

The Second State of Natural Resources Report (SoNaRR2020)

Assessment of the achievement of sustainable management of natural resources: Waste

Natural Resources Wales

Final Report

About Natural Resources Wales

Natural Resources Wales's purpose is to pursue sustainable management of natural resources. This means looking after air, land, water, wildlife, plants and soil to improve Wales's well-being, and provide a better future for everyone.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence-informed organisation. We seek to ensure that our strategy, decisions, operations, and advice to Welsh Government and others, are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

Title: **SoNaRR2020** Assessment of the achievement of Sustainable Management of Natural Resources: Waste

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Restrictions: None

The Second State of Natural Resources Report (SoNaRR2020) contents

This document is one of a group of products that make up the second State of Natural Resources Report (SoNaRR2020). The full suite of products are:

Executive Summary. Foreword, Introduction, Summary and Conclusions. Published as a series of webpages and a PDF document in December 2020

The Natural Resource Registers. Drivers, Pressures, Impacts and Opportunities for Action for eight Broad Ecosystems. Published as a series of PDF documents and as an interactive infographic in December 2020

Assessments against the four Aims of SMNR. Published as a series of PDF documents in December 2020:

SoNaRR2020 Aim 1. Stocks of Natural Resources are Safeguarded and Enhanced

SoNaRR2020 Aim 2. Ecosystems are Resilient to Expected and Unforeseen Change

SoNaRR2020 Aim 3. Wales has Healthy Places for People, Protected from Environmental Risks

SoNaRR2020 Aim 4. Contributing to a Regenerative Economy, Achieving Sustainable Levels of Production and Consumption

The SoNaRR2020 Assessment of Biodiversity. Published in March 2021

Assessments by Broad Ecosystem. Published as a series of PDF documents in March 2021:

Assessment of the Achievement of SMNR: Coastal Margins

Assessment of the Achievement of SMNR: Enclosed Farmland

Assessment of the Achievement of SMNR: Freshwater

Assessment of the Achievement of SMNR: Marine

Assessment of the Achievement of SMNR: Mountains, Moorlands and Heaths

Assessment of the Achievement of SMNR: Woodlands

Assessment of the Achievement of SMNR: Urban

Assessment of the Achievement of SMNR: Semi-Natural Grassland

Assessments by Cross-cutting theme. Published as a series of PDF documents in March 2021:

Assessment of the Achievement of SMNR: Air Quality

Assessment of the Achievement of SMNR: Climate Change

Assessment of the Achievement of SMNR: Energy Efficiency

Assessment of the Achievement of SMNR: Invasive Non-native Species

Assessment of the Achievement of SMNR: Land use and Soils

Assessment of the Achievement of SMNR: Waste

Assessment of the Achievement of SMNR: Water Efficiency

Updated SoNaRR evidence needs. Published as a data table on web in March 2021

Acronyms and Glossary of terms. Published as a PDF in December 2020 and updated in 2021 as a data table on the web

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1. Headline Messages

Issue 1

Wales is transitioning to a high recycling nation which is a necessary component of a circular and regenerative economy. However, more needs to be done to prevent waste from being generated if we are to achieve zero waste and one planet living. The pace of becoming a high recycling nation must be matched with the provision of suitable waste facilities and end markets for materials, particularly for material streams that are currently difficult to recycle.

Response 1

Moving from a recycling economy towards a circular economy will help to keep resources in service for as long as possible, maximising their value when in use and then, when no longer useful to society, ensuring that those resources are captured for re-use and recycling, and recovery or reintegration into ecosystems. Where waste continues to be generated it must be managed appropriately, with necessary environmental safeguards.

Issue 2

There are considerable amounts of recyclable material still present within the residual waste stream. Improving householder and business behaviours to participate in the separation of recyclable waste at source is vital for producing and supplying high quality recyclates to end recycling markets.

Response 2

Producing better quality material is likely to support the retention of material within the Welsh and UK economies, resulting in socio-economic benefits. Recycling retains natural resources, reducing the demand for virgin material. This supports the objectives of the Well-Being of Future Generations (Wales) Act 2015, improves resilience to materials market downturns and reduces the reputational risk associated with the fate of materials collected for recycling.

Issue 3

Waste crime poses risks to the condition and resilience of ecosystems and the benefits they provide through mismanagement of waste.

Response 3

Waste can be viewed as a resource or burden. In both of these views there is an opportunity for criminals to make money. A mandatory waste data tracking system is key to understanding waste and resource flows and to be able to target and focus interventions. Alongside other tools and accompanying resources, the system needs to: support businesses and operators to comply with their regulatory duties and responsibilities; highlight illegal operations and leakages from the system to waste regulators.

2. Introduction

Wales uses many resources for activities in business and industry, farming and food production, home and office, and this impacts on the natural environment. When waste is generated, it can be detrimental to ecosystems, biodiversity and the well-being of the population, especially where it is not managed appropriately at authorised waste sites or is managed through illegal activities. Generating waste also increases pressure on the use of natural resources. For example, once waste is generated it requires treatment at facilities that require land and consume energy and water. Waste should be seen as a commodity but is often viewed as a burden by the holder who no longer wants it, or is required to throw it away.

If everyone in the world were to consume the same as the average Welsh citizen, 2.5 planets would be required to produce global resources (Welsh Government, 2021). This is unsustainable, therefore, Welsh society must start living within its environmental limits. The Welsh Government Circular Economy strategy 'Beyond Recycling' sets a one planet resource use and zero waste aspiration for 2050 (zero waste means that 100% of waste that is still generated in 2050 will be re-used or recycled as a resource).

The circular economy aims to keep materials and products in use for as long as possible, extracting the maximum value from them while in use and eliminating waste. From a resource efficient and low-carbon economy perspective, achieving a more circular use of materials is key to improving resource efficiency and helps to reduce the demand for the extraction of natural materials through displacement (Figure 1).

Preventing waste generation and using waste as a resource are important strategies to reduce overall resource use to sustainable levels. They have considerable potential to reduce the environmental pressures associated with Wales's economic activities (both within Wales and outside), as well as bringing benefits to the economy (European Environment Agency 2019).

A circular economy goes well beyond waste, encompassing aspects such as availability of raw materials, product use and consumption patterns. However, the assessment in this chapter is focused on waste as a surrogate to resource use. More evidence is required on resource use in future assessments in order to assess Wales's progress in moving towards a circular economy.

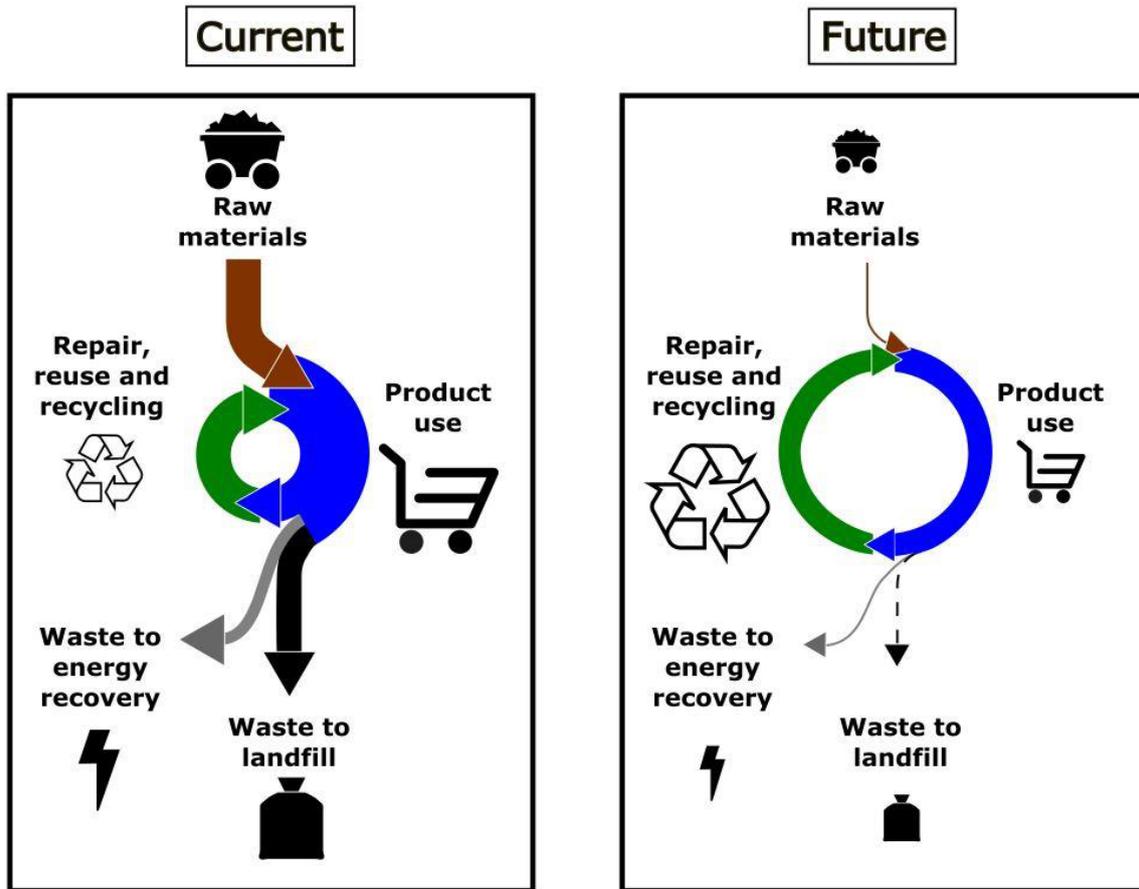


Figure 1 Circular Economy transition diagram (Source Welsh Government 2021).

3. The impact of resource use on the stocks of natural resources (Aim 1)

Summary

An estimated 8.9 million tonnes of waste was generated in Wales in 2018 (excluding waste from mining and quarrying, agriculture, forestry and fishing), with just over half of the waste coming from the construction and demolition sector. There was a statistically significant reduction in waste generated by households, industry and commerce compared to 2012, but assessing the trend of total waste generation is difficult in the absence of a regular comprehensive dataset.

Legislative drivers have contributed to a rapid decline in waste tonnage sent to landfill in Wales over the last 15 years with clear benefits to the environment such as a reduction in greenhouse gas emissions. Industry has responded to demand through the increasing development of specialist recycling facilities, such as anaerobic digestion plants. Furthermore, no new landfills have been created. In 1998-99, only 5% of local authority municipal waste was recycled; in 2018-19 this had reached 63%. Wales is now recognised as having the highest household recycling rate in the UK – the second highest in Europe and the third highest around the world. There has also been significant private investment in municipal waste incinerators in Wales, which manage the waste that Welsh society continues to generate that is not suitable for recycling.

Despite this success, improvements in waste management have unfortunately created more opportunities for waste crime and the mismanagement of waste in Wales and abroad.

The achievement of zero waste by 2050, and a move towards a one planet material footprint for Wales, requires a circular economy that goes far beyond recycling. Waste generation is an indicator of how far Wales has yet to achieve sustainable production and consumption, and how far it needs to go to influence societal attitudes towards waste norms and personal values of society.

Summary assessment of state and trends

The following tables (Table 1 and Table 2) give a brief description of the past trends and future prospects for Waste. These are assessed to be:

- improving trends or developments dominate
- trends or developments show a mixed picture
- deteriorating trends or developments dominate

Further information is provided to put this in context.

Table 1 Key messages – past trends and future prospects for waste generation

Time period	Indicative assessment	Description
Past trends 2012 to 2018	Improving	<p>There was a statistically significant reduction in waste generated by households, industry, and commerce in 2018 compared to 2012.</p> <p>However, there is no updated survey evidence available to assess whether waste has reduced during this period for the construction and demolition sector, which comprised just over half of all waste generated in Wales in 2012 (excluding mining and quarrying, agriculture, forestry and fishing).</p>
Outlook to 2030	Mixed picture	<p>Pressures on resources are likely to increase owing to demographic, social, technological and economic drivers.</p> <p>Waste prevention measures can be expected to counter growth in waste generation, but the extent of their effectiveness remains uncertain and challenging to monitor.</p>
Future prospects to meet policy objectives/ targets 2050	Mixed picture	<p>The Welsh Government strategy 'Beyond Recycling' outlines proposals to reduce the amount of waste generated. However, more evidence is required to evaluate its effectiveness in future assessments.</p>

Note on robustness of data: Quantifying waste generated in Wales in a given year is difficult as there is no single regular source of data. Estimates are calculated by using a variety of different data sources that each have their own frequencies of data collation and confidence limits. This creates considerable uncertainty on the reliability of the total waste generations dataset, especially when assessing trend.

Furthermore, total waste generation is susceptible to large fluctuations each year owing to large industrial infrastructure and large-scale construction and demolition projects. Improvements in the accuracy and frequency of waste data collection from all non-household sources is required to improve data confidence and enable comparisons to waste prevention measures in future assessments.

Table 2 Key messages – past trends and future prospects for waste management.

Time period	Indicative assessment	Description
Past trends 2012 to 2018	Improving	Management of total waste (excluding mining and quarrying) generated by all sectors has generally moved towards recycling and away from landfill.
Outlook to 2030	Improving	Waste management is expected to improve further, driven by existing and new waste management targets and supported by the introduction of new legislation such as mandatory separate recycling collections for Welsh businesses. However, strong implementation efforts are required and consideration of how to maximise participation and material capture rates in recycling infrastructure where opportunities are currently being lost. Substandard and illegal practices are an ongoing concern and require more attention.
Future prospects to meet policy objectives/targets of 2030	Mixed picture	Wales is generally on course to meet European and Welsh Government waste targets for 2020, but efforts must be intensified in order to meet future targets.

Note on robustness of data: Identifying accurate final destinations for waste generated by each source is very difficult using current datasets. Reasons for this include complexities of waste management routes, frequency of data provision, and data limitations linking it back to the origin of the waste. Information on illegal waste activities is also extremely limited. Improvements in tracking waste from start to end point via a singular regular source of data would improve the accuracy and reliability of future assessments.

Waste generation

Quantifying waste generated in Wales in a given year is difficult due to a lack of a regular comprehensive data source. Estimates are calculated by using a variety of different data sources that each have their own frequencies of data collation and confidence limits. This creates considerable uncertainty on the reliability of the total waste generations dataset, especially when assessing trends.

In 2018, the total quantity of waste generated in Wales was estimated to be 8.9 million tonnes, excluding mining and quarrying wastes, agriculture, forestry and fishing. This data is currently estimated for Wales based on UK modelling or extrapolation rather than Welsh derived data directly obtained from these sectors. This estimated data has been excluded owing to the uncertainty on its reliability and

comparability for use in this assessment. This will be considered for inclusion in future assessments.

Figure 2 shows that the majority of waste generated in Wales in 2018 was estimated to originate from the construction and demolition sector (53%) followed by the commercial (17%) and industrial sectors (16%) (DEFRA 2018). In comparison, waste generated from household sources(14%) contributed the least to total waste generation (StatsWales. 2019).

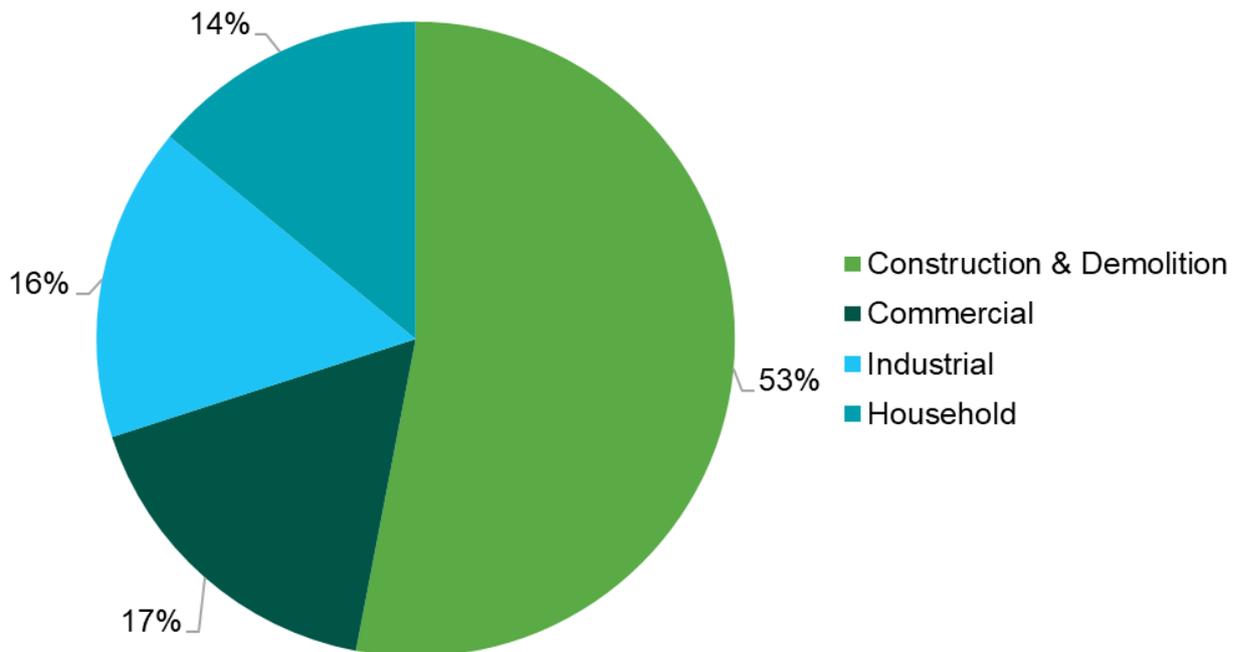


Figure 2 Wastes generated by economic activity and households, 2018 (excluding mining and quarrying, agriculture, forestry and fishing wastes).

Note: Construction and Demolition waste includes dredging spoils.

Note: Welsh estimates for waste from households has been calculated in accordance with the EC Waste Framework Directive. The waste from households has been chosen as the UK interpretation of the EC term 'household waste', which is defined as 'waste generated by households'. Waste from households includes waste from regular household collection, civic amenity sites, bulky waste and other household waste. Waste from households excludes waste from street cleaning/sweeping, gully emptying, separately collected healthcare waste, soil, rubble, plasterboard and asbestos waste. These tonnages are estimated within the construction, demolition and commercial data sets.

Table 3 Comparison of waste generated from key sectors in Wales between 2012 and 2018.

Sector	2012 (millions of tonnes)	2018 (millions of tonnes)	Statistically significant change	Data Source
Construction and demolition	4.37	4.74	No	Data sources are not comparable. 2012 – Primarily Wales waste survey (stratified sampling) 2018 – Primarily based on business population change since 2012 survey
Industrial	2.00	1.44	Yes	Wales waste surveys (stratified sampling both years)
Commercial	1.67	1.45	Yes – marginal	Wales waste surveys (stratified sampling both years)
Household	1.36	1.24	Yes	Welsh local authority reported statistics reported frequently and consistently (WasteDataFlow – both years)
Total	9.40	8.87		

Note: Construction and demolition figures also includes construction and demolition type waste generated from other sources outside of the scope of the survey, including Welsh local authorities and dredging spoils.

Note: Welsh estimates for waste from households has been calculated in accordance with the EC Waste Framework Directive. The waste from households has been chosen as the UK interpretation of the EC term 'household waste', which is defined as 'waste generated by households'. Waste from households includes waste from regular household collection, civic amenity sites, bulky waste and other household waste. Waste from households excludes waste from street cleaning/sweeping, gully emptying, separately collected healthcare waste, soil, rubble, plasterboard and asbestos waste. These tonnages are estimated within the construction, demolition and commercial data sets.

Table 3 provides a comparison of waste generated from key sectors in Wales between 2012 and 2018. There was a statistically significant reduction in waste generated from households, industry, and commerce between these years.

It is very difficult to analyse waste generation trends for the construction and demolition sector since there has been no survey since 2012 and it is influenced by the economy, timing and locations of major infrastructure projects. 2018 Construction and demolition data has been estimated through re-grossing the 2012 survey dataset based on differences in the business population between these years. This does not take into consideration any changes to waste management practices between these years so the difference is not statistically significant.

The creation of a single regular source of data on waste in Wales would improve the accuracy and reliability of future waste generation assessments.

Waste management

A circular economy for waste and resources builds on the waste hierarchy to drive prevention as a priority and move away from a disposal culture to one where resources are kept in use for as long as possible.

Adhering to the waste hierarchy (Figure 3) is key for the sustainable management of natural resources. Preventing waste generation by reducing Welsh consumption and designing out waste in the manufacture of products is the most sustainable use of natural resources and the most effective way of addressing the climate and nature emergencies. Re-use is the next best sustainable option through activities such as the sale of second hand items. Once waste has been generated, the best course of action is to ensure that it is managed appropriately and that as much of the resource is recovered as possible.

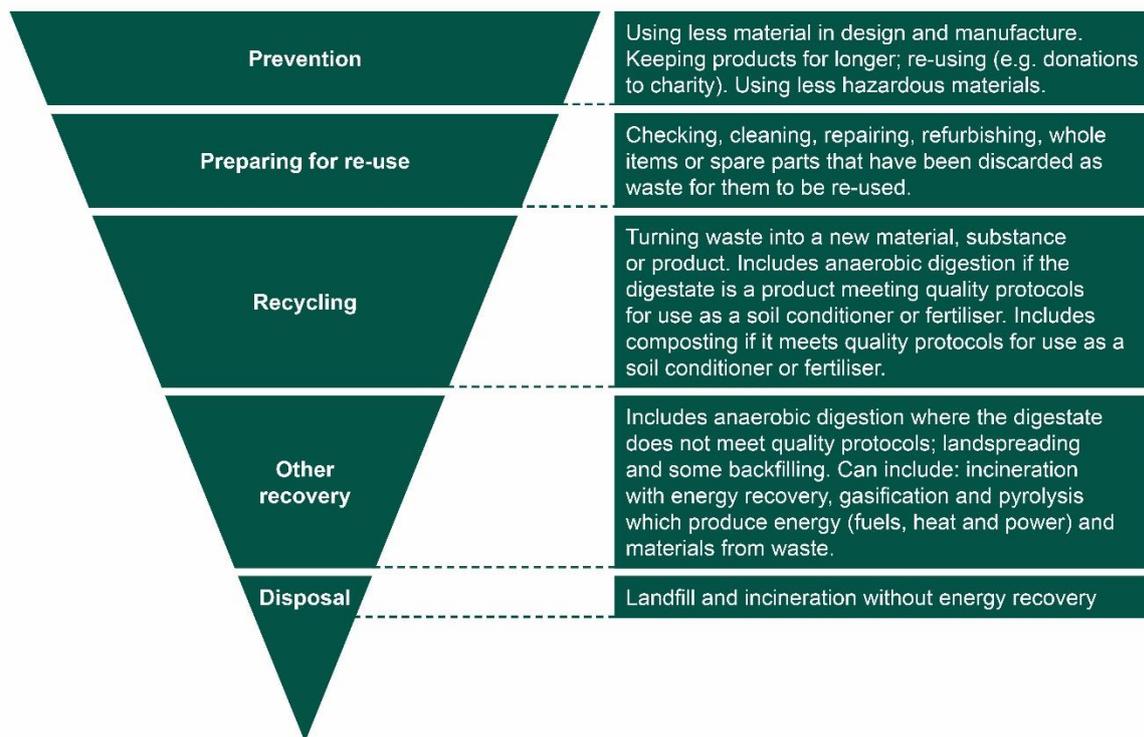


Figure 3 Waste hierarchy (Source: Welsh Government 2019).

When waste has been generated, the most sustainable management of resources is to ensure that the waste is sent for preparation for re-use and recycling. These in turn have greater environmental benefit than other forms of recovery such as energy from waste.

Some waste products may simply require cleaning or repairing a single component, enabling the product to be re-used without any other treatment. This replaces the pressure on natural resources through ensuring that products and materials are kept in use for longer and saves energy associated with the manufacture of a new product.

Recycling is the next best option for products and components that cannot be re-used in any form. Resources can be conserved through converting the material into a new product, reducing the need to use new raw materials (and thereby reducing carbon emissions) and ensuring the security of supply.

Recovery is the next best option where waste cannot be recycled or may be harmful to the environment and human health. For example, incineration with energy recovery is a better option than disposal. This process recovers heat and power, substituting waste in place of other sources of fuel like coal and gas. However, it is unsustainable due to the permanent loss of material.

Disposal, which includes landfill and incineration (without energy recovery), is at the bottom of the waste hierarchy and is the least sustainable management of Welsh waste. When waste is buried or burnt it is lost, missing the opportunity to displace natural resources in manufacturing processes and protect natural resources from over-use. Landfill is the most detrimental waste activity for an ecosystem as it

continually requires new land and is a significant contributor to climate change. For example, landfills that receive biodegradable waste like food produce methane, a greenhouse gas that is 25 times more powerful than carbon dioxide. Once closed, landfills require decades of aftercare until there is no longer a need to manage emissions from a site to prevent harm to the environment and human health. For example, the cost of landfill aftercare is currently estimated for a period of up to 60 years after a landfill closes (DEFRA 2018).

Wales has made major improvements in managing waste over the last decade by increasing the amount sent for recycling, and reducing the amount sent for disposal (latest available management data by source shown Figure 4).

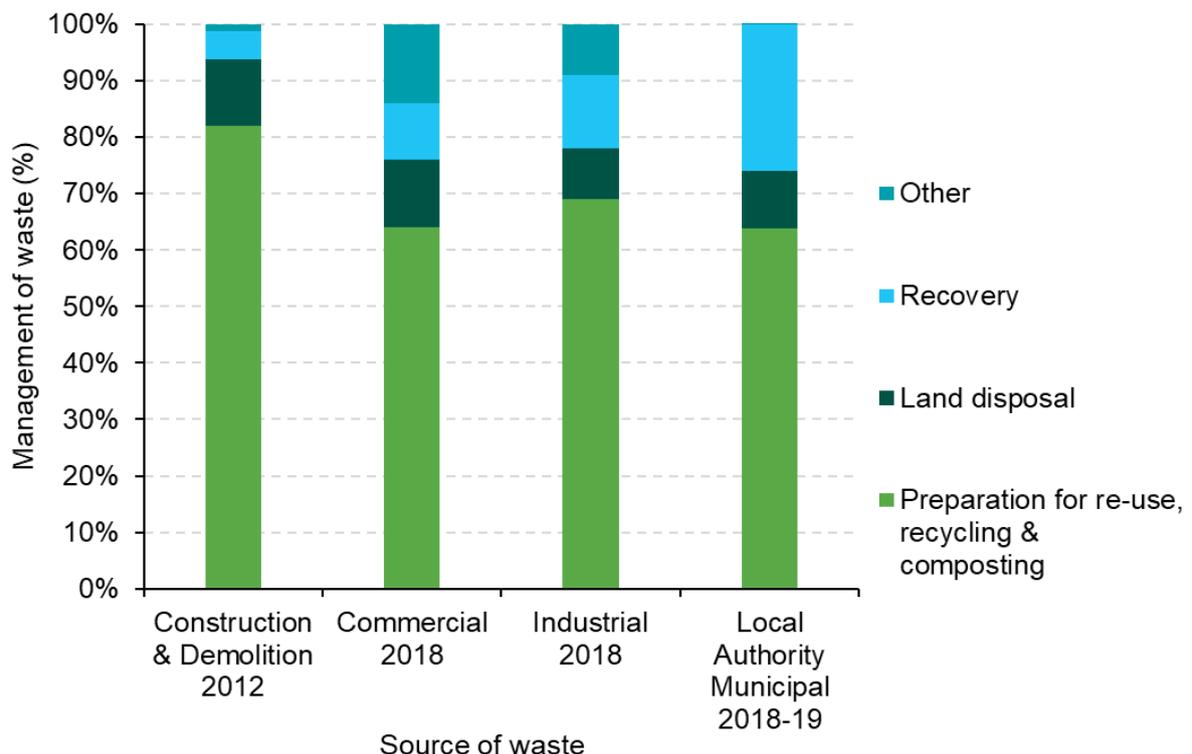


Figure 4 Management of waste generated in Wales by origin (Source: NRW and StatsWales).

Note: Management of Waste generated in Wales. 'Recovery' includes Land Recovery and Incineration with Energy Recovery. 'Other' includes land recovery, incineration, treatment, transfer station and unknown. Construction and Demolition figures exclude hazardous and naturally occurring soils and stones waste. Time series differs owing to availability of data – Construction and Demolition 2012, Industrial and Commercial 2018, Local Authority 2018-19.

Table 4 Comparison of recycling rates of waste generated in Wales by origin (Source: NRW)

Sector	2012 Preparation for Re-use, Recycling and Composting rate (%)	2018 Preparation for Re-use, Recycling and Composting rate (%)	Statistically significant change	Data Source
Construction and demolition	87%	not available	not applicable	Wales survey (stratified sampling)
Industrial	50%	69%	Yes	Waste surveys (stratified sampling)
Commercial	68%	64%	No	Waste surveys (stratified sampling)
Household	52%	54%	Yes	Welsh local authority reported statistics from household sources (WasteDataFlow)

Note on Construction and demolition data: This calculation follows the Welsh Government methodology of excluding hazardous and naturally occurring soils and stones (List of Waste code 17 05 04) so is comparable with the target set in Towards Zero Waste but differs to that shown in Figure 4.

Note: Household waste data is 'waste from households' – Welsh estimates for waste from households have been calculated in accordance with the EC Waste Framework Directive. The waste from households has been chosen as the UK interpretation of the EC term 'household waste', which is defined as 'waste generated by households'. Waste from households includes waste from regular household collection, civic amenity sites, bulky waste and other household waste. Waste from households excludes waste from street cleaning/sweeping, gully emptying, separately collected healthcare waste, soil, rubble, plasterboard and asbestos waste. These tonnages are estimated within the construction, demolition and commercial data sets.

Table 4 shows that the construction and demolition sector had the highest preparation for re-use, recycling and composting rate of all sectors in 2012. Recycling rates are weight-based calculations. The recycling rate of this sector is

significantly influenced by the management of aggregate, which is a heavy material compared to other material types.

The data in Table 4 also shows that there were statistically significant improvements in the preparation for re-use, recycling and composting rates of waste generated by households and the industrial sector between 2012 and 2018. The percentage of local authority municipal waste (which includes waste generated from households) that was prepared for re-use, recycled, or composted has increased substantially over the last two decades from 5% in 1998/99 to 63% in 2018-19 (StatsWales 2019).

During 2018, permitted waste facilities located in Wales managed a total of 10.9 million tonnes of waste. These figures are not comparable with statistics in the waste generation section because they include double counting (the same waste transferred between permitted waste facilities) and wastes originating from outside of Wales. This is also not the total amount of waste managed in Wales because non-permitted waste sites located in Wales are exempt from requiring to report waste management data to NRW.

Figure 5 shows that the quantity of waste sent to landfills located in Wales has decreased from 4 million tonnes in 2005 to 1.3 million tonnes in 2018 – a reduction of 67% (NRW, 2020b). This reduction in waste being sent to landfill was a significant contributor to a reduction in greenhouse gas emissions from the waste management sector; emissions were reduced by over half (53%) during this period (NAEI 2020).

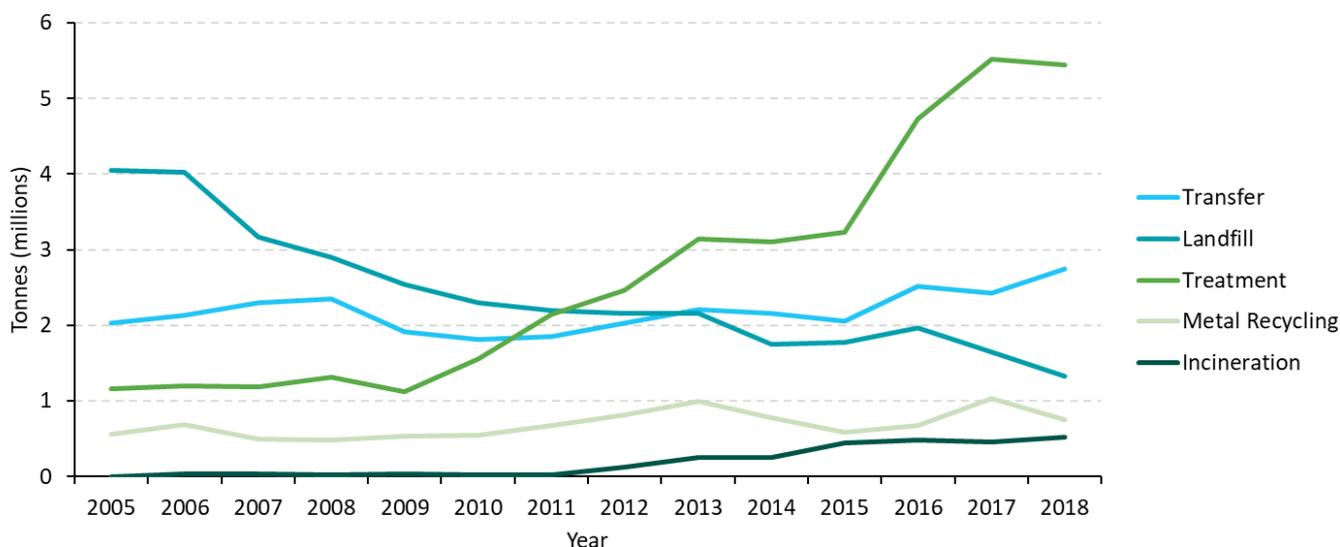


Figure 5 Waste inputs to Welsh permitted waste facilities by type 2005 – 2018 (million tonnes) (Source: NRW).

Recent decreases in quantities of waste landfilled are attributed to a variety of reasons including participation in recycling schemes and changes to the economics of landfilling waste, waste collection service provision and waste management practices. For example, reducing biodegradable landfill allowances (NRW 2020a) and increasing statutory recycling targets (StatsWales 2019) have been a significant factor in diverting Welsh local authority collected waste from landfill to recycling. In addition, landfill is no longer a cheaper alternative to other waste management methods for all collected waste as a consequence of the increasing rates of tax on materials disposed at landfill. New incineration with energy recovery facilities have

also become operational during this period. This is reflected in the quantity of waste sent for incineration in Wales doubling since 2014.

However, the reduction in waste sent to landfills has coincided with considerably more waste being sent for transfer and treatment at Welsh permitted sites during this period – an increase of almost 5 million tonnes. This indicates that waste management practices in Wales have shifted towards prioritising the recovery of materials over disposal. It also illustrates that waste management movements in Wales have become far more complex in recent years leading to some unintended consequences (see Waste section below).

Despite the generally increasing recycling trend and decrease in waste sent to landfill, evidence indicates that there are considerable amounts of recyclable material still present within the mixed residual waste streams generated by industry, commerce and households in Wales. This waste is currently sent for landfill and incineration.

In terms of waste generated by industrial and commercial sectors, the majority of residual waste (74.5%) could be diverted for recycling (WRAP Cymru 2020). The most common material which could be diverted from residual waste is food waste; there are significant opportunities to divert other recyclables such as packaging material generated by the commercial sectors. This indicates that more resources could be captured and sent for recycling through improved source segregation of these waste streams by businesses in Wales.

In terms of waste generated by households, almost half (48.9%) of residual waste collected at the kerbside is widely recyclable. Food waste is the single biggest contributor of this, despite most households having access to a weekly separate food waste collection. Furthermore, of the food waste separately collected for recycling, almost half of it (45.4%) could be avoided and an additional 2.6% was avoidable food waste still in its packaging (WRAP Cymru 2016). This indicates that there are still significant opportunities for preventing food waste generated by Welsh householders and increasing recycling rates by improving participation in existing recycling schemes.

There is evidence that collecting waste in separate material streams at source produces higher quality, less contaminated material than if collected as a mixed waste stream (Eunomia 2016). This increases the likelihood that the material is appropriate for high value recycling uses in the UK and Europe such as closed-loop recycling, which is more sustainable and can have greater climate change mitigation benefits. In contrast, where low quality contaminated waste is generated, it is more likely to be sent for disposal or lower value recycling uses. This slows down the extraction of virgin raw materials but, ultimately, it is not a sustainable solution since eventual downgrading renders the material non-useable – this therefore contributes to waste generation at the end of the lifecycle. Furthermore, some low value recycling solutions only delay the disposal of waste as they are a temporary recovery solution that require disposal at a later date. A good example of this is the recovery of waste to make composite materials which cannot be recycled at the end of their lifecycle.

Waste crime

There has been significant changes in the way waste is managed in Wales over the last 15 years. Quantities of waste received at permitted waste treatment facilities in Wales have risen from approximately 1 million tonnes in 2005 to almost 5.5 million tonnes in 2018 (Figure 5) (NRW 2020b). The industry has transformed from a 'collection and disposal at landfill' model towards a recycling industry that separates, sorts, and treats waste through a myriad of collectors, handlers, processors, and exporters. This supports the transition to a circular economy and managing resources in a more sustainable way.

However, this changing landscape of the waste industry where greater quantities of waste are managed above ground has had some unintended consequences. It has become increasingly attractive to those seeking to profit from mis-managing waste. Criminals have taken advantage of the increasing cost of legitimate waste disposal, by collecting or storing waste at low prices without any intention of recovering it or disposing of it correctly.

The complexity of interactions between waste movements have made it increasingly challenging to provide suitable regulatory oversight as some key regulatory systems were designed to meet the needs of the simpler 'collection and disposal' model.

Criminals are deliberately choosing to enter the industry due to ease in gaining large profits in short time periods, as well as the perceived low risk of being caught and subsequent enforcement action. The incentives to undertake criminal activities are typically economically driven, rather than an explicit desire to cause environmental harm (Welsh Government/DEFRA 2018).

Waste crime takes many forms and is committed on a large scale by organised criminal gangs, and on a small scale on impulse. Criminals are shifting their focus to waste crime as they expand their illegal activity and operate across political boundaries.

Waste crime includes activities such as:

- sites operating illegally without authorisation and outside the regulatory system which lacks the controls and infrastructure required to manage waste safely
- sites handling material that is not covered in their authorisation or operating without any intention to comply
- inappropriate disposal of waste such as abandonment, fly-tipping, littering and burning
- illegal export of waste
- the deliberate misclassification or misdescription of waste, typically for financial gain and avoiding the proper cost of disposing of waste, such as by avoiding Landfill Disposals tax

Each individual that produces or handles waste, whether they are a business, multinational waste company, or a householder, has a duty of care to ensure that waste is dealt with appropriately. Legitimate waste sites play a critical role in

managing waste through the resource chain to achieve high levels of resource recovery. However, criminal activity and poor performance in the industry undermines this ambition by creating shortcuts for inappropriate or illegal waste disposal. This results in reduced resource recovery when that material is not recycled or recovered. It also reduces confidence in recycled products produced by the legitimate waste sector and therefore, negatively impacts market demand.

Waste crime damages the natural environment and well-being of the population through pollution, nuisance, and loss of valuable materials. Legitimate waste businesses are undercut, hindering the economy and sustainable growth of the industry in Wales.

Whether Welsh waste is recycled in the UK or abroad will depend on several factors such as current UK reprocessor infrastructure and global market demand for the specific material type. Welsh generated recyclates may detrimentally impact the ecosystems of other countries if they are illegitimately sent or managed inappropriately abroad. This can contribute to global pollution like marine litter and have a negative impact on the well-being of communities outside of Wales.

Waste activities that have significant impacts on human health and the environment are more likely to occur when the waste is:

- in the wrong place/type of facility
- mismanaged
- deliberately misdescribed
- of low value, hazardous, or is contaminated at unauthorised sites

The main economic costs are lost business revenues to the legitimate waste sector, loss of Landfill Tax through misclassification of waste, and costs to the public sector of enforcing offenders and dealing with abandoned or fly-tipped waste. There is also the loss of resources and materials, which damages the sustainability of the Welsh economy.

As with any criminal activity, its prevalence and impact can be difficult to quantify, However, evidence from recent reports suggests the scale of the issue is significant and may be increasing. Across the UK, serious and organised waste crime is estimated to cost the UK economy at least £730 million a year. A Home Office review in 2018 reported that perpetrators are often involved in other serious criminal activity, including large scale fraud and in some cases modern slavery (HM Government 2018).

The estimated cost to the Welsh Treasury alone of the unauthorised disposal of waste is between £5.5 and 9 million per annum in lost Landfills Disposals Tax revenue. In 2018/19 there were over 35,000 instances of fly-tipping recorded by Welsh local authorities and nearly £2m spent in clearance costs.

While the cost to legitimate businesses, landowners and the wider economy are difficult to quantify, it is estimated that misclassification, illegal exports and exemption abuses amounted to £15.2 – £32.4 million of economic impact to Wales in 2015/16 (Table 5) (Eunomia 2017).

Table 5 Estimated costs of waste crime by type in Wales 2015-16. (Source: Eonomia estimates).

Type	Cost Range (£m)
Illegal waste sites	£2.3–5.6 million
Waste fires	£0.7–1.1 million
Fly-tipping	£4.7–11.8 million
Misclassification	£1.3–7.3 million
Permit breaches	£4.9 million
Illegal exports	£1.3–1.7 million
All types	£15.2–32.4 million

Note: Fly-tipping costs are estimated for those cleared by Natural Resources Wales and Welsh local authorities. Does not include clearance costs for fly-tipping on private land.

Different legislative frameworks and scrutiny from the regulator in different parts of the UK can often lead to perpetrators moving location or taking up other lucrative and lower risk criminal enterprises. Waste crime is already thought to be perceived as a low risk/high reward venture when compared to other types of (financially acquisitive) crime. Maintaining similar regulatory reform in Wales to parts of the UK and other countries will minimise the risk of creating opportunities for crime in Wales.

Waste crimes such as illegal waste sites and incidents, are persistently reported across Wales. These reported incidents are particularly concentrated around the population centres and along the M4 and A55 corridors in Wales (NRW 2020c).

National activities to tackle serious and organised crime in Wales will be aided by the recent establishment of a Joint Unit for Waste Crime (UK Government 2020a). This new multi-agency body will bring together resources from Natural Resources Wales with the Police, HMRC, National Crime Agency, Scottish Environment Protection Agency and the Environment Agency to focus on and tackle waste crime across the UK. Table 6 summarises some of the other actions undertaken nationally in Wales in response to waste crime.

Table 6 National action being undertaken in response to waste crime in Wales.

Organisation/Partnership	Examples of national work being undertaken in response to waste crime in Wales
Welsh Government	<ul style="list-style-type: none"> • provide dedicated funding to support other organisations • policy and legislative changes
Natural Resources Wales (NRW)	<ul style="list-style-type: none"> • dedicated crime officers for multi-agency collaboration • work with Welsh Government to improve tools available to the waste regulator in Wales to target waste crime and poor performance in the industry • gather evidence of the extent of waste crime in Wales • use data and evidence to target regulatory activity • prosecute and take crime proceeds away from offenders
Fly-tipping Action Wales	<ul style="list-style-type: none"> • work collaboratively with over 50 organisations. • wales-wide initiatives include developing reporting tools to identify fly-tipping hotspots and running media campaigns
Welsh Revenue Authority	<ul style="list-style-type: none"> • provide dedicated funding for the Landfill Disposals Tax team within NRW to assist with collection and management in Wales • work collaboratively with NRW on the use of a new unauthorised tax rate so it can be used to best effect to tackle waste crime by providing an additional financial penalty to offenders and act as a deterrent to others

More evidence is required to better understand the scale and economic impact of waste crime in Wales because, at present, the available intelligence does not capture sufficient detail to fully appraise its impact (Eunomia 2017)¹⁴. More improvements are also required to track waste from start to finish. The creation of a mandatory electronic waste transfer system would record all movements and transfers of ownership of waste. This would improve accountability and auditability for all parties transferring waste in a chain. This real-time data would also enable the regulator to identify and respond to suspicious activity in a more timely manner than at present.

4. The impact of resource use on ecosystem resilience and ecosystem services (Aims 2, 3 and 4)

Impact of managing waste

The management of waste impacts resource use and can impact surrounding ecosystems. Once waste is generated it requires treatment at waste facilities which consume additional resources such as land, energy and water. These facilities also produce emissions such as greenhouse gases and leachate that can be detrimental to local ecosystems. The permitting and regulation regime is a legislative framework that puts conditions in place to manage, monitor and control these impacts to protect the environment.

Where a waste site operates outside of the legislative framework it may impact the surrounding environment and communities. Communities may suffer from odour, litter, dust, noise, vermin, and fly infestations from non-compliant permitted sites or illegal waste sites. In addition, ecosystems suffer where waste is inappropriately treated, stored or disposed of without the correct and proper infrastructure.

Waste crime and poor waste management practices can lead to fires which impacts on key infrastructure and local amenities and can risk the closure of main roads, railway lines, schools and hospitals, as well as damaging amenity for nearby communities. In addition, fire incidents consume a large amount of public sector resources, pollute the environment and disrupt communities. This impacts on the protection and health of people, places and ecosystem resilience.

Fly-tipping is an example of waste crime where the perpetrator's aim is financial gain and has no intention of complying with the legislative framework. This, including littering, has a detrimental impact on Welsh ecosystems by blighting the landscape, potentially contaminating the land and harming animals and plant life. It impacts socially by creating a negative perception of an area, which can harm recreation, tourism and house prices (Zero Waste Scotland 2020). It has health impacts by attracting vermin and can impact on the mental well-being of people in the local community. It can also be very expensive to clear and manage the waste appropriately, which bears a financial cost to the landowner or tax payer. Where the tax payer has paid to clear fly-tipped waste or the Fire and Rescue Services are called to arson attacks at fly-tipping hotspots, there are hidden costs to public resources that could have been used to benefit the community (Welsh Government, 2015).

Issues and opportunities of managing waste streams

There are examples where managing waste streams is having a positive benefit to ecosystems in Wales. For example, Wales is leading the way in the UK for providing separate food waste recycling for households, with 99% of households having access to a food waste collection. In 2018-19, Welsh local authorities reported that the majority (71%) of food waste that they collected from households and businesses was recycled at anaerobic digestion (AD) facilities located in Wales (NRW 2020d).

In the UK, AD is the main source of biogas as a renewable energy technology. Food waste breaks down naturally in the AD plants in the absence of oxygen and produces a gas, which can then be used to produce electricity and heat. The leftover organic material, known as digestate, is rich in nutrients and can be used as a substitute to chemical based fertilisers and as a soil improver.

This high percentage of Welsh biodegradable waste, which is processed by Welsh recycling infrastructure and diverted away from landfill, demonstrates that Wales is moving towards a localised circular economy for this waste stream.

Soils are crucial to terrestrial ecosystems. Maintaining the resilience of soil biodiversity and ecosystems is essential in order to protect the services it can provide. The application of waste derived organic materials, such as the digestate from food treatment plants and compost from garden waste composting plants, can have a positive impact on soils. The treatment and use of waste derived organic materials can have a positive effect on:

- climate change
 - capturing and storing carbon
 - producing energy from the anaerobic digestion process
- soil health – increasing carbon and essential nutrients, reducing soil loss
- increasing water retention in the soils and helping to reduce flooding

However, when waste derived organic materials are handled incorrectly it can be detrimental to an ecosystem. For example, inappropriate use of this material, such as overspreading, can negatively impact future soil health and water courses (via run-off). Digestate from the AD plants is spread on agricultural land across Wales. More evidence is required in order to assess the tonnages of all waste derived organic materials spread to land in Wales, the available landbank and its impacts.

Recycling and waste treatment processes for other waste streams is mostly reliant on external infrastructure and markets. The current recycling infrastructure within Wales is limited. For example, approximately 61% (WRAP Cymru 2018) of collected plastic waste is recycled outside of Wales. Checks are made in line with relevant legislation, before waste is exported, to ensure that the receiving overseas site is of broadly equivalent standards to that within the UK. However, there is still the possibility that Welsh waste may be managed at inappropriate locations around the world and treated or disposed of irresponsibly.

Once waste is exported it becomes difficult to monitor and ensure its safe and proper recovery. For example, in 2019, forty-two containers of plastic waste were returned

from Malaysia to the UK due to non-compliance with Malaysian importation requirements. Two of these containers were returned to the exporter in Wales to ensure correct and proper recovery or disposal of the waste.

When Welsh waste is managed inappropriately abroad or illegally exported through mismanagement, there are global impacts such as marine pollution or waste abandoned at docksides. In order to prevent this and work towards becoming a high recycling nation, the current infrastructure for enabling correct processing in Wales should be addressed. In addition, accurately tracking the movements of waste is vital to ensure that different waste products are correctly dealt with and that as much as possible is recycled or re-used at home or abroad. An electronic waste tracking system would provide regulators with real-time information on movement within and outside of Wales, providing an opportunity to complete more thorough audits of waste flows and movements.

Energy from waste infrastructure has been developed within Wales in order to divert waste from landfill. As Wales moves to a circular economy, incineration is necessary to manage waste streams that we continue to generate with no means for recycling. There will be occasions where incineration will continue to be the most appropriate method of managing certain waste, like medical waste, treated hazardous wood or plastics containing persistent organic pollutants, in order to protect the environment and human health. However, the use of residual heat from Combined Heat and Power (CHP) plants in Wales has not been maximised. Where incineration does occur both heat and power need to be recovered to ensure the maximum benefit is recovered from the waste being processed.

Disposal of waste at landfill is the least sustainable use of resources. Wales has been successful in reducing the volume of waste being sent to landfill over the last few decades. However, there are over 100 legacy landfills in Wales which may impact on local ecosystems and may continue to impact for decades to come. It must be recognised that for certain waste types landfill represents the most appropriate management option for asbestos and other hazardous waste. There will also be occasions when landfill might be required as a contingency or to address a temporary shortfall in capacity of more sustainable alternatives.

5. Main pressures affecting resource use

Demographic drivers

Population growth

Population make-up, size and consumption patterns will influence how resources are used and waste is produced. The population of Wales is expected to continue to grow up until 2043 (ONS 2019), which will increase the pressures on resources. However, data on waste generated from households, industry and commerce in

2018 indicates that less waste was generated from these sectors compared to 2012, despite a growth in population.

Population demographics

The UK's population is ageing, with the older generations now accounting for a larger proportion. This can lead to a change in the types of products and services used, which can in turn affect the types of waste generated. Absorbent hygiene products are one example of this, where the proportion of adult incontinence products compared to children's nappies is growing as people live longer and are cared for in their own homes.

Many of the largest cities in Wales have significant transient student populations. Studies into student behaviour have shown a generally lower interest and uptake in recycling in this demographic compared to the overall UK population (SITA 2013).

Increased urbanisation

Increased urbanisation has benefits relating to the viability of circular economy initiatives such as leasing, hiring or sharing schemes (such as car share, bikes) and re-use/resale options (such as charity shops, car boot sales, swap shops, re-use cafes). It can have significant carbon savings where recycling collections and the distribution of goods and services are planned efficiently. It can also provide more opportunities for industrial symbiosis, for example in the construction and demolition sector, by offering aggregates for further use rather than disposal.

Urbanisation can lead to conflict as waste should be handled and processed close to the source where it is generated. However, industrial processes can potentially impact human health which must be taken into account through the permitting process. Instead of looking at sites/processes in isolation, a consideration of the mass/cumulative impacts is necessary.

New developments consume more natural resources if recycled materials are not used at the construction and furnishing stage. These new developments can also be an additional source of waste generation, for example at the construction phase, throughout their use or at the end of their lifespan. Continuous generation of waste will require more waste treatment facilities which further puts pressure on land use in or close to urban areas.

Where non-recyclable waste is generated and incineration with energy recovery is the most appropriate option, the proximity of combined heat and power plants to neighbourhoods provides the ability to generate both power and heat. This can be fed into neighbourhood heating schemes to heat homes and businesses, however, this benefit must be offset against air quality and emissions. It can also be a contentious issue in highly populated areas owing to perceptions and concerns of the local population.

Economic drivers

The economic drivers affecting Wales have altered over the last century with a general growth in the economy and GDP, and a move from an industrial-based to a post-industrial service-based economy. There is still a strong manufacturing base compared to other parts of the UK, but it is now widely recognised that Wales needs to move to a low-carbon, high technology-based circular economy.

A circular economy for waste and resources builds on the waste hierarchy to drive prevention as a priority and move away from a disposal culture, keeping resources in use for as long as possible.

Waste is a global commodity and there is demand to export recyclable materials to destinations with high industrial/manufacturing economies like Asia. However, this has changed significantly since 2018 with countries following China's lead and banning or restricting the waste materials they will accept. This is likely to increase in the near future, requiring increases in domestic reprocessing and production of recycled materials.

Demand for using recycled materials is greatly influenced where it is cheaper than extracting and using virgin materials. For example, if oil prices fall recycling plastic material becomes less appealing from an economic perspective without any Government interventions in place. The recent Covid-19 global pandemic demonstrated this by causing oil demand and prices to plummet. The knock-on consequences of such economic drivers can cause an over-supply of cheap virgin plastic to the market and in doing so, reduce the demand for more expensive recycled plastic material.

The typical size of business and industry has grown across the globe. This is reflected in the development of larger industry bases and the impact of the growth of multinational companies and globalisation on the flow of trade and market conditions for many commodities and products.

As a nation, Wales has a high proportion of small and medium-sized enterprises (SMEs) which have to compete in global markets against large businesses and industries.

This has also changed the quantities and types of waste generated. For example, the closure of fossil fuel/biomass fired power stations has significantly reduced waste generated by industry, notably pulverised fuel ash.

Market forces

It is widely accepted that current Welsh levels of consumerism are unsustainable so must be halted and reversed so that Wales can grow its economy in a way that uses fewer resources and reduces waste generation.

Market demand for experiences/services instead of products, used/second hand products (such as swap shops, ICT re-use, furniture) and recycled materials to replace virgin materials (such as recovered metals, recycled plastics, paper) is vital to drive investment in recycling/re-use infrastructure and green growth. These must

provide beneficial long-term sustainable uses rather than unsustainable uses that ultimately only delay the disposal of waste.

Where waste is generated, it must be recycled to a high quality as much as possible. Higher quality recyclate helps keep the retention of material within the Welsh and UK economies, resulting in socio-economic benefits. Recycling retains natural resources, reduces the demand for virgin material, improves resilience to market downturns and reduces the risk associated with materials collected for recycling being disposed of or inappropriately managed.

Bringing materials out of the waste stream, and recycling or reprocessing back into products, having met criteria such as the 'end of waste' (NRW 2020e) requirements, needs to be supported by evidence and analysis that shows the benefits, demand, and quality of the reprocessed product.

Increased confidence in the quality and specification of recycled products to replace new or virgin materials will increase the market and demand for such materials. Frameworks like quality protocols (UK Government 2015) and industry standards are a key tool in supporting waste recyclers to demonstrate this.

Socio-political drivers

Legislation

Waste and resources legislation and regulations in Wales originate from a wide range of levels including international, European and the United Kingdom.

Devolution allows opportunities for Welsh Government to also develop Wales-only legislation and policy to react to and reflect the particular mix of pressures and societal demands in Wales.

A number of measures currently exist to help make Wales a high recycling nation and some are in progress to move towards a circular economy.

The Beyond Recycling strategy (Welsh Government 2021) on making a circular economy a reality in Wales was published by Welsh Government in 2021. This set out the aims to:

- support businesses to reduce their carbon footprint by becoming more resource efficient
- provide the tools to enable community action
- phase out unnecessary single-use items, especially plastic
- eradicate avoidable food waste
- procure on the basis which prioritises goods and products which are made from remanufactured, refurbished and recycled materials or come from low carbon and sustainable materials like wood
- strive to achieve the highest levels of recycling in the world
- reduce the environmental impact of the waste collection from our homes and businesses
- take full responsibility for our waste

The Circular Economy Package (Welsh Government 2020a) will be transposed into Welsh law and this introduces further steps for the reduction of waste and the aims of the Welsh Government's Beyond Recycling strategy. This will include amendments to:

- revised Waste Framework Directive requirements
- producer Responsibility obligations
- landfill waste restrictions for recyclable materials

The Environment (Wales) Act 2016 (Welsh Government 2016) introduces new powers, aiming to increase the amount of materials for recycling, improve the quality of materials available for recycling, and ensure that materials that could be recycled are not wasted.

The new powers will:

- Require business and other waste producers like the public sector to make sure that specified recyclable materials are separated before they are collected.
- Require waste collectors to collect specified recyclable waste by means of separate collection.
- Ban the burning of recyclable materials in incineration plants.
- Ban the disposal of food waste to sewers by businesses and the public sector.

Extended Producer Responsibility (UK Government 2019a) requires producers to pay the full net cost of managing their products at the end-of-life stage, encouraging the more sustainable use of resources. This will include:

- Reforming the current producer responsibility regulations for packaging, electrical goods and batteries to ensure producers fund the full net costs of the end of life management, including collections of the goods they place on the market.
- Encouraging eco-design – such as making goods easily repairable or recyclable, single materials, light weighting.
- Promoting the waste hierarchy – making waste prevention key and encouraging re-use.
- Providing a mechanism to tackle other problematic waste streams to ensure those that make money from goods take responsibility for the end life of their management such as mattresses, textiles, tyres, carpets, fishing gear for example.
- Working alongside other producer responsibility mechanisms such as deposit return schemes, taxes and so on.

A Deposit Return Scheme (DRS) (UK Government 2019b) is being considered to add a refundable fee to the sale price of drinks in Wales. This deposit would be redeemed when consumers return their empty drinks containers to a designated return point. This aims to increase recycling and reduce littering of drinks containers.

Welsh Government is considering banning the sale of single-use plastic items such as food containers, cutlery, cups, straws and stirrers, cotton buds and balloon sticks (Welsh Government 2020b). These are items that can cause harm to the environment and wildlife if littered and their consumption could be reduced by using more appropriate materials.

Import and export restrictions

Many countries are now restricting the types of waste they will receive for recycling and reprocessing.

Restrictions and bans on the import and export of waste and resources will mean that, whilst Wales continues to generate waste and resources, more domestic infrastructure is needed to treat these materials.

Increasing data recording and reporting requirements for waste exports would increase the understanding of the overseas destinations and assist in ensuring that it is not being managed poorly or disposed of.

Recyclability of black trays

Black plastic is often used for packaging because it enables colours or imperfections to be masked. Black plastic packaging is commonly disposed of in landfill or incineration because of current difficulties sorting and recycling this material. The UK Plastics Pact aims for 100% of plastic packaging to be reusable, recyclable or compostable by 2025 (WRAP 2020a).

Persistent Organic Pollutants (POPs)

Materials containing persistent organic pollutants, for example flame retardants in plastics in televisions, cables, furniture and so on, must be treated so that the harmful substances are removed from the material stream. This will limit the recycling options but the priority must be to remove the risk these substances can cause to the environment and human health.

Cultural and behavioural drivers

Wales is transitioning to becoming a high recycling nation, where the general public see segregating household waste (metals, paper, glass, food waste, absorbent hygiene products and so on) as the norm, enabling local authorities to collectively achieve a 63% recycling figure.

The Welsh Government's Circular Economy Strategy 'Beyond Recycling' sets out how it wants to build on the foundations achieved by a clear focus and investment in recycling to move to a circular economy culture.

Environmental attitudes and the media

Public attitudes and awareness of these issues have changed in recent years, leading to greater participation, and this needs to be capitalised and built on. Social media is an important tool that needs to be used to encourage a change in attitudes.

Media reporting can have both positive and negative effects on the public. Raising awareness of how people can prevent or recycle waste can have significant impacts, for example promoting WRAP Cymru's 'Love Food Hate Waste' campaign (WRAP 2018).

Negative media coverage can have a detrimental effect on people's attitudes and behaviour. For example, articles claiming that recycling is a 'waste of time' can discourage people from recycling and provide a justification or excuse for not properly separating their household waste.

Scientific and technological drivers

Innovation and technological change

Technology advancements and global supply has increased consumer choice. In addition, planned obsolescence encourages consumers to buy newer items sooner than they actually need. Conversely, technology has helped offset this to some extent through the development of superior products that have a trade-off with the waste created. For example, the development of multi-functional devices like smart phones has replaced the need to own separate camera, music and media playing devices. Likewise, technology has helped to reduce the demand to manufacture items that have a short life span before entering the waste stream such as newspapers. There are also examples of value engineering whereby designing less durable products can help to save resources. For example, where smart phones have a limited lifespan owing to the rapid rate of technological development, it is less wasteful to build the parts with a similar lifespan, rather than using more resources to make the parts last longer than the technology (PERC 2012).

Many of these products, especially ICT equipment and batteries, use diminishing rare earth metals and can cause problems when they reach the end of their life. For example, lithium-ion batteries can cause fires and recycling solutions do not currently exist for new emerging waste streams such as batteries from electric vehicles (Harper, G., Sommerville, R., Kendrick, E. et al. 2019).

There are emerging waste streams that will increase over the short term and could have significant impacts:

- Photovoltaic panels from solar power systems and batteries from electric vehicles are emerging as significant waste streams that need to be recycled and recovered appropriately and efficiently. Further technical and innovative solutions are needed to recover the maximum benefits and resources from these waste streams.
- There are a growing range of compostable and bio-degradable items that require specific conditions for the decomposition process to take place successfully. If handled or treated incorrectly, for example in a home compost bin instead of a commercial composting facility, the material will not degrade properly. These items can also look very similar to plastic items, and if incorrectly mixed with plastic for recycling, can contaminate the plastic stream. As with other materials, the aim must be to prevent the unnecessary use and generation of the waste streams.

Technological and innovative developments provide new and better solutions for how Wales can deal with waste and resources:

- Advanced thermal treatment technologies such as gasification or pyrolysis can be a recovery option for plastic waste that is not suitable for other re-use or recycling options. These are new and developing technologies with limited capacity at present but there is the possibility that this could change as the technology develops.
- A variety of new technologies are being developed to use biomass for the production of heat, electricity and transport fuels, ranging from direct energy production through to more novel techniques of bio-digestion and fermentation. However, since this destroys limited natural resource (including using land needed to grow food) the use of biomass as a source of energy is not consistent with a circular economy.
- Advancements in sorting and segregation equipment technology can help ensure that mixed can be accurately separated for recycling. Source segregation must remain the most favourable option for different materials but further sorting into materials and grades, for example plastic polymer, can increase the opportunities for recycling and recovery into high quality recycled products.

Technology can help to enable and drive the circular economy through digital disruption and artificial intelligence. Technological advancement can catalyse the development and implementation of circular business models, drive new processes, new communication channels and improvements in operational and resource efficiencies. For example, the advancement of robotics can enable companies to dismantle their discarded products, separate component parts into useable materials and capture the value of resources at an unprecedented rate (World Economic Forum 2017).

Covid-19 pandemic

The unprecedented times experienced during the Covid-19 pandemic have had significant and far ranging impacts on the goods that are used and how these are purchased and consumed. Lockdown restrictions led to a surge of online shopping and home deliveries. There were significant increases in the use of disposable single-use items, often plastic, like personal protective equipment (PPE). The recent outcome of the Everyday Plastic Survey completed during the pandemic has indicated that domestic plastic waste production increased by 25% under lockdown conditions, particularly fruit and veg packaging, snack wrappers, parcel bags and PPE (Everyday Plastic 2020).

It is likely that there has been an increase in the use of other single-use packaging items. For example, the closure of pubs and restaurants and restrictions in people movement led to an increase in food and drink takeaways. Some restaurants experimented with takeaways for the first time and may be permanent converts after realising the benefits of increasing profit margins (Citywire 2020). It is too early to understand how Covid-19 has impacted waste generation and the longer term impact to consumer behaviours where some progress had been made prior to the pandemic in raising awareness and encouraging re-use (i.e. coffee cups).

The pandemic had widespread impacts to the UK recycling industry and supply chain with closures of local authority household waste recycling centres (HWRCs), changes to household waste and recycling collection schedules, and closures and

restricted operations of recyclers and reprocessors. There were also reductions in end markets for waste and recycled materials in the UK and abroad (WRAP 2020b) and an increase in some recyclable materials being disposed (Letsrecycle.com 2020).

An unforeseen and undesirable outcome has been the highly visible, and widely reported, widespread littering of PPE items (masks and gloves) and food and packaging items (drinks cans, bags, crisp packets and so on) at public spaces and beauty spots like parks and beaches (BBC 2020).

The pandemic has highlighted how far away Wales is from achieving a circular economy and the scale of the challenges ahead with behaviour change and the reliance on overseas markets. How Wales comes out of the pandemic will determine how it moves towards a circular economy and it is an opportunity to make the fundamental shifts needed. It is now not a simple case of moving forward but of first getting back to where Wales as a society was before the pandemic. A circular economy must be embedded in all the actions which are taken through the green recovery ambitions for Wales and be resilient to absorb the inevitable shocks that the future will bring.

6. Opportunities for action to achieve the sustainable management of natural resources

Following the waste hierarchy (Figure 3) is key for the sustainable management of natural resources.

Prevention

Prevention must be a priority as everything used requires resources and has an impact. Therefore, as a society we must use less and keep items in life for longer.

Changes in product design can support this through creating modular systems, making products that can be upgraded and removing built in obsolescence.

Quantifying prevention can be difficult as it has not yet entered a waste stream. However, observed reductions in sales of new items may indicate that items are being used for longer and not being replaced.

When something becomes waste, regulatory powers and tools can be used to ensure it is treated properly and responsibly to protect the environment and prevent harm to human health.

Re-use

When something is no longer needed, it must be ensured that such items are re-used in their original form.

Using and buying used goods must be promoted to remove the social stigma that can deter people from doing so. This can be promoted through swap shops, second hand shops, and so on

Changes in product design can support this through allowing individual components to be repaired or replaced, such as from removing sealed units or the need for specialist tools.

Recycling

Recycling is not a process designed to increase value or enhance natural resources. Recycling processes have been designed at the end of life stage when waste is generated. It is important to recognise the limits to recycling processes and to address the longer term solutions to waste production.

Once something is no longer fit for use and it becomes waste it must be ensured that as many of the resources as possible are recovered for re-use and recycling. This could mean harvesting parts and components for a second use or recovering parts for recycling and recovering materials. This is important for all materials but is especially important for diminishing rare earth metals. The preferred option for recycling is a closed loop system where materials are recycled back into new items, for example, drinks bottles back into new bottles. Where this is not feasible, open loop recycling can be used to recycle materials into other items. New technology and innovation in collection, separation and treatment can maximise the amount and quality of material available for re-use and recycling.

End of waste

Where there is treatment of waste to a recognised and appropriate standard, it can be capable of meeting an end of waste criteria. When waste meets an end of waste criteria, it results in the creation of a new product, meaning that it is no longer subject to waste controls and will provide an alternative material to virgin resources.

There are currently 14 recognised frameworks for various waste types. They provide clear quality standards and a framework that industry can use to demonstrate that their process outputs have been fully recycled into products that no longer fall under waste management controls. For example, processing inert waste like rubble to produce a quality aggregate can be used as a replacement to virgin material in construction activities, including pipe bedding drainage and producing new concrete.

The quality protocols provide a robust way to assist regulators to monitor and assess where process outputs meet the end of waste criteria. These frameworks allow a like for like replacement to prevent virgin materials being used where there is a suitable alternative and utilising waste as a resource. This ensures a more efficient use of

natural resources, directly contributes to the circular economy and protects the environment through the sustainable use of resources.

Recovery

Once everything that can be re-used or recycled has been captured, remaining items should be reprocessed to recover further benefit. This might result from using new innovative technology like plastic pyrolysis or bio treatment. For some waste streams, like contaminated medical waste, incineration may be the only available option. Where this is the case, the full benefit of recovery must take place to recover both energy and heat.

Disposal

Disposal should only be considered as an option in the short-term for managing problematic wastes and contingency whilst Wales transitions to a high recycling nation. Disposal has no place in a circular economy.

Regulations

Extended producer responsibility places the obligation on companies that place goods and products on the market to pay for the collection and recycling of these items when they become waste.

The current producer responsibility regimes, packaging, electrical goods, batteries and vehicles are being reformed to ensure the full costs are covered.

Further items could also be brought into produce responsibility schemes; these include:

mattresses, furniture, clothes, carpets, fishing equipment, chewing gum, nappies and so on

Mandatory recycling content targets could be introduced for a wide range of materials and uses, including plastic goods and building materials. This would increase markets for recycled products and materials.

Local authority recycling targets have increased household collections and recycling in Wales. These could be further developed to increase re-use and recycled material outputs.

Bans on what material can be exported will mean that there will be a need to manage waste and resources here in Wales.

A deposit return scheme for items purchased on the go could encourage the return and collection of items that are purchased away from the home, and may not be captured by current household or business collections.

Taxes, like the plastic tax, could be introduced to discourage the use and sale of difficult to recycle items, like composite/mixed materials items, and encourage the use of recycled raw materials in new products.

What are the barriers to achieving this?

Infrastructure

To be fully accountable and responsible for the waste Welsh society produces, an adequate domestic infrastructure needs to be put in place with the capacity to effectively deal with the waste and resources produced. Reliance on shipping waste overseas needs to be decreased. This will require a significant increase to current waste management infrastructure in Wales, and provide employment and further opportunities for green growth.

Behaviours

Movement away from the current consumerist, resource intensive, lateral economy is required. Instead, Welsh society must consume and use less, and keep items for long term use. This will require changes to the way our society purchases goods and services, to include leasing and hiring rather than owning products like white goods, cars and so on

Society has become used to many of the items that are convenient and save time, such as disposal nappies. If these are no longer available, there will be significant impacts on society as a whole.

Markets

Collecting, re-using, and recycling items is not enough on its own; there must be a demand and need for recycled items to be used.

Increasing confidence in the quality and specification of the recycled products and materials promotes their use over virgin materials. This can clearly be seen in the construction industry where there is potential to re-use materials and use more recycled products.

Removing the stigma and attitudes around used goods and products like electrical goods, clothes, and furniture will increase the demand and markets for recycled products.

Separating materials for recycling and keeping them as free from contamination as possible throughout the collection, reprocessing and recycling process, is key to ensuring the quality of the end products and maximising the demand for reprocessed material from end markets.

Legacy

Waste that has been disposed of in landfill sites must continue to be managed to ensure that it does not harm the environment or people in the future.

Waste crime

Appropriate resources and tools must be in place to identify, stop and take enforcement against waste criminals. This must include using new and available tools including multi-agency task forces, intelligence systems and enforcement actions such as prosecution, forfeiture and civil sanction.

Waste and second hand goods have a wide range in values and in the costs associated with correct management, which increases the risk of criminal activity. Normally, the more hazardous or difficult something is to manage properly, the more expensive it will be to handle. Therefore, the risk of crime increases with the hazardous nature of the waste. Crime affects all parts of the waste and resource management chain; it causes harm to the environment and human health (dumping, burying, burning and so on), affects legitimate operators, and deters investment.

7. Evidence needs

Construction and Demolition Waste

There was no recent evidence available to assess the quantities of waste generated and management practices of the Welsh construction and demolition waste sector. However, there are currently plans to update this national survey dataset for the next SoNaRR assessment.

Waste Data Tracking

Accurately tracking waste movements is vital to ensure that different waste products are correctly dealt with and as much as possible is recycled or re-used. Understanding what happens to Wales's waste from start to finish is beneficial for the environment and the economy.

The UK Environment Bill 2020 has mandated powers to introduce an electronic waste tracking system in the future (UK Government 2020b).

Accurate waste tracking will strengthen compliance, reduce administration and increase transparency allowing targeted action to tackle waste crime more efficiently and effectively. The cost of waste crime to the Welsh economy was estimated to be between £15.2 and £32.4 million in 2015/16. The sooner we can detect waste disappearing from the system or unexpected changes in type, the sooner we can step in to prevent and mitigate the damage this crime causes for people, businesses, and communities.

Waste tracking needs to link with data and systems from associated regimes and activities, such as international waste shipments, extended producer responsibility systems and deposit return schemes.

A joint waste data tracking project is currently underway between UK governments and regulators to deliver a waste data tracking solution to fulfil these evidence

requirements. The project is in the development stage with a planned phased implementation over several years.

Improvements in tracking waste from start to finish are also required to improve the reliability and monitoring of future SoNaRR assessments. It is anticipated that this will provide a regular and reliable dataset for waste generated and their final fate from all sources of waste in Wales.

Land Use / Soil Health

To ensure that the use of biowaste to land does not negatively impact on future soil health, better evidence is required to:

- Ensure we identify clearly what landbank is available in Wales in terms of the scale and suitability to receive biowastes to land.
- Identify and assess emerging risks – such as chemicals, microplastics, and anti-microbial resistance. Work is already under way on understanding and assessing these risks in biosolids through the latest Chemicals Investigation Program (CIP3).
- Obtain wider understanding of assessing further positive and negative impacts on soil health from the application of biowastes to land. Currently, assessment focuses on the demonstration of nutrient benefit to the receiving soil and crops. Greater understanding of the potential impact that applications have on soil health, function and biodiversity is required.

Exports

Under the International Waste Shipment Regulations, many non-hazardous sorted and segregated waste materials, such as paper, plastic or metal, are classified as '[greenlist](#)' waste (UK Government 2020c). If an exporter can demonstrate that the material will be recycled under broadly equivalent standards (UK Government 2020d), is accompanied with the correct documentation and a contract is in place between the shipper and recycler, then the material can be exported without prior permission or notification. Exact data or figures for these exported waste streams is not available.

To understand the full life cycle and flow of waste and resources, the following exports data is needed:

- tonnages and types of 'greenlist' waste exported
- end destination/recycler for all exported waste

Data is available from accredited exporters of packaging waste where a Packaging Export Recovery Note (PERN) has been issued.

This is currently being considered as part of the review of the International Waste Shipments Regulations and the revised regulations are expected for implementation around 2022.

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