy Package, which calls for extended producer responsibility fees to be "modulated, where possible, for individual products or groups of similar products, notably by taking into account their durability, reparability, re-usability and recyclability and the presence of hazardous substances, thereby taking a life-cycle approach".
- ²² HM Government, December 2013, *Prevention is better than cure: the role of waste prevention in moving to a more resource efficient economy*. The original plan was widely derided by industry as embodying a tick box approach towards EU requirements. See, for instance, the article by Professor Tim Cooper, *Guardian*, 9 January 2014, 'The UK remains on course to retain its throwaway culture'. A review was meant to be completed by the end of 2019. Given the ambitions set out in the overarching resources and waste strategy, it would be reasonable to expect a more ambitious approach towards waste prevention and greater circularity.
- ²³ A Valenturf et al, [forthcoming], *Pathways to a sustainable circular economy*; and Resource Recovery from Waste, 2019, *Resource Recovery from Waste*, end of programme brochure
- ²⁴ EU Technical Expert Group on Sustainable Finance, June 2019, *Taxonomy technical report*. This follows the report: European Commission, December 2015, *Closing the loop: an EU action plan for the circular economy*, which set out that "funding for new facilities for the treatment of residual waste, such as incineration... [should] be granted only in limited and well justified cases, where there is no risk of overcapacity and the objectives of the waste hierarchy are fully respected."
- ²⁵ The UK government explicitly includes incineration as part of the circular economy in its resources and waste strategy, noting: "But it's not just in material reuse that the circular economy delivers benefits. It's also relevant to energy generation and savings. Incinerating non-recyclable or contaminated waste (such as food packaging) can generate energy." (See: HM Government, 2017, op cit)
- ²⁶ Grant Thornton, May 2018, *Annual waste and resource management review*
- ²⁷ European Union, 14 June 2018, *Official Journal of the European Union*, Volume 61
- ²⁸ This was highlighted by a number of respondents to the consultation on extended producer responsibility for packaging. According to the analysis of responses: "Some respondents felt that the principles and outcomes are too focused on the end-of-life costs of managing packaging waste and that we should also consider the full life-cycle costs of packaging. Other respondents felt that the waste hierarchy needs to be better reflected, and more emphasis given to prevention and the use of reusable/ refillable packaging." For its part, the

- government says it will “give further consideration to opportunities for encouraging use of reusable and refillable packaging.” See: Defra et al, July 2019, *Consultation on reforming the UK packaging producer responsibility system: summary of consultation responses and next steps*
- ²⁹ HM Government, 2018, op cit
- ³⁰ Grant Thornton, May 2018, op cit
- ³¹ WRAP, 2019, *Plastics market situation report 2019*
- ³² Viridor press release, 30 May 2019, ‘Ground-breaking South West project sees Viridor power plastic recycling with non-recyclable waste’
- ³³ Green Alliance, 2018, *By popular demand: what people want from a resource efficient economy*. According to this research, 75 per cent of people support government moves to ensure businesses produce repairable and recyclable products; 81 per cent want businesses to support repair, maintenance and disposal; and 78 per cent want businesses to provide remanufactured and refurbished products.
- ³⁴ For the material specific streams, we consider household waste on its own, rather than municipal or municipal and commercial and industrial waste. This is because we have the most reliable information for wastes from households (commercial and industrial waste is not reliably tracked, and because, according to the government: “The majority (76 per cent) of waste treated at energy recovery facilities is ‘Household & similar wastes’”. Our calculations have assumed only a proportion of existing infrastructure is dedicated to household waste. See: HM Government, March 2019, *UK statistics on waste*
- ³⁵ Green Alliance, 2018, *Completing the circle: creating effective UK markets for recovered resources*
- ³⁶ This assumes that the share of plastics being landfilled drops by 17 per cent in 2017 to ten per cent in 2030, in line with EU targets. What is diverted from landfill is added to the current share of waste being treated through EFW and incineration plants.
- ³⁷ Green Alliance, 2018, op cit
- ³⁸ WRAP, 2018, *A roadmap to 2018: the UK Plastic Pact*
- ³⁹ NAO report by the Comptroller and Auditor General, 23 July 2018, *The packaging recycling obligations*. Since China closed its doors to low quality recyclate, the UK has begun sending plastic waste to countries like Malaysia and Indonesia. These countries often lack the resources and infrastructure to manage the waste well, especially given its sometimes dubious quality.
- ⁴⁰ Defra, 2019, *Consultation on consistency in household and business recycling collections in England*
- ⁴¹ *Independent*, 1 August 2019, ‘Waitrose extends “bring your own” container trial to reduce plastic waste’
- ⁴² The business as usual situation is changing for plastics more than other materials, with several new recycling facilities announced. These are not included in this graph, but are considered in greater detail in our methodology, available online at: www.green-alliance.org.uk///XXXXXX//
- ⁴³ Environmental Audit Committee, 19 February 2019, *Fixing fashion: clothing consumption and sustainability*
- ⁴⁴ WRAP, 2016, *Textiles market situation report*
- ⁴⁵ EAC, 2019, op cit
- ⁴⁶ There is limited information on textile recycling infrastructure in England, but estimates suggest that capacity is insufficient to handle current levels of textiles collected for recycling. WRAP estimates that, in the UK, £140 million worth of clothing ends up in landfill every year. See: WRAP, 2017, *Valuing our clothes: the cost of UK fashion*
- ⁴⁷ WRAP, 2012, *Valuing our clothes: the true cost of how we design, use and dispose of clothing in the UK*
- ⁴⁸ WRAP, 2017, op cit
- ⁴⁹ Ellen MacArthur Foundation, 2017, *A new textiles economy: redesigning fashion’s future*; criteria for assessing durability could include number of washes an item withstands or the minimum number of times it can be worn without showing signs of wear and tear.
- ⁵⁰ Ibid

- ⁵¹ 3.3 billion tonnes CO₂e for the clothing industry, if considering the full lifecycle, compared to 3.5 billion tonnes CO₂e for EU28 countries. See: Environmental Audit Committee, 2019, op cit
- ⁵² Ellen MacArthur Foundation, 2017, op cit
- ⁵³ WRAP, 2017, *Switched on to value: powering business change*
- ⁵⁴ Ibid
- ⁵⁵ Current levels of recycling are complemented by informal reuse systems. According to WRAP, despite the fact that a quarter of electronic items being sent to waste are thought to be suitable for reuse, only ten per cent end up being repurposed for second life. Reuse takes part through informal means at the same time as consumers stockpile waste, so it is not currently entering the formal waste stream. Our material flows analysis therefore concentrates on material that actually enters the waste stream.
- ⁵⁶ C Cole et al, 2019, 'An assessment of achievements of the WEEE Directive in promoting movement up the waste hierarchy: experiences in the UK', *Waste Management*, 87, pp 417-427
- ⁵⁷ HM Government, July 2019, op cit. The government has suggested it will take the power to set resource efficiency standards in the forthcoming Environment Bill.
- ⁵⁸ C Cole et al, 2019, op cit
- ⁵⁹ techUK, 2018, *Reuse, repair, remanufacture in the ICT sector*
- ⁶⁰ Tellus Institute with Sound Resource Management, 2011, *More jobs, less pollution: growing the recycling economy in the US*
- ⁶¹ Graph derived from ONS dataset 'Industry (2, 3 and 5 - digit SIC) - Business Register and Employment Survey (BRES): Table 2' for 2015 (revised), 2016 (revised) and 2017 (provisional)
- ⁶² Green Alliance and WRAP, 2015, *Employment and the circular economy: job creation in a more resource efficient Britain*
- ⁶³ Green Alliance, 2018, *Less in, more out: using resource efficiency to cut carbon and benefit the economy*
- ⁶⁴ Manufacturing Commission, 2015, *Industrial evolution: making British manufacturing sustainable*
- ⁶⁵ Institute for Manufacturing, 2013, *The next manufacturing revolution: non-labour resource productivity and its potential for UK manufacturing*
- ⁶⁶ Green Alliance, 2017, *Lean and clean: building manufacturing excellence in the UK*
- ⁶⁷ Green Alliance, 2018, *Completing the circle: creating effective UK markets for recovered resources*
- ⁶⁸ Infrastructure and Projects Authority, March 2016, *National infrastructure delivery plan 2016-2021*
- ⁶⁹ National Infrastructure Commission, July 2018, op cit
- ⁷⁰ See, for example, A P M Velenturf, [no date], 'The National Materials Databank can improve governance for better material use by industry: an evidence briefing from the Resource Recovery from Waste programme'
- ⁷¹ HM Government, 2018, op cit
- ⁷² A P M Velenturf, 2019, op cit
- ⁷³ Presentation by Simon Duddy, Business Development Director for the ONS, at the Resourcing the Future Conference, 13 June 2019
- ⁷⁴ BEIS, 2019, *Designing the Industrial Energy Transformation Fund*; HM Government press release, 13 December 2018, 'World-first carbon "net-zero" hub of heavy industry to help UK seize global economic opportunities of clean growth'
- ⁷⁵ CREDS, 2019, *Shifting the focus: energy demand in a net zero carbon UK*
- ⁷⁶ www.international-synergies.com/projects/national-industrial-symbiosis-programme/
- ⁷⁷ Aldersgate Group, 2017, *Beyond the Circular Economy Package: maintaining momentum on resource efficiency*
- ⁷⁸ A Velenturf et al, [forthcoming], and Resource Recovery from Waste, 2019, op cit

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