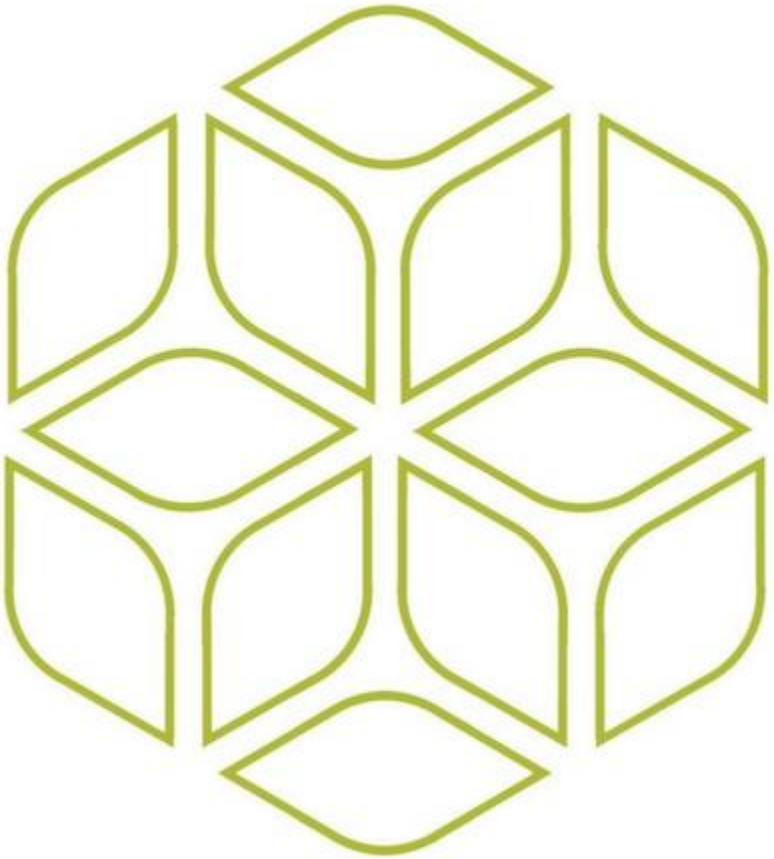

Waste management and illegal disposal in Northern Ireland

A baseline evidence assessment for the Office for Environmental Protection

October 2023

resourcefutures

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Limitations

This report has been produced by Resource Futures on behalf of the OEP. Whilst Resource Futures has taken all due care to interpret and collate the information presented within the report, any third party relying on the results of the analysis shall do so at their own risk and neither Resource Futures nor the OEP shall be liable for any loss or damages arising there from.

Executive summary

Overview

The Office for Environmental Protection (OEP) has the mission to protect and improve the environment by holding government and other public authorities to account.[1] The OEP corporate plan sets out its commitment to:

> *Review the available evidence of the regulation, management and monitoring of waste in Northern Ireland.*[2]

Resource Futures was commissioned in June 2023 to support the OEP's activities by undertaking a baseline evidence assessment of waste management and illegal disposal in Northern Ireland. Through desk research, waste data mapping, and stakeholder engagement, this assessment describes:

- The environmental and public health impacts of waste in Northern Ireland.
- The legal duties, responsibilities, and powers placed on public authorities with regard to waste management and illegal disposal in Northern Ireland, including monitoring and reporting requirements, and targets.
- Legal and illegal waste flows within Northern Ireland and across its boundaries, and the drivers of waste crime.
- Best practice in waste management and illegal disposal.

Environmental and health impacts of waste

The management and disposal of waste exerts pressure on the natural environment and can cause harm to public health (see Chapter 3). Emissions of greenhouse gases (GHG) from waste management, including methane from landfills, carbon from incineration, and black carbon from open burning, contribute to climate change. Failure to apply the waste hierarchy also leads to emissions from unnecessary resource use, at a global level.

Terrestrial and aquatic ecosystems are impacted by the demand for space to manage waste, and the consequences of management and disposal activities. The establishment of landfill sites creates habitat loss, and leachate of harmful substances can cause pollution of soil, ground water, and surface water as waste breaks down. Entanglement in and consumption of waste, including microplastics, are also widely understood as threats to species, resulting in poisoning, starvation and death.

The impact of waste management and disposal on the natural environment and public health in Northern Ireland is not fully understood. Limitations to monitoring and reporting frameworks are such that the evidence base for Northern Ireland is incomplete. For example, while data suggests that methane emissions from landfills are dropping, the extent of open burning is unknown. Given black

[1] The Office for Environmental Protection (2022) Our strategy and enforcement policy
[2] The Office for Environmental Protection (2023) Corporate plan 2023-2024

carbon has a warming potential 5,000 times greater than carbon this is a concerning gap. The type, scale, and impact of illegal disposal, including known sites, is also not sufficiently monitored across Northern Ireland. These gaps in knowledge create risk to conserving the natural environment and protecting public health.

The impacts of waste management and disposal in Northern Ireland will grow without further interventions. Landfill capacity is expected to be reached within the next five to ten years. The establishment of any further landfills will cause habitat loss. On the other hand, if targets to reduce waste to landfill are not accompanied by strong measures to reduce residual waste generated, there will be a higher risk of irresponsible disposal or exports. This demonstrates the importance of well-designed targets supported by clear plans to achieve them, considering potential unintended consequences to both the natural environment and public health. There is a clear need to improve the monitoring and evaluation frameworks for both regulated and illegal waste management and disposal in Northern Ireland.

Public authorities: duties, roles, and targets

To understand the duties on public authorities regarding waste management and illegal disposal in Northern Ireland, a review of waste legislation was conducted (see Chapter 4). The review covered primary and secondary legislation related to waste planning, licensing and permits; hazardous waste; illegal disposal; transboundary waste movements; and producer responsibility.

The UK's waste legislation has been shaped by European Council (EC) directives. Northern Ireland has, however, lagged behind the other devolved nations in updating and implementing legislative changes. This has been slowed further by the absence of functioning political institutions. Furthermore, unlike in the rest of the UK, some areas of waste legislation remain linked to European developments after the UK's exit from the European Union. This uniquely complex legislative framework in Northern Ireland creates a risk of divergence from waste legislation in both the UK and the Republic of Ireland (ROI).

Waste strategies, policies, and targets in Northern Ireland are hindered by relatively low ambition, and lack of action. Positive steps have been taken such as the consultation on the Department for the Economy's draft Circular Economy Strategy in 2022. However, delays in the development and approval of key strategies, including the Environmental Improvement Plan (EIP) under the Environment Act 2021, places Northern Ireland further behind in improving waste management and disposal. Where targets are in place, or required (e.g. Climate Change (Northern Ireland) Act 2022), progress is also limited. Recycling rates have plateaued, there are no targets for commercial and industrial waste, construction and demolition waste targets lack ambition, and proposed reductions to landfill could have untended consequences on ambitions for a circular economy. Compared with the EU, ROI and rest of the UK, Northern Ireland's waste programme is faltering.

Understanding Northern Ireland's waste management

Domestic and transboundary waste flow analysis for Northern Ireland demonstrates the origins, types, treatment locations, and end fates of waste handled by district councils (see Chapter 5). Waste generation varies by council area, reflecting demographics (e.g. density, rurality), and levels of industrial or commercial activity. The types of collection service (e.g. separate or mixed recycling) also affect waste flows. This analysis reveals that the majority of waste originating in Northern Ireland is removed to destinations within Northern Ireland (72-75%). However, transboundary flows—both imports and exports—represent an increasing percentage of overall waste flows.

Waste management in Northern Ireland should be improved. Several potential weaknesses have been identified. Currently, the data suggests that a significant quantity of waste is sent directly to landfill without undergoing sorting for reuse or recycling. There is a clear need to increase the scale and quality of sorting activities. This is particularly important due to the expectation that infrastructure capacity could be reached by 2028 or soon after. Additional landfill capacity will create environmental, social, and economic pressures. There is also no infrastructure for emerging waste streams including batteries and solar panels within Northern Ireland.

An assessment of illegal waste flows was also conducted, but data was very limited for both domestic and transboundary flows. Illegal waste disposal, including fly-tipping, is a key public concern. However, due to the voluntary and inconsistent nature of monitoring and reporting by councils, the extent and impact of illegal disposal is underestimated and not fully understood. Action to strengthen the enforcement of waste legislation, including through implementation of the Mills Review recommendations, appears to be ongoing.

Decision-making on how to improve waste management in Northern Ireland is constrained by gaps in, and limitations to, monitoring and reporting. Where data exists, issues with voluntary monitoring and inconsistent reporting undermine the quality of the evidence. Furthermore, a number of data sources are not publicly available such as on larger scale and hazardous fly-tipping incidents cleared by the NIEA. In many instances, we found significant data gaps. For example, there is no legal requirement to report data on illegal disposal, transboundary waste movements, or commercial and industrial waste collected by private companies. There is no requirement for exporters to track and take responsibility for waste beyond its first destination. There is a clear need to improve the quality and quantity of data collected and assessed on waste management and disposal in Northern Ireland.

Best practice in waste management and disposal

No example of overall best practice was identified through the assessment. Rather several case studies were chosen to highlight particular aspects of waste management and disposal. The territories chosen were Flanders in Belgium, Wales, the Republic of Korea, Germany, and France. These case studies showcase options for Northern Ireland to improve its waste management and disposal framework. These include greater clarity on responsibilities for data collection; measures aimed at reducing waste sent to both landfill *and* incineration; expanding application of the 'polluter pays' principle (to producers through extended producer responsibility, and to perpetrators of waste crime by making them pay for

the full costs of clean-up); additional incentives to reduce residual waste such as ‘pay-as-you-throw’ for households and statutory weight-based targets for councils; increasing cross-jurisdictional cooperation; and continuous improvement through more regular evaluation and policy response.

Contents

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Abbreviations

C&D waste	-	Construction and demolition waste
C&I waste	-	Commercial and industrial waste
DAERA	-	Department of Agriculture, Environment and Rural Affairs
Defra	-	Department for Environment, Food and Rural Affairs
DRS	-	Deposit return scheme
EC	-	European Council
EfW	-	Energy from waste
EPR	-	Extended producer responsibility
EU	-	European Union
HMRC	-	HM Revenue and Customs
HWRC	-	Household waste and recycling centre
LMICs	-	Low- and middle-income countries
NIEA	-	Northern Ireland Environment Agency
PERN	-	Packaging waste export recycling notes
POCs	-	Persistent organic compounds
PRN	-	Packaging waste recycling notes
ROI	-	Republic of Ireland
UK	-	United Kingdom
UNEP	-	United Nations Environment Programme

Glossary

Anaerobic digestion	AD	A process through which bacteria break down organic matter, used in waste management and the production of fuels
Energy from waste	EfW	Combustion of waste materials to produce electricity and/or heating
European Waste Catalogue	EWC	A waste classification code for common types of waste, also referred to as the List of Wastes (LoW), introduced through the European Council's Waste Framework Directive
Extended producer responsibility	EPR	A policy measure aimed to ensure that business that manufacture, import, and sell certain products are responsible for their end-of-life environmental impact
Household waste and recycling centre	HWRC	A local authority-run site where household waste and recycling can be taken, usually in limited quantities
In vessel composting	IVC	Composting of food and garden waste that takes place in an enclosed environment
Materials recovery facility	MRF	A waste management facility where recyclables are sorted from mixed waste streams
Municipal solid waste	MSW	Household waste, or waste similar in composition to household waste, collected by or on behalf of a local authority
Open windrow composting	Windrow	A process used for garden waste, where the material can break down in the open; not suitable for food waste
Refuse derived fuel	RDF	The process by which waste is shredded and pre-treated, with the combustible fractions sent for incineration as a form of fuel
Solid recovered fuel	SRF	A type of waste-derived fuel used by energy companies, though the mixed is more refined than RDF

1 Introduction

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Resource Futures was commissioned in June 2023 to support the OEP's activities by undertaking a baseline assessment of waste management and illegal disposal in Northern Ireland. This included addressing:

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- The legal duties, responsibilities, and powers placed on public authorities with regard to waste management and illegal disposal in Northern Ireland, including monitoring and reporting requirements, and targets.
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- Best practice in waste management and illegal disposal.

The scope of these objectives is limited to waste management and illegal waste disposal on land. This study excludes measures aimed at upstream waste prevention, such as single-use plastic bans. Biosolids are also out of scope.

1.1 Structure of the Report

The report is formed of seven chapters. The methodology is outlined in Chapter 2. Chapters 3 to 6 address the four topics listed above. Chapter 7 presents findings and conclusions, with a focus on gaps and potential weaknesses in the design and oversight of Northern Ireland's waste management system. Appendix A provides details of the waste flow analysis conducted to inform Chapter 5, and Appendix B provides additional waste flow analysis results at district council level.

[3] The Office for Environmental Protection (2022) Our strategy and enforcement policy
[4] The Office for Environmental Protection (2023) Corporate plan 2023-2024

2 Methodology

Information was gathered through desk-based research, stakeholder engagement, and analysis of relevant data. An overview of the methodology is provided here, and a detailed methodology for the waste flow analysis is provided in Appendix A.

2.1 Desk-based research

All desk-based research was conducted between July and September 2023.

Environmental and health impacts of waste. Research was conducted in order to provide an overview of the key impacts of waste on the natural environment and public health, taking a global perspective but also considering impacts in Northern Ireland. Sources included academic articles, and reports by reputable organisations and government entities (international and domestic).

Public authorities: duties, roles, and targets. Legislation related to waste management in Northern Ireland was identified by reviewing online policy information, guidance and position statements published by Northern Ireland's Department of Agriculture, Environment and Rural Affairs (DAERA) and the Northern Ireland Environment Agency (NIEA); and by searching in the UK Government's legislation database.[5] Legal requirements related to monitoring, reporting and targets were identified from within each individual piece of legislation. Official statistics and related publications were used to assess performance against targets.

Understanding Northern Ireland's waste management. Waste flow analysis was conducted, as outlined in section 2.2. Desk research was also conducted to gather evidence on the drivers of waste crime in Northern Ireland, and potential solutions. Sources included official waste crime surveys and reviews conducted or commissioned by public authorities and parliamentary committees, notably the report produced by Christopher Mills in 2014 in relation to illegal dumping of waste at Mobuoy. Some sources were specific to Northern Ireland, while others related to the UK as a whole. Sources also included academic and media reports related to Northern Ireland.

Best practice in waste management and illegal disposal. Examples of best practice were identified through desk research, with sources including reports from EU-funded projects such as Interreg, international organisations such as the UN Development Programme, public authorities and non-governmental organisations (NGOs). Media sources were also consulted. Examples were selected to highlight different aspects of waste management.

2.2 Waste flow analysis

The waste flow analysis was conducted using publicly available data and contextual information gathered from stakeholder engagement and desk-based research. All data analysed pertained to the

[5] Legislation.gov.uk

year 2021-22. Where available, more recent data obtained from desk based research was also included in the analysis. Key data sources include the WasteDataFlow platform, which hosts waste data reported by district councils; DAERA's publicly available datasets; and data shared by DAERA in response to direct requests.

The analysis of domestic waste flows considered district council-collected waste streams, looking at their treatment options, end fates based on treatment, interim treatment locations and final destinations as tracked by WasteDataFlow. Analysis of transboundary flows considered a broader range of waste sources (beyond district council collections), as it used data reported by waste management facilities.

Visualisations were used to present the data, including Sankey diagrams to show waste flows through different stages of their treatment; maps produced using QGIS, showing locations of treatment facilities and end destinations; as well as charts and graphs, representing proportions of different waste material types treated, imported and exported.

2.3 Stakeholder engagement

Stakeholder engagement with individuals involved in the operation, oversight or study of waste management in Northern Ireland was used to ensure robust analysis in all sections of the report. It was used to verify and fill gaps in the information found through desk research, and to ensure the accurate interpretation of waste flow data. To maximise the information shared, all stakeholder engagement was conducted on condition of anonymity. Stakeholders gave their consent for their insights to be included in the report without any identifying information; they have been assigned a letter from A to I for the purpose of citing them in this report.

Stakeholders were selected to represent a range of perspectives and areas of expertise. In August and September 2023, six interviews were conducted by video call. Information was received by email from three further stakeholders. Finally, one stakeholder provided expert feedback on the analysis in the report. Resource Futures was responsible for the analysis and editorial decisions, and the report does not reflect the views of any individual stakeholders.

3 Environmental and health impacts of waste

3.1 Overview

In order to provide context for the baseline assessment, desk research was conducted to identify and summarise the main impacts of waste on the natural environment and public health. Sources included academic articles as well as studies by reputable organisations and public bodies. The aim was first to provide an overview of the most important potential impacts, drawing on evidence from the UK and elsewhere in the world, and next to identify the main risks associated with waste management and illegal disposal in Northern Ireland.

3.2 Impacts on the natural environment

The production, management, and disposal (legal or illegal) of waste can negatively impact the environment through contributing to climate change and habitat loss, contaminating water and soil, polluting the air, and driving unnecessary resource use. It can also lead to a reduction in people's enjoyment of the natural environment, for example due to the visual impacts of litter and fly-tipping, and odour from waste management facilities.

There is evidence of a high level of public concern about the environmental impacts of waste in Northern Ireland. According to the government's 2023 environmental statistics report, 80% of the public in Northern Ireland are concerned about the environment, and their biggest environmental concern is the illegal dumping of waste and litter. The most common environmental actions taken by householders included disposing of waste products appropriately—including reusing and recycling—and reducing food waste. When asked what the greatest threat to biodiversity was, the top answer was pollution.[6]

This section focuses on the key impacts of waste management and illegal disposal on climate change, and on terrestrial and aquatic environments.

3.2.1 Climate change

Methane from landfill is by far the most significant greenhouse gas produced by the waste sector. The sector is the third largest source of global anthropogenic methane emissions globally, contributing between 11% and 18% of emissions.[7,8] Landfills also produce significant quantities of ammonia and nitrous oxides.[9,10] In the UK, the waste sector produced around 4% of greenhouse gas

[6] DAERA, the NIEA and the Northern Ireland Statistics and Research Agency (2023) Northern Ireland environmental statistics report
[7] Silpa et al. (2018) What a waste 2.0: A global snapshot of solid waste management to 2050
[8] Ayandele et al. (2022) Key strategies for mitigating methane emissions from municipal solid waste
[9] Roe, S. et al. (2004) Estimating ammonia emissions from anthropogenic non-agriculture sources
[10] Lee et al. (2023) Dynamic emissions of N_2O from solid waste landfills: a review

emissions in 2021, of which 90% were methane from landfill.[11] Methane has an 84 times stronger impact on climate change than carbon dioxide on a 20-year timescale, though it does not remain in the atmosphere as long.[12]

The Committee on Climate Change recommends three approaches to reducing these emissions. First, prevent waste. Second, divert biodegradable waste from landfill. Third, capture gas at landfill sites.[13] If possible, the captured gas should be treated and used for energy; if not, it must be flared under current regulations.[14]

Northern Ireland has significantly reduced the amount of biodegradable waste sent to landfill through targets and regulations requiring separate food waste collections for households and businesses.[15] Landfill operators must also capture gas from landfill, using measures such as covers and pipes.[16] An illustration is provided in Figure 1.[17] DAERA attributes much of the 60% fall in waste sector emissions from 1990 to 2020 to the introduction of such systems.[18] No recent data was found on the proportion of landfill gas that is captured, used for energy and flared in Northern Ireland, though DAERA's predecessor, the Department of Environment, stated in 2015 that no flaring was taking place at landfill sites.[19] We consider that there is an obligation to collect this data under the current regulatory framework.

When landfills in Northern Ireland are closed, they must be sealed with a capping layer to prevent further gas leakage. However, this rule did not apply to landfills which closed before July 2001, so there are likely to be ongoing emissions from some historical landfill sites.[20] No data was found on these. There is also a lack of data on the quantity of waste, or related emissions, from waste which is illegally deposited on land in Northern Ireland without any precautionary measures. (See chapter 5 for further information on illegal disposal.)

[11] Department for Business, Energy and Industrial Strategy (2023) 2021 UK greenhouse gas emissions, final figures
[12] European Commission (undated) Methane emissions
[13] Committee on Climate Change (2019) Reducing emissions in Northern Ireland
[14] The Landfill Regulations (Northern Ireland) 2003
[15] DAERA, the NIEA and the Northern Ireland Statistics and Research Agency (2023) Northern Ireland local authority collected municipal waste management statistics: Annual report 2021/22
[16] DAERA (n.d.) Regulation of landfills in Northern Ireland
[17] Ayandele et al. (2022) Key strategies for mitigating methane emissions from municipal solid waste
[18] DAERA and Northern Ireland Statistics and Research Agency (2022) Northern Ireland carbon intensity indicators 2022
[19] Department of Energy and Climate Change and Ricardo-AEA (2015) UK greenhouse gas and air quality pollutant inventory improvement programme: Analysis of volumes of landfill gas flared in the UK between 1990 and 2013
[20] DAERA (n.d.) Regulation of landfills in Northern Ireland

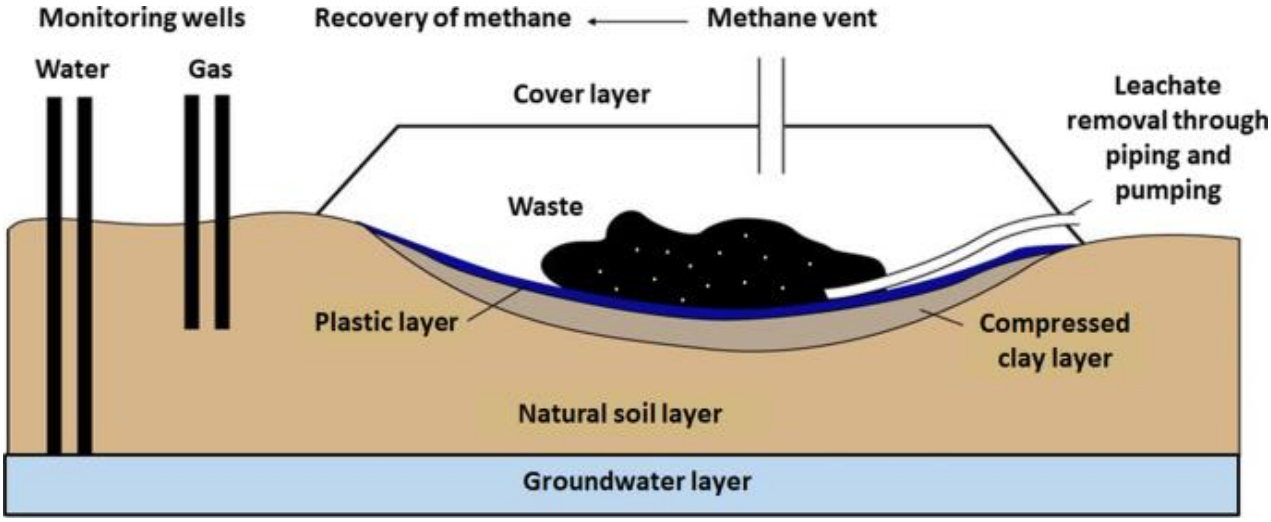

Figure 1 Landfill design to prevent environmental contamination[21]

Waste incineration is a rising source of carbon emissions. Incineration is the second largest source of greenhouse gas emissions from waste management in the UK (excluding wastewater treatment). Carbon emissions are produced from incinerating waste containing plastics and materials such as wood and paper.[22] Incineration also produces other greenhouse gases, such as nitrogen oxides and ammonia.[23] Many countries generate electricity from waste incineration, but this is a relatively inefficient process and is not a low carbon form of energy production. In 2019, the energy produced by European incinerators was twice as carbon intensive as energy produced through the electricity grid overall.[24] While incineration has successfully diverted waste from landfill, many recyclable materials end up in this waste stream, resulting in emissions that could be reduced with better waste management.[25] In particular, removing fossil-based plastic from the incinerated waste stream is important to reducing emissions.[26]

As more waste has been diverted from landfill, emissions from incineration have risen over the past decade in the UK.[27] In Northern Ireland, data was not found on emissions from waste incineration, however we consider that there is an obligation to collect this data under the current regulatory

[21] Siddiqua A. et al. (2022) An overview of the environmental pollution and health effects associated with waste landfilling and open burning, CC BY 4.0
[22] Zero Waste Europe (2020) Understanding the carbon impacts of waste to energy incineration
[23] Environment Agency (2016) Pollution inventory reporting – incineration activities guidance note
[24] Zero Waste Europe (2019) The impact of waste-to-energy incineration on climate
[25] Scottish Government (2023) Stop, sort, burn, bury? Independent review of the role of incineration in the waste hierarchy in Scotland
[26] Scottish Government (2023) Stop, sort, burn, bury? Independent review of the role of incineration in the waste hierarchy in Scotland
[27] Committee on Climate Change (2020) The sixth carbon budget: Waste

framework. The share of waste being sent for incineration with energy recovery has also increased in Northern Ireland.[28]

Open burning of waste produces black carbon, a short-lived pollutant with a global warming potential 5,000 times greater than carbon dioxide. According to a 2019 study, the climate impact of black carbon is equivalent to 2-10% of global greenhouse gas emissions.[29] Open burning also produces toxic chemicals such as dioxins, metals, and polychlorinated biphenyls (PCBs) which may be transported by wind and deposited in soil and water (see section 3.2.2). According to the UNEP, 26% of all waste globally is burned by householders and a further 15% is burned at dump sites.[30] Open burning is more common in low- and middle-income countries (LMICs); however, illegal waste burning does occur in Europe.[31] In the UK, a survey of waste sector employees in England in 2023 found that an estimated 14% of waste organisations engaged in illegal burning of waste.[32] A 2016 investigation involving Freedom of Information requests in 2016 revealed a significant problem with the burning of tyres in recycling centres in Northern Ireland, with other mixed waste also burnt.[33] Stakeholders D and F confirmed that this is still an issue, though it has reduced in recent years. (See also chapter 5.) Data on the scale of illegal/open burning of waste in Northern Ireland was not found.

Failure to apply the waste hierarchy leads to emissions from unnecessary resource use. According to the United Nations Environment Programme (UNEP), the extraction and processing of materials accounts for half of global emissions.[34] By capturing and processing reusable and recyclable waste items, demand for new materials and products is cut and so are upstream emissions. A failure to reuse and recycle therefore leads to unnecessary emissions.

3.2.2 Impact on terrestrial and aquatic environments

The clearing of land for landfill sites can lead to habitat loss, and this can be exacerbated by fires if landfills are not correctly managed.[35] In Northern Ireland, planning policy encourages district councils to choose sites that limit the negative environmental impacts,[36] and regulations require best available techniques to be applied in landfill management (see chapter 4). No evidence was found of recent landfill fires. Based on current permits, Northern Ireland currently has 24 active landfill sites and four closed sites.[37] Quantities of waste going to landfill have fallen over the past decade, and the draft

[28] Committee on Climate Change (2019) Reducing emissions in Northern Ireland
[29] Reyna-Bensusan et al. (2019) Experimental measurements of black carbon emission factors to estimate the global impact of uncontrolled burning of waste
[30] Engineering X (2022) Open burning of waste in Africa: challenges and opportunities
[31] See for example Reuters (2018) Poland vows to fight illegal waste dumps after toxic fires; and Reuters (2013) Italy passes decree against illegal waste disposal
[32] Environment Agency (2023) National waste crime survey 2023: results and findings
[33] Campbell, C., (2016), Waking up to waste: How Northern Ireland's waste problem could leave a toxic legacy, The Detail.
[34] International Resources Panel of the United Nations Environment Programme (2019) Global resources outlook 2019
[35] Iravanian A. and Ravari S. (2020) Types of contamination in landfills and effects on the environment: A review
[36] Department of the Environment (2015) Strategic planning policy statement for Northern Ireland
[37] NIEA (2021) PPC Waste Permits – August 2021

circular economy strategy for Northern Ireland, published in 2022, aims to achieve further reductions (see also section 4.3).[38] Nonetheless, Stakeholders B and D indicated that Northern Ireland's current landfill capacity was not enough to meet requirements in the next decade. This is supported by an assessment conducted in 2017, which predicted that Northern Ireland would run out of landfill capacity by 2028.[39] The extent of demand for future landfill sites will depend on progress on waste prevention and the availability of alternative infrastructure, such as incinerators.[40]

Open dumping and leakage from poorly designed landfills can lead to contamination of soil, ground water, and surface water as waste breaks down.[41] Where landfills are poorly designed or damaged, any toxic chemicals that are leaked can penetrate the soil and contaminate groundwater and surface water.[42] Depending on the waste that has been dumped or deposited in landfill, these chemicals can include heavy metals, persistent organic compounds (POCs), dissolved methane, phosphates, nitrate, sulphates, and calcium. These can prevent plant growth and damage vegetation.[43] This in turn can impact local wildlife populations when affected plants are ingested, by causing death or by affecting reproduction. These chemicals tend to accumulate in organisms, resulting in negative impacts throughout the food chain.[44] This contamination can be long lasting and studies have found that the environmental impact of landfill sites can continue up to 30 years after closure.[45] While it is beyond the scope of this report, it should be noted that due to a failure to implement the legislation there is no register of contaminated land in Northern Ireland.

There is also a growing body of evidence on the harmful impacts of plastics and microplastics on terrestrial and aquatic wildlife.[46] When illegally dumped, plastics (and items made from other materials) can lead to entanglement or ingestion, resulting in starvation and death.[47] This can also result in animals ingesting harmful chemicals, as plastics often either contain harmful substances or absorb other pollutants after becoming waste.[48]

In Northern Ireland, landfill sites must be engineered to limit environmental contamination through linings, covers and monitoring of chemical levels (Figure 1). Site operators are required to monitor

[38] Northern Ireland Executive (2021) Draft environment strategy for Northern Ireland
[39] WDR & RT Taggart (2017) Northern Ireland landfill capacity report
[40] Not all waste types can be diverted from landfill to incineration, for example certain hazardous materials such as asbestos cannot be incinerated.
[41] Siddiqua A. et al. (2022) An overview of the environmental pollution and health effects associated with waste landfilling and open burning
[42] Li et al. (2021) Sources and consequences of groundwater contamination
[43] Iravanian A. and Ravari S. (2020) Types of contamination in landfills and effects on the environment: A review
[44] Baziene et al. (2020) Level of pollution surrounding environment from landfill aftercare
[45] Iravanian A. and Ravari S. (2020) Types of contamination in landfills and effects on the environment: A review
[46] Diggle and Walker (2022) Environmental and economic impacts of mismanaged plastics and measures for mitigation
[47] RSPCA (undated) How littering harms animals
[48] Gallo et al. (2018) Marine litter plastics and microplastics and their toxic chemical components: the need for urgent preventative measures

impacts on local ground and surface water.[49] Once full, a landfill must be covered and sealed to limit further contamination.[50] As noted above, the current rules do not apply to landfills which closed before July 2001, and there is no systematic environmental monitoring of earlier sites. As for illegally dumped waste, data was neither found on the extent of the problem nor on its monitoring. However, Stakeholder F stated that there was inadequate environmental monitoring of known sites, which numbered in the thousands.

Open burning and incineration can also lead to contamination of soil and watercourses. These impacts are greater from open burn sites, which can leave high levels of chemicals in the surrounding soil.[51] Smoke from burning waste can be carried on the wind and deposited at a distance from the burning site.[52] This smoke can contain heavy metals, sulphur dioxide, nitrogen oxides and ammonia, which are particularly harmful to vegetation.[53] Incineration plants can use scrubbers and filtration units to minimise the release of chemicals in smoke, so fewer chemicals are released compared to open burning.[54] In Northern Ireland, incinerators must apply best available techniques to limit environmental impacts, in line with regulations on pollution prevention and control.[55] As noted above, data on the scale of illegal/open burning of waste in Northern Ireland was not found, though there is evidence that it does occur.

Failure to apply the waste hierarchy leads to unnecessary resource use. This has an impact on terrestrial and aquatic environments in locations where materials are extracted or grown, and where goods are produced. The UNEP estimates that resource extraction and processing causes 90% of biodiversity loss and water stress globally.[56]

3.3 Impacts on public health

Waste management and illegal disposal can impact public health in ways that are connected to the environmental impacts discussed above, and in terms of workplace health and safety.

People on lower incomes are disproportionately impacted by the impacts of waste globally, as they are more likely to live in close proximity to waste sites.[57] In the UK, a 2020 investigation by Unearthed found that existing and planned waste incinerators were disproportionately located in

[49] Siddiqua A. et al. (2022) An overview of the environmental pollution and health effects associated with waste landfilling and open burning
[50] DAERA (n.d.) Regulation of landfills in Northern Ireland
[51] Ferronto and Toerretta (2019) Waste mismanagement in developing countries
[52] Siddiqua A. et al. (2022) An overview of the environmental pollution and health effects associated with waste landfilling and open burning
[53] European Environment Agency (2022) Impacts of air pollution on ecosystems
[54] UNEP (2019) Waste to energy: Considerations for informed decision making
[55] DAERA (n.d.) The Industrial Emissions Directive and the Pollution Prevention and Control (Industrial Emissions) Regulations
[56] International Resources Panel of the United Nations Environment Programme (2019) Global resources outlook 2019
[57] Vergara and Tchobanoglous (2012) Municipal solid waste and the environment: A global perspective

deprived neighbourhoods, and that the one industrial incinerator in Northern Ireland was located in a relatively deprived area.[58] No evidence was found on the locations of landfill sites in Northern Ireland in this respect. Planning policy encourages district councils to consider public health impacts and the impact on local communities when giving permission for new waste management sites. It does not specifically call for consideration of social equality,[59] but district councils are required to carry out equality impact assessments of local development plans.[60]

Poorly managed or illegally dumped waste can contaminate drinking water. As outlined in section 3.2.2, toxic chemicals can leach into groundwater. Depending on the location of the waste, this may affect local drinking water, posing risks to human health. Water that is high in heavy metals, organic chemicals, and POCs can cause non-communicable diseases such as damage to the liver, kidneys and intestines.[61] Other chemical contaminants can lead to skin irritations.[62] Water that is heavily contaminated with bacteria can cause the transmission of communicable diseases,[63] for example if waste is contaminated with human or animal faeces.[64] In many countries, medical waste is not managed differently to municipal waste and this can cause transmission of infectious disease, while improper handling of sharps can put waste sector workers at risk. [65]

In Northern Ireland, there are clear rules on managing hazardous waste, including medical waste (see chapter 4),[66] and landfill operators must monitor local water. However, as noted in section 3.2.2, there are potential gaps related to the monitoring of landfills that closed before July 2001 and of illegally dumped waste. A water monitoring system is in place at the Mobuoy site, where large-scale illegal dumping was discovered in 2013.[67] Mobuoy is located near to the River Faughan, which is a source of drinking water for Derry/Londonderry. Monitoring is not routinely taking place at other less prominent illegal disposal sites.

The open burning of waste can lead to, and exacerbate, respiratory illnesses, owing to the production and spread of hazardous gases, toxic chemicals, and fine particulate matter.[68, 69] It can also release carcinogenic chemicals such as dioxins and furans, which are particularly toxic to humans.[70] Smoke from incineration plants may also contain these chemicals, but as noted above, in Northern

[58] Unearthed (2020) UK waste incinerators three times more likely to be in poorer areas
[59] Department of the Environment (2015) Strategic planning policy statement for Northern Ireland
[60] See for example: Derry City and Strabane District Council (2019) Local development plan 2032: Draft equality impact assessment
[61] EPA (undated) Potential water contaminants and their impact
[62] Li et al. (2022) Effects of water pollution on human health and disease herogeneity: A review.
[63] UNEP (undated) Solid waste management
[64] CDC (undated) Disease impact of unsafe water
[65] Ferronto and Toerretta (2019) Waste mismanagement in developing countries
[66] Public Health Agency (n.d.) The Northern Ireland regional infection prevention and control manual
[67] DAERA (2023) Mobuoy remediation project – Water quality environmental monitoring programme
[68] Ferronto and Toerretta (2019) Waste mismanagement in developing countries
[69] Vergara and Tchobanoglous (2012) Municipal solid waste and the environment: A global perspective
[70] Engineering X (2022) Open burning of waste in Africa: challenges and opportunities

Ireland mitigating measures are put in place to minimise harmful emissions. For example, gas from incineration plants is captured and cooled slowly to prevent the release of dioxins and furans.[71]

As noted above, the open burning of waste, including tyres, does occur in Northern Ireland but the extent of this is unknown. Burning tyres generates harmful chemicals, including severe irritants which can cause short-term effects—particularly for people with pre-existing respiratory conditions—as well as carcinogens which can increase cancer risk, particularly with repeated exposure. Exposure varies according to factors such as distance from the affected population and wind speed.[72] No evidence was found on the cancer risk related to short-term, rather than chronic, exposure.[73]

Working in the waste sector involves relatively high health and safety risks.[74] In Great Britain, approximately 5% of individuals in the sector suffer work-related health impacts each year, which is higher than any other industry.[75] Impacts include musculoskeletal disorders, stress, being struck by a vehicle, struck by an object, contact with moving machinery, and slips. In 2019, the waste sector (which employed around 5,720 people) reported 44 incidents to the Health and Safety Executive for Northern Ireland (HSENI), including one fatality.[76] The HSENI works with the Waste Industry Safety and Health Forum for Northern Ireland (WISHNI), a partnership of private industry, trade unions, national government bodies and district councils, to raise awareness of workplace health and safety.[77]

3.4 Gaps and potential weaknesses

The review of the environmental and public health impacts of waste revealed the following knowledge gaps and potential weaknesses in Northern Ireland:

- No recent data was found on the proportion of landfill gas that is captured, used for energy and flared in Northern Ireland, so it was not possible to assess whether greenhouse gas emissions are being minimised.
- Data specific to Northern Ireland was not found on emissions from waste incineration, though UK-level data is available.
- There is a lack of evidence to determine whether waste management infrastructure is disproportionately located close to more deprived communities.
- Rules on the management of closed landfills only apply to those closed from July 2001, and there is no systematic monitoring of potential impacts from landfills closed prior to this.

[71] European Environment Agency (2022) Impacts of air pollution on ecosystems
[72] California Air Resources Board (2002) Tire fire smoke: Office of Environmental Health Hazard assessment
[73] A review of academic articles and government studies on the cancer risks associated with burning tyres or with inhaling relevant carcinogens, such as polycyclic aromatic hydrocarbons, found a focus on long-term chronic exposure, such as occupational exposure.
[74] Vergara and Tchobanoglous (2012) Municipal solid waste and the environment: A global perspective
[75] HSE (2019) Waste Statistics in Great Britain, 2022
[76] HSENI (n.d.) WISHNI - Statistics, enforcement and prosecutions in the waste and recycling sector
[77] HSENI (n.d.) HSENI's role in the waste industry

- The extent of illegal disposal is unknown (including illegal dumping and open burning), meaning it is not possible to assess the extent of associated greenhouse gas emissions or other environmental and public health impacts.
- There may also be insufficient monitoring of the impacts of illegal dumps that are known to public authorities.

4 Public authorities: duties, roles, and targets

4.1 Legislative framework

4.1.1 Overview

To understand the origins, evolution, and status quo of the duties on public authorities regarding waste management and illegal disposal in Northern Ireland, and to identify which disposal activities are illegal, a review of key waste legislation was conducted for the OEP in August-September 2023. The review covered primary and secondary legislation related to waste planning, licensing and permits; hazardous waste; illegal disposal; transboundary waste movements; and producer responsibility (to the extent that the latter creates public duties). It captured key provisions including duties, targets, definitions, and prohibitions, as well as enforcement measures and responsible authorities.

The main sources used for the research were:

- The UK Government's legislation database.[78]
- Policy information, guidance and position statements published by DAERA and the NIEA.[79]
- Interviews with stakeholders.

This section provides a summary of findings from the review of waste legislation.

4.1.2 Waste management planning, licensing, and permits

The question of which waste management and disposal activities are legal or illegal is determined through a system of planning, licensing and permits. Anyone who manages waste—whether an individual, a company or a public authority—has a duty of care to ensure that is kept safely, and that it is only passed to people or companies who are authorised to take it, and who will manage it responsibly in line with current legislation.[80]

Table 1 summarises Northern Ireland's legal framework for waste planning, licensing and permits. Where there are references to "the Department", these refer to DAERA since its formation in 2016, and in earlier legislation to its predecessor, the Department of Environment. This is not a comprehensive list

[78] Legislation.gov.uk
[79] DAERA (n.d.) Waste
[80] NIEA (2016) Waste management: The duty of care – a code of practice

of all relevant laws, which would include a sizeable body of secondary legislation introducing more detailed processes and technical amendments over time, and addressing specific waste categories.

Table 1 Waste management legislation in Northern Ireland: planning, licensing and permits

Legislation	Key provisions
Pollution Control and Local Government (Northern Ireland) Order 1978 (Revoked except for Part 2: Waste on Land)	Changes when introduced: - Required district councils to prepare a waste disposal plan and introduce licensing conditions, inspections and enforcement. Relevant provisions still in force: - Councils may remove waste dumped in contravention of the Waste and Contaminated Land (Northern Ireland) Order 1997.
Waste and Contaminated Land (Northern Ireland) Order 1997 ("The 1997 Order")	- Transposed elements of the European Council (EC)'s Waste Framework Directive (1975). - Transferred responsibility for waste regulation from district councils to the Department. - Established a duty of care and required the Department to issue a code of practice on this. - Replaced waste disposal licences with site licences (called waste management licences), issued by the Department. - Defined a "fit and proper person" to hold a waste management licence. - Prohibited the deposit of waste on land without having, or meeting the terms of, a licence. - Prohibited the transport of waste by a person who is not a registered carrier. - Gave district councils powers to remove waste unlawfully deposited. - Introduced duties related to remediation of, and liability for, contaminated land.
Environment (Northern Ireland) Order 2002	- Amended the 1997 Order so waste site licences do not expire, with rules to prevent a site operator from walking away without meeting requirements. - Introduced permitting for certain large landfill installations.
The Controlled Waste (Duty of Care) Regulations (Northern Ireland) 2002	- Required people transferring and receiving consignments of waste to complete and sign a transfer note.
The Waste Management Licensing Regulations (Northern Ireland) 2003	- Implemented key parts of the 1997 Order, as well as transposing EC directives on waste, landfill and end-of-life vehicles. - Set requirements for the registration of waste brokers and dealers. - Defined offences that might prevent someone from receiving a waste management licence.
Landfill Regulations (Northern Ireland) 2003	- Transposed elements of the EC Landfill Directive. - Established the rules for permits to create and operate a landfill, and for closure notices which are required to close a landfill. - Amended the "fit and proper person" test, to ensure sites are properly managed and financed.

	- Prohibited sending certain types of waste to landfill, including liquids, certain hazardous substances and most tyres. - Made it an offence for a landfill operator to accept waste contrary to requirements.
The Waste Regulations (Northern Ireland) 2011	- Transposed the EC's revised Waste Framework Directive (2008). - Made changes to requirements for waste management plans. - Required all waste holders to apply the waste hierarchy. - Introduced requirements for district councils to arrange separate collections of paper, metal, plastic and glass, and made it an offence for waste carriers to contravene these requirements.
The Controlled Waste and Duty of Care Regulations (Northern Ireland) 2013	- Gave clarity on the classification of waste as 'household', 'commercial' or 'industrial'. - Identified when a charge may be levied for collection and disposal. - Updated the Controlled Waste (Duty of Care) Regulations (NI) 2002 to update the information required on waste transfer notes, to improve waste tracking.
Controlled Waste (Seizure of Property) Regulations (Northern Ireland) 2013	- Set out the procedures to be followed when the Department seizes property suspected of being used, or about to be used, in illegal waste activity.
Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013	- Transposed the EC's Industrial Emissions Directive. - Established the current process for issuing permits for waste management facilities, including landfill, incineration, and other forms of recovery, disposal and storage. - Required a "fit and proper person" test; planning permission; and for facilities to apply "best available techniques" for pollution control.
The Environment Act 2021	- Established a legal framework for environmental governance following the UK's exit from the EU. - Supplemented the charging powers available to the Department for administering waste management rules, for example when intervening at waste sites that are in breach of licencing rules. - Enhanced the Department's powers to enforce the removal of waste.
The Waste and Contaminated Land (Amendment) (2011 Act) (Commencement No.3) Order (Northern Ireland) 2022	- Commenced parts 4 and 5 of the Waste and Contaminated land (Amendment) Act (Northern Ireland) 2011 as of January 2023. - These amended the 1997 Order to introduce fixed penalty notices for offences related to the unauthorised or harmful disposal of waste, as an alternative to court action; and to enhance the Department's powers to seize and hold property suspected of being used for illegal waste activity.

Northern Ireland introduced a requirement for district councils to prepare waste management plans, and to introduce and enforce waste licensing requirements, in the **Pollution Control and Local Government (Northern Ireland) Order 1978**.[81] This allowed councils to obtain information related to enforcement.

The **Waste and Contaminated Land (Northern Ireland) Order 1997** ("the 1997 Order") updated waste legislation in line with the 1975 EC Waste Framework Directive.[82] It shifted responsibility for waste regulation from district councils to the Department. Waste disposal licences were replaced with waste management (site) licences, and a definition was provided of a "fit and proper person" to hold a licence. Rules on moving waste were tightened, including through a duty of care on those handling waste. The Department became responsible for issuing licences, registering waste carriers, and publishing a waste strategy, while district councils had to prepare local waste management plans. The waste strategy was aimed at limiting impacts on the environment and public health, and preventing waste.[83]

Legislative updates over the following two decades were driven to a large extent by European legislation. In 2003-4, the 1999 Landfill Directive was transposed.[84] The **Landfill Regulations (Northern Ireland) 2003** introduced rules for landfill permits and closure.[85] A series of additional regulations created the **Northern Ireland Landfill Allowances Scheme (NILAS)**, which between 2005 and 2020 set upper limits on the amount of waste each district council could send to landfill.[86]

In 2011, the 1997 Order was amended in line with the 2008 EC Waste Framework Directive, via the **Waste Regulations (Northern Ireland) 2011**.[87,88] A partnership approach was created between the Department and district councils in tackling illegal disposal. Both were given powers to obtain information related to their duties, including by entering premises. The Department's waste management strategy now had to include recycling targets, and a duty was placed on all organisations handling waste, public or private, to apply the waste hierarchy. District councils were required to provide separate waste collections for paper, metal, plastic, and glass from the start of 2015.[89]

[81] Pollution Control and Local Government (Northern Ireland) Order 1978
[82] Council Directive 75/442/EEC of 15 July 1975 on waste
[83] The Waste and Contaminated Land (Northern Ireland) Order 1997
[84] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
[85] The Landfill Regulations (Northern Ireland) 2003
[86] Waste and Emissions Trading Act 2003; The Landfill Allowances Scheme (Northern Ireland) Regulations 2004; The Landfill (Scheme Year and Maximum Landfill Amount) Regulations 2004
[87] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
[88] The Waste Regulations (Northern Ireland) 2011
[89] Waste and Contaminated Land (Amendment) Act (Northern Ireland) 2011

The **Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013**, transposing the 2010 EC Industrial Emissions Directive, brought in requirements for permits and "fit and proper person" checks for all main forms of waste disposal, and set emissions limits for pollutants.[90,91]

New powers to regulate on resources and waste were introduced through the **Environment Act 2021**, in light of the UK's withdrawal from the EU in January 2020.[92] The **Climate Change Act (Northern Ireland) 2022** will have the effect of increasing the focus on greenhouse gas emissions in DAERA's plans for the waste management sector in coming years (see also sections 4.2.2 and 4.3.2).[93]

4.1.3 Hazardous waste

The aim of regulations in Northern Ireland on hazardous waste, referred to in early legislation as special waste, is "to provide an effective system of control for wastes which are dangerous and difficult to handle", with consignment notes and unique codes required for individual waste consignments.[94] A timeline of hazardous waste regulations is provided in Figure 2.

As with other forms of waste, the **1997 Order** handed regulatory powers over hazardous waste from district councils to DAERA.[95] The 1991 EC Hazardous Waste Directive was implemented by the **Hazardous Waste Regulations (Northern Ireland) 2005**,[96,97] along with the **List of Waste Regulations (Northern Ireland) 2005**.[98] These require records to be kept for three years, showing the location and nature of hazardous waste deposited on land; and advance notification to the Department of hazardous waste movements.

After the Hazardous Waste Directive was superseded in 2008 by the new Waste Framework Directive, amendments to the 2005 regulations were made through the **Waste Regulations (Northern Ireland) 2011**, but these were minor and did not include changes to the management of hazardous waste.[99] In 2018, the Waste Framework Directive was amended to require EU member states to introduce separate collections for hazardous waste from households by 2025.[100] This was not taken forward in Northern Ireland, though a more technical amendment (to rebrand the Department's waste strategies as waste plans) was transposed.[101] Since the UK's exit from the EU, the Waste Framework Directive no longer directly shapes Northern Ireland's domestic legislation (see section 4.1.6).

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[90] The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013
[91] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions
[92] The Environment Act 2021
[93] The Climate Change Act (Northern Ireland) 2022
[94] DAERA (2019) Guide to consigning hazardous waste
[95] The Waste and Contaminated Land (Northern Ireland) Order 1997
[96] Council Directive 91/689/EEC of 12 December 1991 on hazardous waste
[97] The Hazardous Waste Regulations (Northern Ireland) 2005
[98] The List of Wastes Regulations (Northern Ireland) 2005
[99] The Waste Regulations (Northern Ireland) 2011
[100] Directive 2008/98/EC of the European Parliament and of the Council, Article 20
[101] Waste Regulations (Northern Ireland) 2019

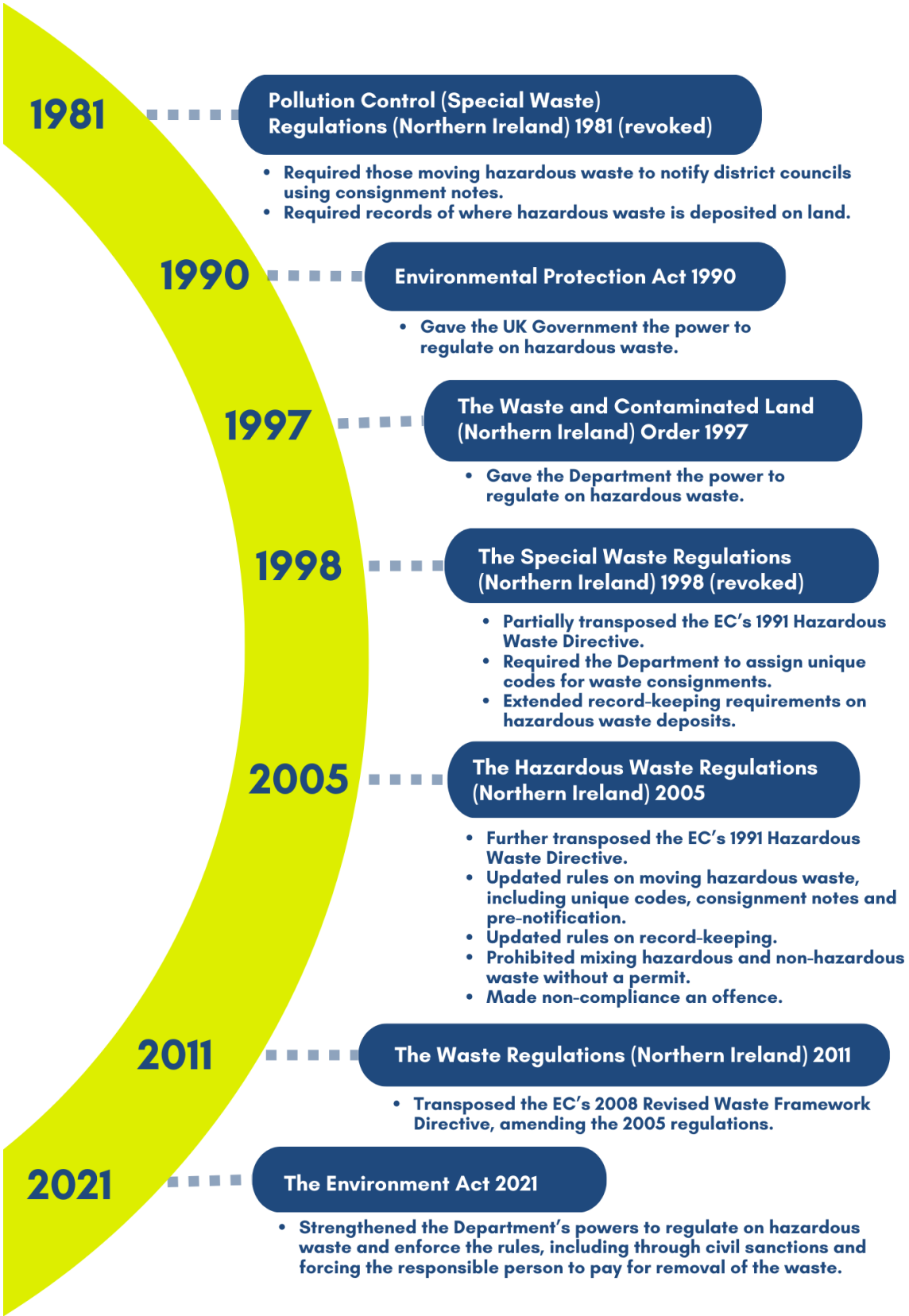

Figure 2 Timeline of hazardous waste legislation in Northern Ireland

The Northern Ireland Environment Agency (NIEA) oversees the consignment note and pre-notification system. Every movement of hazardous waste must be accompanied by a consignment note which outlines the persons and facilities involved.[102] There is no legal requirement for the Department or the NIEA to set targets or publish reports on hazardous waste. **The Environment Act 2021** amended the 1997 Order to update provisions on hazardous waste, giving DAERA increased regulatory powers, including the ability to impose civil sanctions for non-compliance.[103]

4.1.4 Transfrontier waste shipments

The import and export of waste is not a devolved matter, so is legislated on at UK level. However, the topic also appears in devolved legislation where there is overlap with the domestic waste management system. Northern Ireland's devolved regulations on the duty of care regarding transfers of controlled waste still apply when waste is bound for export,[104] as does the hazardous waste consignment note system.[105] Importers are treated as producers of waste under the **Waste Regulations (Northern Ireland) 2011**.[106] This means that anyone who transfers waste to another party must find out whether it is likely to be exported, and if so, whether this is being done lawfully. Waste exports require approval from the NIEA and the destination country.[107]

The Department (via the NIEA) is charged with implementing the UK rules on waste imports and exports, except in the case of shipments transiting the UK, and enforcement in marine areas, which are the responsibility of the UK Secretary of State for the Environment, Food and Rural Affairs. **The Environmental Protection Act 1990** enabled the Secretary of State to regulate the import and export of waste that presents a risk to the environment or humans.[108]

The UK's current regulations were informed by the United Nations (UN) Basel Convention; the Organisation for Economic Cooperation and Development (OECD) Council Decision on a control system for waste; and the EU's Waste Shipments Regulation (see information box, below).[109] The EU regulation was transposed by the **Transfrontier Shipment of Waste Regulations 2007**, which set out rules on waste imports and exports, including notification and record-keeping duties.[110]

Following the UK's withdrawal from the EU, the UK remains a signatory to the Basel Convention and a member of the OECD. The EU Waste Shipments Regulation was retained in UK law and will not be revoked

[102] DAERA (2019) Guide to consigning hazardous waste
[103] The Environment Act 2021
[104] The Waste and Contaminated Land (Northern Ireland) Order 1997
[105] NIEA (2016) Waste management - The duty of care: A code of practice
[106] The Waste Regulations (Northern Ireland) 2011
[107] NIEA (2016) Waste management - The duty of care: A code of practice
[108] Environmental Protection Act 1990
[109] DAERA (2021) The transfrontier shipment of waste
[110] The Transfrontier Shipment of Waste Regulations 2007

under the Retained EU Law (Revocation and Reform) Act 2023.[111,112] Under the Protocol on Ireland / Northern Ireland (referred to as the Northern Ireland Protocol), no changes were made to the arrangements regarding waste movements between Northern Ireland and either the EU or the UK.[113,114] The later amendments brought in by the Windsor Framework in relation to the Green Lane system, which addresses goods flowing between the UK and Northern Ireland, do not apply to waste shipments. Stakeholder A confirmed that the rules on transboundary waste movements have not changed.[115]

International and UK rules on waste imports and exports

The Basel Convention is intended to protect human and environmental health from the effects of waste. It aims to ensure the environmentally sound management of hazardous waste (applying a broad definition that includes hazardous waste, household waste and incinerator ash), by increasing regulation of imports and exports. It prohibits exports to Antarctica, to states not party to the Convention, and to states that have banned waste imports. It is based on a system of prior informed consent.[116]

The OECD Decision C(2001)107/FINAL provides more explicit rules for waste imports and exports between OECD countries, where the waste must undergo a recovery operation. 'Recovery' includes recycling, composting and use as a fuel other than in direct incineration. The Decision aims to ensure that waste is only exported where it will undergo an environmentally sound recovery operation. It outlines procedures for two categories of waste: the Green Control Procedure is for low risk waste, while the Amber Control Procedure provides additional checks for higher risk waste.[117]

The EU's Waste Shipments Regulation (1013/2006) prohibits the export of waste for disposal other than to EU or European Free Trade Area countries, and prohibits the export of certain wastes for recovery to non-EU, non-OECD Decision countries. The UK's Transfrontier Shipment of Waste Regulations 2007 implemented the Waste Shipments Regulation.[118]

The UK plan for shipments of waste states that imports and exports of waste for disposal are prohibited in most cases. An exception exists for hazardous waste generated in, and moving between, Northern Ireland and the Republic of Ireland.[119]

4.1.5 Producer responsibility

Producer responsibility regulations aim to ensure that producers contribute towards the waste management costs of the goods they place on the market, and to increase recycling rates. They were introduced in the UK, including Northern Ireland, as a result of EC directives. They address packaging,

[111] International Waste Shipments (Amendment) (EU Exit) Regulations 2019
[112] Retained EU Law (Revocation and Reform) Act 2023
[113] DAERA (n.d.) Brexit - Environment waste questions & answers
[114] DAERA (2021) The transfrontier shipment of waste
[115] UK Government (2023) Windsor Framework unveiled to fix problems of the Northern Ireland Protocol
[116] United Nations Environment Programme, Basel Convention (n.d.) Overview
[117] Organisation for Economic Cooperation and Development (2009) Guidance manual for the control of transboundary movements of recoverable wastes
[118] The Transfrontier Shipment of Waste Regulations 2007
[119] Defra (2021) UK plan for shipments of waste

batteries, waste electrical and electronic equipment (WEEE), and end-of-life vehicles. In some cases, legislation was revised over time to increase the recycling targets.

The current schemes operate on a UK-wide basis. In recent years the UK and devolved governments have agreed to work together to introduce more ambitious 'extended producer responsibility' (EPR) regulations. The new EPR regulations will aim to ensure producers pay the full net cost of managing their products at end of life, and will be designed to incentivise more recyclable and reusable products.[120] Producers will start reporting data for the new packaging EPR scheme in 2024.[121] The Department for Environment, Food and Rural Affairs (Defra) has announced that consultations on new WEEE and batteries regulations will take place during 2023.[122,123]

There are some differences in how producer responsibility legislation is being dealt with in post-EU exit regulatory changes (see section 4.1.6). Northern Ireland's legislation on packaging and batteries will remain linked to EU legislation, while rules on WEEE and end-of-life vehicles are being assimilated into domestic legislation. There is a risk of divergence in the case of batteries legislation, as the EU has just introduced a new Batteries Regulation which goes significantly further than the previous Batteries Directive.[124] This will apply in Northern Ireland under the Northern Ireland Protocol. The extent of the potential divergence is unclear, as the UK and devolved governments have yet to consult on their own new batteries regulations. However, concerns about this have been raised in the UK Parliament, including the potential for there to be lower waste standards in Great Britain than in Northern Ireland.[125]

4.1.6 EU legislation and the impacts of EU exit

As sections 4.1.2 to 4.1.5 have shown, Northern Ireland's waste legislation framework has been strongly shaped by European legislation. When the UK was an EU member state, all EU legislation that was directly effective in the UK, or transposed into UK law, was 'dynamically aligned' with EU law. This meant that any amendments at EU level were also updated in UK law. In its implementation, UK courts were required to accept European Court of Justice jurisdiction, EU law principles and the primacy of EU laws over national ones.

When the post-Brexit transition period ended in January 2021, EU legislation was temporarily retained in UK law as a result of the EU (Withdrawal) Act 2018, but for most of the UK, dynamic alignment ended. The next major change will come at the end of 2023, under the Retained EU Law (Revocation and Reform) Act 2023 (REUL Act). Retained EU laws (REUL) will be dealt with in one of two ways. The default

[120] UK Government (2018) Our waste, our resources: A strategy for England
[121] Defra (2023) Update on packaging reforms to help drive down inflation
[122] Defra (2023) Environmental Improvement Plan 2023: First revision of the 25 Year Environment Plan
[123] UK Parliament (2023) Twenty-First Report of Session 2022–23: Documents considered by the Committee on 12 July 2023
[124] EC Directorate-General for Environment (2023) Circular economy: New law on more sustainable, circular and safe batteries enters into force
[125] UK Parliament (2023) Twenty-First Report of Session 2022–23: Documents considered by the Committee on 12 July 2023

is for REULs to be converted into 'assimilated laws', forming part of domestic legislation. Remaining links to the European Court of Justice, EU law principles and the primacy of EU law will be fully revoked. However, a group of 587 REULs listed in a revocation schedule to the REUL Act will be fully or partially revoked.[126] (None of these relate to waste management or illegal disposal.[127]) In addition, UK ministers, and ministers of the devolved governments, will have broad powers to restate (without substantive changes), or to revoke and replace, REULs and assimilated laws until June 2026, with less scrutiny than is usually the case when changing laws.[128]

The situation in Northern Ireland is different and more complex, as a result of the Northern Ireland Protocol, which forms part of the UK-EU Withdrawal Agreement (2020).[129] The Protocol was amended in 2023 by the Windsor Framework. As a result of the Protocol, REUL in Northern Ireland will be dealt with in one of three ways at the end of 2023:

- Some EU laws, listed in annexes to the Protocol, will continue to apply in Northern Ireland and will be dynamically aligned to any changes at EU level. For most of these, the EU Court of Justice jurisdiction, EU law principles, and primacy of EU law still apply. However, the Windsor Framework introduced the option of a 'Stormont brake', which enables members of the Northern Ireland Assembly to apply a 'brake' to otherwise automatic updates if they view them as potentially disruptive.
- Some EU laws that are not listed in annexes to the Protocol will become assimilated laws under the REUL Act.
- The REULs listed in the revocation schedule to the REUL Act will be fully or partially revoked.[130]

The level of complexity presents implementation risks. According to Stakeholder I, the Northern Ireland Civil Service is struggling to develop systems to monitor all these developments, due to the complexity and divergence. These risks are exacerbated by the absence of functioning political institutions in Northern Ireland at present, which is slowing the implementation of post-EU exit changes. Senior civil servants currently have the authority to make or amend laws, but these powers are limited to minor changes that do not deviate from existing policy, and do not include cross-departmental issues.[131] This is creating a lag, meaning that the full impacts of recent changes affecting Northern Ireland may not be understood for some time.

[126] Cowie, G (2023) Retained EU Law (Revocation and Reform) Act 2023
[127] Retained EU Law (Revocation and Reform) Act 2023, Schedule 1
[128] Sarah McKay (2023) The Retained EU Law (Revocation and Reform) Act 2023, Scottish Parliamentary Information Centre (SPICe)
[129] Protocol on Ireland/Northern Ireland
[130] Whitten, L (2023) Dynamic regulatory alignment and the Protocol on Ireland/Northern Ireland - Two year and 6 month review, Queen's University Belfast, Post-Brexit Governance NI – Explainer No. 11
[131] Northern Ireland (Interim Arrangements) Act 2023

Table 2 Status of EU legislation on waste in Northern Ireland after EU exit

EU legislation	Post-EU exit status
Waste Framework Directive	Not in Annexes to the Northern Ireland Protocol; transposed regulations will apply as REUL/assimilated law unless altered/revoked
Landfill Directive	Not in Annexes to the Northern Ireland Protocol; transposed regulations will apply as REUL/assimilated law unless altered/revoked
WEEE Directive	Not in Annexes to the Northern Ireland Protocol; transposed regulations will apply as REUL/assimilated law unless altered/revoked
End-of-Life Vehicles Directive	Not in Annexes to the Northern Ireland Protocol; transposed regulations will apply as REUL/assimilated law unless altered/revoked
Industrial Emissions Directive	Continues to apply under Annex 4 of the Northern Ireland Protocol, but only with respect to the generation, transmission, distribution, and supply of electricity; no longer affects Northern Ireland's waste permits
Packaging and Packaging Waste Directive	Continues to directly apply under Annex 2 of the Northern Ireland Protocol
Batteries Directive	Continued to directly apply under Annex 2 of the Northern Ireland Protocol, until being revoked by the new Batteries Regulation
Batteries Regulation	As this replaced the Batteries Directive, it continues to apply under Annex 2 of the Northern Ireland Protocol

4.1.7 Gaps and potential weaknesses

The review of Northern Ireland's legislation on waste management and illegal disposal revealed several potential weaknesses:

- A tendency for legislative updates to lag behind the rest of the UK.
- Lags between legislation being approved and being put into force.
- A uniquely complex legislative framework after the UK's exit from the EU.
- Risks of legislative divergence with both the rest of the UK and the Republic of Ireland (ROI).

4.2 Reporting and monitoring framework

4.2.1 Overview

This section assesses the legal requirements on public authorities in Northern Ireland related to monitoring and reporting on waste management and illegal disposal. It outlines reporting requirements in the form of strategies, plans, progress reports, public registers, and data. It then presents evidence of compliance and identifies gaps and potential weaknesses.

4.2.2 Strategies and plans

A summary of legal requirements for strategies, plans and progress reports is provided in Table 3.

Table 3 Legal requirements for strategies and plans

Legislation	Reporting requirement	Evidence
The Producer Responsibility Obligations (Packaging Waste) Regulations (Northern Ireland) 2007	Regulations 31-32 require the Department to provide a report by 1 December each year, setting out its compliance monitoring plan for the coming year, including number of persons it will monitor (obligated producers, scheme operators, reprocessors, exporters).	The monitoring plan for 2023-24 was published in July 2023, 7 months later than required.
The Waste Regulations (Northern Ireland) 2011	Regulations 10-13 transposing the EU Waste Framework Directive require the Department to publish a waste prevention programme and review it at least every 6 years. The programme should include targets and indicators, if appropriate, to monitor progress.	DAERA published waste prevention plans in 2013 and 2019. The current programme does not include any quantitative targets or indicators.
The Environment Act 2021	Section 48, Schedule 2 requires the Department to publish an environmental improvement plan (EIP) and lay it before the Northern Ireland Assembly within 12 months of commencement (which was on 25 July 2022).	The draft environment strategy for Northern Ireland was published on 11 Nov 2021. As of September 2023, a final version has yet to be published and approved.
The Environment Act 2021	After the EIP has been launched, Section 48, Schedule 2 requires the Department to publish annual reports for the Northern Ireland Assembly, including data demonstrating progress under the environmental improvement plan, within 4 months of the reporting year ending.	n/a
The Climate Change Act (Northern Ireland) 2022	Part 1, Sections 13 and 18 require the Department to publish plans for the waste management sector setting out how it will achieve targets for reducing emissions by 2050 (including interim targets), and a target for 70% of waste to be recycled by 2030. The plans must demonstrate how DAERA will ensure a just transition.	n/a

Under provisions transposed from the European Waste Framework Directive and kept in place following the UK's exit from the EU, the Department is required to publish a waste prevention programme and review it at least every 6 years. It should include targets and indicators if appropriate, to enable monitoring of progress.[132] The current plan, running from 2019, does not include quantitative progress indicators.[133] It is positioned as an interim plan, prior to publication of a circular economy strategy with more ambitious targets. A draft circular economy strategy was published by the Department for the Economy in January 2023, and proposes a target to halve the nation's material footprint per capita by 2050.[134] It does not specify new targets related to waste management.[135]

Recently, the Department (DAERA) has accumulated several new reporting requirements related to waste under the UK-wide Environment Act 2021 and the Climate Change Act (Northern Ireland) 2022. The former requires it to publish an environmental improvement plan (EIP) setting out steps to be taken by itself and other departments. Unlike the parallel requirement for England, Northern Ireland's plan does not need to be time-bound and there is no requirement for legally-binding targets related to resources and waste. Nonetheless, the Department must publish annual progress reports that include monitoring data. The first EIP (or environment strategy) has been consulted on in draft form but not approved, owing to the absence of functioning political institutions.[136]

The Climate Change Act requires the Department to publish plans for the waste management sector, setting out how it will achieve new targets for emissions reductions, and for 70% of waste to be recycled by 2030, while ensuring a just transition. No time limit is set for publication of these plans.[137]

4.2.3 Public registers

Transparency of public administration of waste management is ensured through a number of legal requirements for free public registers, outlined in Table 4 along with information on how they are implemented. These registers are maintained by DAERA (in practice, the NIEA). Most requirements for registers are complied with, though details related to monitoring and enforcement are absent from the waste licensing register. There is no requirement for monitoring and enforcement information in the registers of waste carriers, dealers, and brokers. Public registers are also required in relation to producer responsibility legislation, but in practice these are maintained at UK level, with the NIEA feeding in data to UK-wide databases in the cases of packaging and batteries.

[132] The Waste Regulations (Northern Ireland) 2011
[133] DAERA (2020) Waste prevention programme 2019: Stopping waste in its tracks
[134] Because this strategy requires cross-departmental sign-off, it cannot be approved under the temporary governance arrangements in Northern Ireland. This was confirmed by Stakeholder I.
[135] Department for the Economy (2023) Draft circular economy strategy for Northern Ireland
[136] DAERA (2021) Environment strategy consultation
[137] Climate Change Act (Northern Ireland) 2022

Table 4 Legal requirements for registers

Legislation	Reporting requirement	Implementation
The Environmental Protection (disposal of Polychlorinated Biphenyls and other Dangerous Substances) Regulations (Northern Ireland) 2000	Regulations 9-11 require the Department to keep a free public register of PCB holders and inventories of contaminated equipment, specifying the quantity, origin, nature and PCB content of used PCBs.	DAERA provides guidance on registration and online forms; there is no evidence of an online register, but the regulations do not specify the required format.
The Waste and Contaminated Land (Northern Ireland) Order 1997 ("The 1997 Order")	Articles 34-46 require the Department and district councils to maintain free public registers of: - Licence holders - Applications - Exemptions - Notices issued revoking or suspending licences, or imposing requirements on licence holders - Convictions of licence holders for offences under the 1997 Order - DAERA enforcement actions	DAERA maintains free public databases of waste licence holders and exemptions from licensing, but these do not include information on notices issued, convictions, or enforcement actions.
The Waste Management Licensing Regulation (Northern Ireland) 2003	Regulations 9-10 create additional requirements for the public register of waste licences, as required under the 1997 Order. Additions include: - Monitoring information - Information on special waste - Applications for surrender of licences	DAERA's waste licence databases do not include information on monitoring, special waste or licence surrender applications.
Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations (Northern Ireland) 1999	Regulation 3 requires the Department to maintain a free public register of carriers of controlled waste.	DAERA maintains a free public database of registered waste carriers, including company names, contact names and postcodes.
The Waste Management Licensing Regulation (Northern Ireland) 2003 *(as amended)*	Regulation 22 and Schedule 4 require the Department to maintain a free public register with names and addresses of professional waste collectors, transporters, dealers and brokers.	DAERA maintains free public databases of registered waste carriers and brokers, including company names, contact names and postcodes.

Legislation	Reporting requirement	Implementation
The Producer Responsibility Obligations (Packaging Waste) Regulations (Northern Ireland) 2007	Regulation 33 and Schedule 7 require the Department to maintain a free public register of producers, schemes, reprocessors and exporters.	The Environment Agency maintains a UK-wide register with this information. Information has been uploaded to it from the NIEA during 2023.
The Waste Batteries and Accumulators Regulations 2009	Regulations 76-80 require a free public register of producers, and a list of compliance schemes, scheme operators, approved battery treatment operators and approved battery exporters.	The Environment Agency maintains a UK-wide register with this information. Information has been uploaded to it from the NIEA during 2023.
The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013	Article 33 and Schedule 16 require district councils to maintain a register of installations and mobile plants used for waste disposal (including landfills, incinerators and other facilities), including: Applications Enforcement notices Permits, as well as variation, transfer and surrender of permits Monitoring information Convictions or cautions under the 2003 Landfill Regulations	DAERA maintains free databases of permits and draft permits, with information including: Applications Enforcement notices Permit variations, transfers and surrenders Monitoring information No evidence was found of convictions or cautions.
The Waste Electrical and Electronic Equipment Regulations 2013	Regulations 77-79 and Schedule 13 require a free public register of producers, authorised representatives, schemes and scheme operators. Regulation 81 requires a public list of all approved authorised treatment facilities (AATFs), operators of AATFs and approved exporters.	In practice, this is implemented at UK level.

4.2.4 Waste data reporting

Northern Ireland's waste data reporting requirements, and what happens in practice, are summarised in Figure 3.

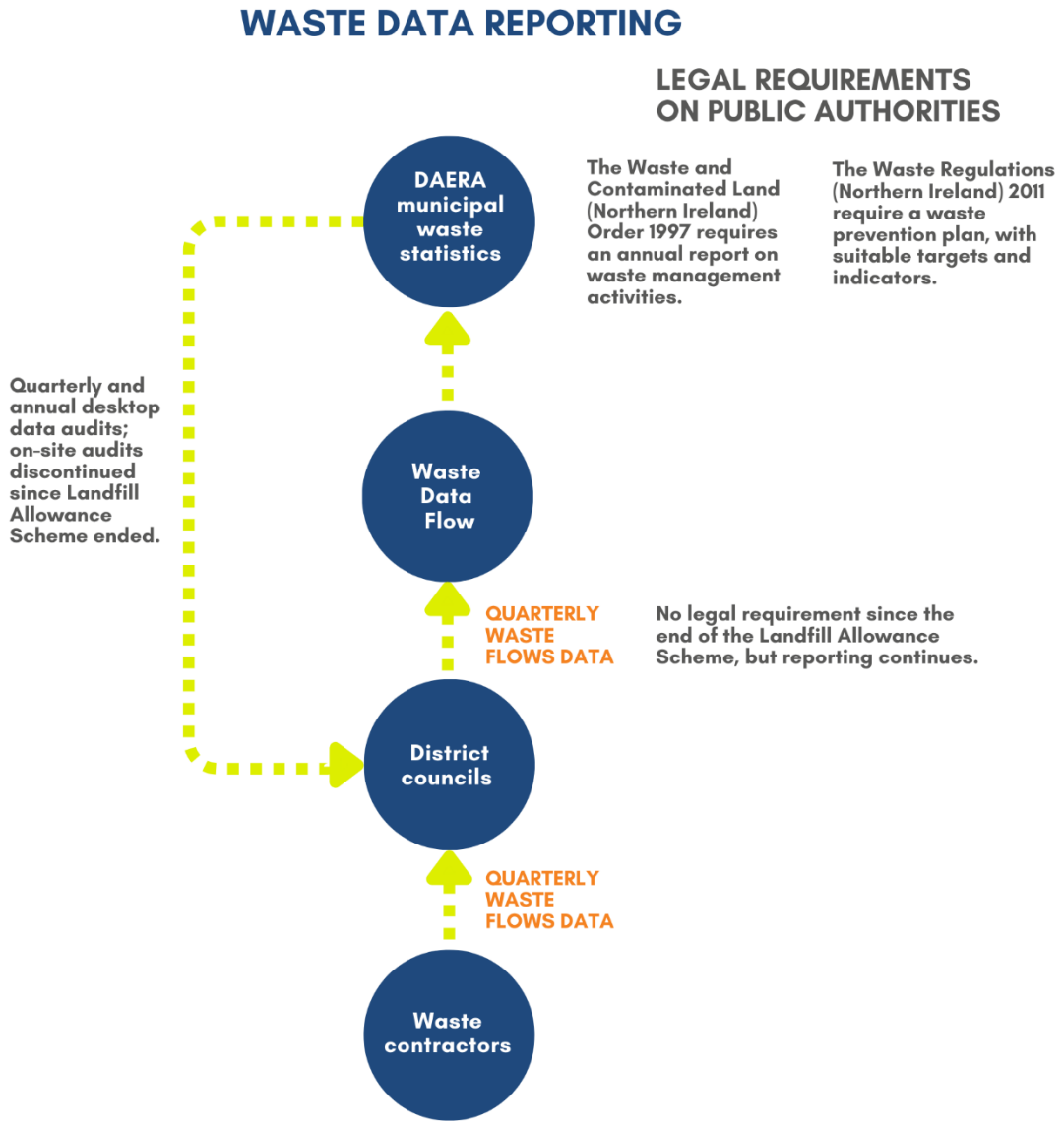

Figure 3 Waste data reporting requirements in Northern Ireland[138]

[138] Source: Stakeholder G; Resource Futures' review of waste legislation in Northern Ireland.

The Department is legally responsible for publishing an annual report on specific elements of its waste management activities, and on the implementation of district council waste plans, under the 1997 Order.[139] As Table 5 shows, the NIEA's annual report covers some of the requirements,[140] with others covered by public registers. However, no evidence was found that DAERA or the NIEA reports on the implementation of district council waste plans.

The gathering and reporting of municipal waste flows data was mandatory for landfill authorities and district councils for the duration of the Landfill Allowance Scheme, which ended in 2020-21. However, it is still reported via the WasteDataFlow database, which is publicly available.[141]

Since EU recycling targets were transposed through the Waste Regulations (Northern Ireland) 2011, the Department has been legally required to publish benchmarks (baseline data), and encouraged to publish indicators and targets, related to recycling and recovery as part of its waste prevention programme.[142]

The recycling target introduced under the Climate Change Act (Northern Ireland) 2022 will also require monitoring of recycling data. This involves reporting data on the proportion of municipal waste prepared for reuse and recycling, and on the amount of local authority collected construction and demolition waste prepared for recovery. This data is published quarterly as municipal waste management statistics. An annual report is published towards the end of the year.[143] A summary of waste statistics is also included as a chapter in DAERA's annual Northern Ireland environmental statistics report.[144]

The legal requirements on public authorities in Northern Ireland related to waste data reporting are outlined in Table 5. As in the rest of the UK, there are no requirements to collect data on commercial and industrial (C&I) waste collected by private waste management companies, nor is this data routinely collected in practice. DAERA estimated in 2016 that around 1.1 million tonnes of C&I waste were generated in Northern Ireland each year.[145]

[139] The Waste and Contaminated Land (Northern Ireland) Order 1997
[140] Northern Ireland Environment Agency annual report and accounts 2022-2023
[141] WasteDataFlow
[142] Waste Regulations (Northern Ireland) 2011
[143] DAERA (n.d.) Northern Ireland local authority collected municipal waste management statistics
[144] DAERA, the NIEA and the Northern Ireland Statistics and Research Agency (2023) Northern Ireland environmental statistics report
[145] DAERA (2019) Waste management plan for Northern Ireland

Table 5 Legal requirements for waste data reporting in Northern Ireland

Legislation	Reporting requirement	Implementation
The Waste and Contaminated Land (Northern Ireland) Order 1997	Article 37 requires publication of an annual report containing information on the action the Department and district councils are taking under Part 2 of the Order ("Waste on land"). Reports must include data on waste licenses, licensed activities, implementation of district council waste plans, number of prosecutions, incurred costs and sums received.	Some elements are reported in the NIEA's annual report. Data on waste licences and licensed activities is provided through public registers. No evidence was found of a report on implementation of district council waste plans.
The Landfill Allowances Scheme (Northern Ireland) Regulations 2004	Regulation 10 sets out requirements *during scheme operation, which concluded in 2019-2020,* for quarterly reporting of local authority collected municipal waste arisings, including: - Weight collected - Weight sent to landfill - Weight sent to other waste facilities	This data is in the WasteDataFlow database, which is freely available to the public on registration.
The Landfill Allowances Scheme (Northern Ireland) Regulations 2004	Regulation 11 requires landfill operators *during scheme operation, which concluded in 2019-2020,* to submit quarterly reports, including: - Weight of waste received - Description - Originating district and area - Treatment applied	n/a
The Waste Batteries and Accumulators Regulations 2009	Regulation 81 requires data to be published for each compliance period on batteries placed on market and collected by producers.	In practice, this is implemented at UK level.
The Waste Regulations (Northern Ireland) 2011	Regulations 10-13 require a waste prevention programme which must include benchmarks, and which may include targets and indicators to monitor progress.	DAERA published waste prevention plans in 2013 and 2019. The current programme does not include any quantitative targets or indicators.

4.2.5 Gaps and potential weaknesses

The following gaps and potential weaknesses were identified with regard to Northern Ireland's monitoring and reporting requirements on waste management and illegal disposal.

Strategies and plans:

- There have been delays to approval and publication of some reports, including the EIP required under the Environment Act 2021.
- Limitations in ambition compared to the rest of the UK: Unlike the parallel requirement for England, Northern Ireland's EIP does not need to be time-bound and there is no requirement for it to contain legally-binding targets related to resources and waste.

- There is no mandated timeframe for DAERA to publish its first plan under the Climate Change Act (Northern Ireland) 2022, which could jeopardise 2030 targets.

Public registers:

- Details on monitoring and enforcement are absent from the waste licensing register.
- There is no requirement for monitoring and enforcement information in the registers of waste carriers and brokers.
- Details of convictions and cautions are absent from the pollution prevention and control register.

Data reporting:

- Since the Landfill Allowance Scheme ended, mandatory reporting of waste flow data has been limited to indirect requirements for data in support of targets. However, there is no evidence that this has negatively affected reporting in practice.
- There are no requirements for data reporting related to illegal waste disposal or transboundary waste movements.
- There are no requirements to collect data on C&I waste collected by private companies.

4.3 Performance against targets

4.3.1 Overview

A review of waste targets in Northern Ireland was conducted to assess:

- The quality of data reporting (for tracking progress towards targets).
- Whether targets are being met.
- The ambition level of targets, compared to the rest of the UK, the ROI and the EU.

Table 6 summarises the waste management targets for which public authorities are legally responsible. There are also targets in producer responsibility legislation, but as the name suggests, responsibility for these falls to producers and so is beyond the scope of this assessment. The subsequent sections (4.3.2 to 4.3.5) explore the targets in more detail.

Table 6 Summary of waste targets in Northern Ireland

Legislation	Target	Most recent data
The Climate Change Act (Northern Ireland) 2022	For the waste management sector: - Section 1: net zero total emissions by 2050; net zero carbon emissions by 2050; methane emissions to be 46% lower than the 1990 baseline by 2050. - Section 3: carbon and methane emissions in 2040 to be on track for the 2050 targets. - Section 4: total emissions to be 48% below the 1990 baseline by 2030. - Section 18: at least 70% of waste recycled by 2030.	Total emissions 61% below baseline (2021) Recycling target not yet defined
The Waste Regulations (Northern Ireland) 2011	- By 2020: 50% by weight of waste from households is prepared for reuse or recycled. - By 2025: 55% by weight of waste from households is prepared for reuse or recycled. - By 2030: 60% by weight of waste from households is prepared for reuse or recycled. - By 2035: 65% by weight of waste from households is prepared for reuse or recycled.	49.7% (2022-23)
The Waste Regulations (Northern Ireland) 2011	- By 2020: 70% by weight of construction and demolition (C&D) waste is subjected to material recovery.	Northern Ireland: 70% (2009-10) UK: 92.6% (2020)
The Landfill (Maximum Landfill Amount) Regulations 2011	- By 2013: Tonnage of biodegradable waste sent to landfill does not exceed 320,000. - By 2020: Tonnage of biodegradable waste sent to landfill does not exceed 220,000.	126,286 tonnes (2019/20)

4.3.2 Emissions from waste

The Climate Change Act (Northern Ireland) 2022 introduced targets for greenhouse gas emissions from the waste management sector. Emissions must be at least 48% below the 1990 baseline by 2030. In 2021, they were already 61% below the baseline (Figure 4).[146] The fact that the 2030 target has already been surpassed suggests a lack of ambition in the short to medium term, and in fact these emissions have plateaued since 2014. By 2040, the sector has to be on track to reach net zero in 2050.

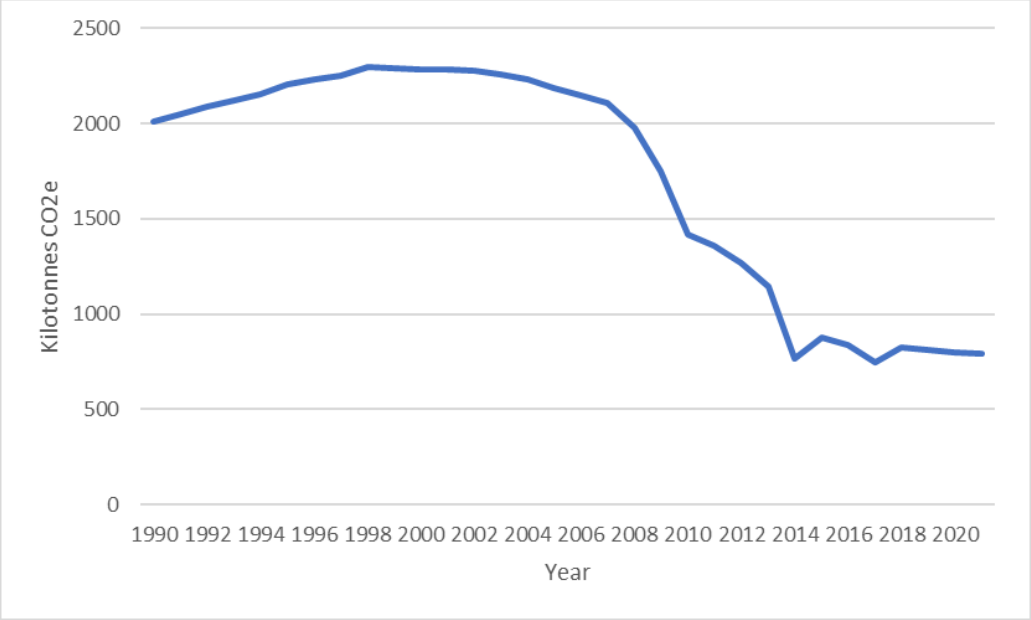

Figure 4 Emissions from the waste sector in Northern Ireland[147]

4.3.3 Municipal waste

Northern Ireland's municipal waste recycling targets were transposed from the 2008 Waste Framework Directive, and will continue as part of assimilated law. As Figure 5 shows, the 2020 target to prepare 50% of waste for reuse or recycling was met in 2018-19 and exceeded in 2019-20. However, the recycling rate fell during the Covid-19 pandemic and has since stagnated.[148] The targets for 2025, 2030 and 2035 are 55%, 60% and 65%.[149] Stakeholder B expressed doubt that Northern Ireland could reach the targets without additional infrastructure and noted that local authorities were facing challenges in receiving permission to build this. However, a 2019 study for WRAP concluded that it would be possible for Northern Ireland to reach a recycling rate of 65% in advance of 2035.[150]

[146] National Atmospheric Emissions Inventory (2023) Devolved administrations - Greenhouse gas reports
[147] National Atmospheric Emissions Inventory; data for 1991-1994 and 1996-1997 is estimated.
[148] WasteDataFlow
[149] The Waste Regulations (Northern Ireland) 2011
[150] Wrap (2019) Municipal recycling potential in Northern Ireland

By way of comparison, Wales achieved a municipal waste recycling rate of over 65% in 2021-22,[151] and has set itself a target to reach 70% by 2025, in its Beyond Recycling strategy.[152]

The Climate Change Act (Northern Ireland) 2022 set a recycling target of 70% by 2030, but does not define how this is to be measured.[153] As a result, the dictionary definition applies, which includes waste from all sources. This is a significant weakness, because by weight, construction and demolition (C&D) waste is the dominant waste stream. Across the UK, the vast majority (93% in 2020) of C&D waste undergoes low value recycling to create construction materials such as aggregate.[154] When Defra set a new target for halving residual waste per capita in England (by 2042, from 2019 levels), which is a form of recycling and reuse target, it excluded major mineral wastes.[155] According to stakeholder A, there may be future work to redefine the Climate Change Act target to focus on household waste.

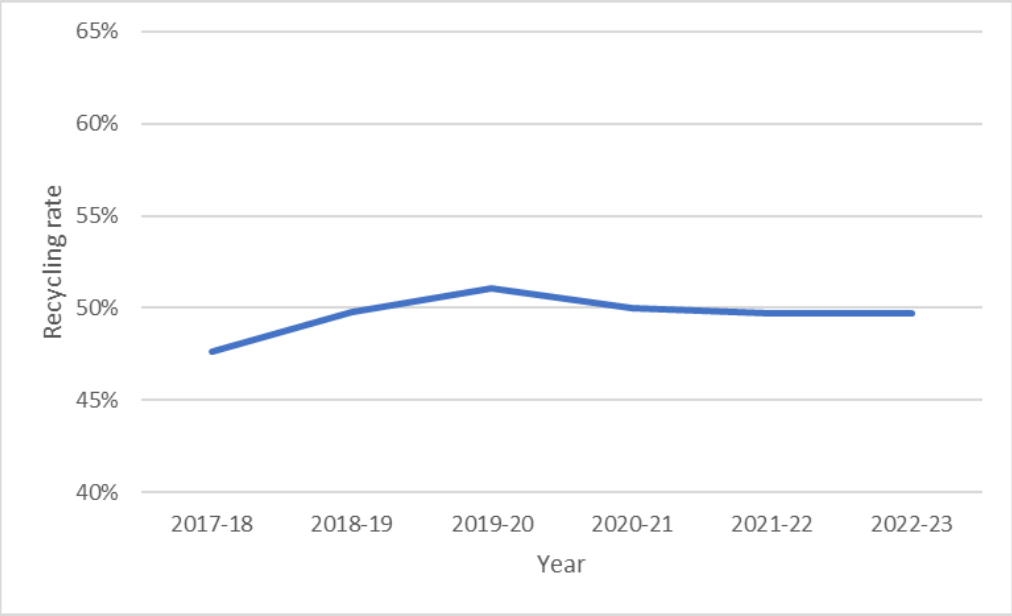

Figure 5 Northern Ireland's municipal waste recycling rate[156]

[151] Welsh Government (2023) Local authority municipal waste management: April to June 2022
[152] Welsh Government (2021) Beyond recycling
[153] Climate Change Act (Northern Ireland) 2022
[154] Defra (2023) UK statistics on waste
[155] Defra and Natural England (2022) Delivering on the Environment Act: new targets announced and ambitious plans for nature recovery
[156] WasteDataFlow, Resource Futures analysis.

4.3.4 Construction and demolition waste

Northern Ireland's C&D waste recovery target, of 70% by 2020, stems from the Waste Framework Directive.[157] Recent data for Northern Ireland is not available,[158] but UK data shows an overall C&D waste recovery rate well above the target, at nearly 93%.[159] As best practice increasingly embraces circular economy principles, where the aim is to keep materials and products in use at their highest value for as long as possible, having a basic C&D waste recovery target alone, while still the norm in most of the UK, can no longer be considered ambitious. For example, the Mayor of London has issued guidance on preparing circular economy statements related to major planning applications, which calls for pre-demolition audits in order to identify ways to save and reuse materials at higher value. It refers to the recycling of waste materials from demolition as the "least preferable option".[160]

4.3.5 Waste to landfill

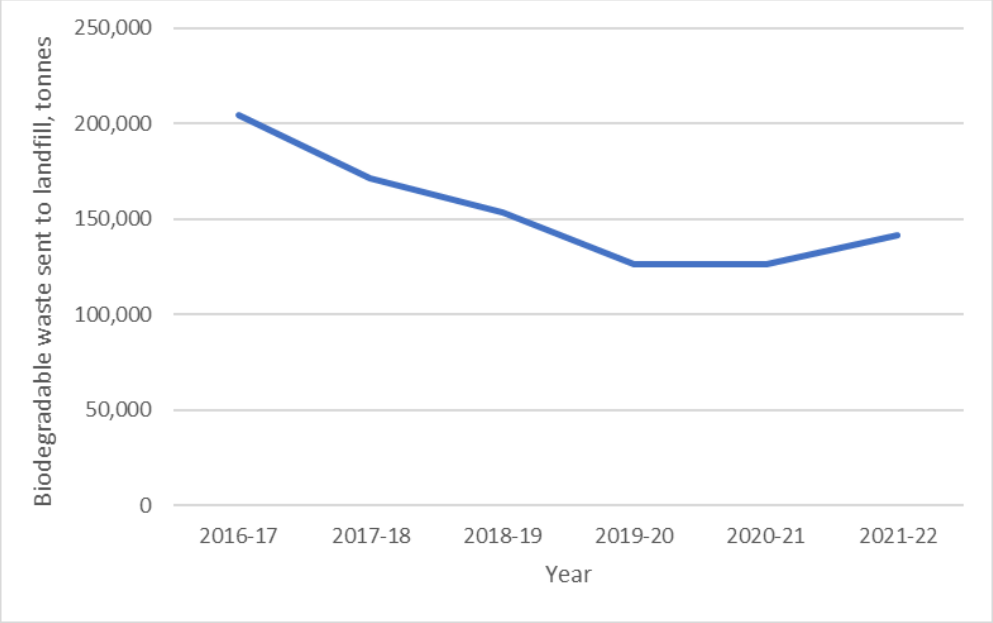

Figure 6 Biodegradable municipal waste sent to landfill in Northern Ireland[161]

Landfill targets to date have focused on reducing quantities of biodegradable waste, because it produces methane, a potent greenhouse gas (see chapter 3). Municipal biodegradable waste sent to landfill in Northern Ireland decreased each year between 2015 and 2020, outperforming the 2020 target

[157] The Waste Regulations (Northern Ireland) 2011
[158] DAERA (2011) Construction, demolition and excavation waste arisings, use and disposal in Northern Ireland 2009 -10
[159] Defra (2023) ENV23 - UK statistics on waste
[160] Mayor of London (2022) London Plan guidance: Circular economy statements
[161] DAARA; Resource Futures analysis

and reaching 126,300 tonnes in 2019-20 (see Figure 6).[162] It then plateaued for a year and increased by 12% between 2020-21 and 2021-22, to reach 141,301 tonnes.[163]

The draft Environment strategy for Northern Ireland, published in 2021, proposed a new target (which would not be legally binding) to send no more than 10% of all waste to landfill by 2035.[164] Without adequate progress on waste reduction, or increases in facilities and systems for reuse, recycling and composting, this risks having unintended consequences such as an increase in waste incineration, which could lock in infrastructure that disincentivises a circular economy. For this reason, the non-governmental organisation Zero Waste Europe has cautioned against landfill bans.[165] As mentioned above, England has opted for a target to reduce residual waste going to either landfill or incineration.

4.3.6 Gaps and potential weaknesses

The review of Northern Ireland's waste targets revealed the following gaps and potential weaknesses:

- Municipal recycling rates have plateaued, creating a risk that future targets will not be met.
- Municipal recycling targets, and current performance, are lower than in Wales.
- The recycling target in the Climate Change Act (Northern Ireland) 2022 is ineffective under its current definition.
- There are no recycling targets for C&I waste collected by private companies.
- The target for C&D waste recovery is not ambitious due to its focus on low value recycling, and there is a lack of recent data to track performance.
- A proposed target to reduce waste to landfill could have unintended consequences on waste management and ambitions for a circular economy.

[162] NIEA (2020) The landfill allowance scheme (Northern Ireland) regulations (2004) (as amended) 2019/20 Annual Report
[163] DAERA, the NIEA and the Northern Ireland Statistics and Research Agency (2023) Northern Ireland local authority collected municipal waste management statistics: Annual report 2021/22
[164] Northern Ireland Executive (2021) Draft environment strategy for Northern Ireland
[165] Zero Waste Europe (2015) Zero waste to landfill and/or landfill bans: false paths to a circular economy

5 Understanding Northern Ireland's waste management and disposal

5.1 Waste flows within Northern Ireland

5.1.1 Overview

Northern Ireland has six permitted landfill sites,[166] one industrial scale energy from waste (EfW) site (with others planned),[167] 46 authorised composting and biogas plants,[168] and in total over 10,000 organisations and individuals registered with waste licences. Many licence holders are not primarily waste management companies, for example water companies, health trusts and vegetable producers.[169]

Official statistics on municipal waste management in Northern Ireland are published quarterly, with analysis at national and district council level published annually (see section 4.2.4). The headline figures for 2021-22 show that:

- 1,034,637 tonnes of waste were collected by district councils.
- 49.7% of this was sent to be prepared for reuse, dry recycling or composting.
- 24.9% was sent to landfill.
- 23.2% was sent for energy recovery.[170]

In order to provide a more nuanced picture of how waste is collected and managed, this section presents a baseline assessment of waste flows handled by district councils in Northern Ireland. It considers district council origins, types and locations of treatment and processing activities, and end fates of the different waste streams. All data is from 2021-22. Key findings and data gaps are highlighted. The methodology for the assessment and visualisations is presented in Appendix A.

The data used, from the WasteDataFlow database, is limited to municipal waste collected by district councils from households and commercial sources such as trades and local businesses. It covers waste collected at the kerbside, received at household waste recycling centres (HWRCs), and from other sources such as highways, street sweepings and litter bins. It excludes any waste not handled by district councils (except where district councils have contracted private operators). C&I waste flow data is not available in the public domain. However, private companies which hold a waste management license are

[166] DAERA (n.d.) Regulation of landfills in Northern Ireland
[167] River Ridge (n.d.) Waste to energy; United Kingdom Without Incinerators Network (UKWIN) (n.d.) UK incinerators
[168] DAERA (2022) List of composting and biogas plants in Northern Ireland and the total tonnage processed by each plant in 2020
[169] DAERA (n.d.) Waste management licensing public register
[170] DAERA, the NIEA and the Northern Ireland Statistics and Research Agency (2023) Northern Ireland local authority collected municipal waste management statistics: Annual report 2021/22

required to record collections data and make it available to the NIEA on request.[171] Data on C&D waste is also unavailable.

The analysis in section 5.1.2 presents the waste flows from district councils to the first or interim point of treatment or processing, known as primary treatment destinations. Section 5.1.3 looks at the final destinations of waste. For instance, waste materials may first be sent to a material recovery facility (MRF) as a primary destination, in order to separate out recyclable and non-recyclable materials. These material streams will then be sent to final destinations for either recycling or residual waste treatment.

Section 5.1.4 maps the locations of primary treatment facilities, to illustrate the proportions treated domestically, sent to other parts of the UK, and exported. Section 5.1.5 maps the final treatment destinations of those materials sent by district councils for reuse or recycling, providing a more nuanced understanding of the data behind the headline recycling statistics.

5.1.2 Waste streams and primary treatment facilities

In 2021-22, waste streams collected by district councils in Northern Ireland were sent to the following primary treatment facilities:

- Organic waste was sent for in-vessel composting (IVC), open windrow composting (windrow) or anaerobic digestion (AD), with different facilities using either food waste, garden waste or a mixture of both.
- Mixed (co-mingled) recyclables were sent to MRFs, to be sorted prior to recycling. Note that separately-collected recyclables are not captured in this data, and only appear in final destination tonnages.
- Some residual waste was sent to residual MRFs for sorting prior to final disposal or recovery.
- Some residual waste was sent directly to non-hazardous landfills ("non-haz landfill").
- Hazardous waste was sent to hazardous landfills ("haz landfill").
- Some waste was treated by "other disposal" (unspecified). This is assumed to represent waste materials requiring treatment not specified above, such as road sweepings that are sent to specialised facilities for dewatering.

The Sankey diagram in Figure 7 shows the relative quantities, origins and primary treatment of these waste streams by weight.[172] The coloured ribbons represent the flows between district councils and primary treatment facilities. The thickness of each ribbon indicates the relative quantities. Figure 7 shows that:

- Waste generation broadly correlates with population: Belfast, Northern Ireland's largest city, produced the largest share (over 150,000 tonnes) of district council collected waste, and Fermanagh and Omagh, with the smallest population, generated the least.

[171] NIEA (n.d.) Waste Management License requirements in Northern Ireland
[172] Created using SankeyMATIC

- IVC facilities received the greatest proportion of waste by weight, at around 214,000 tonnes. IVCs typically process a mix of food and garden waste. Food is a relatively heavy waste stream, due to its water content.
- Non-hazardous landfill sites received the second highest proportion of waste, at around 191,000 tonnes.
- Other treatment facilities receiving relatively large proportions of waste were residual MRFs that process residual waste (nearly 144,000 tonnes) and MRFs that process mixed recyclables (around 125,000 tonnes).
- Around 149,000 tonnes of waste were sent for "other disposal".

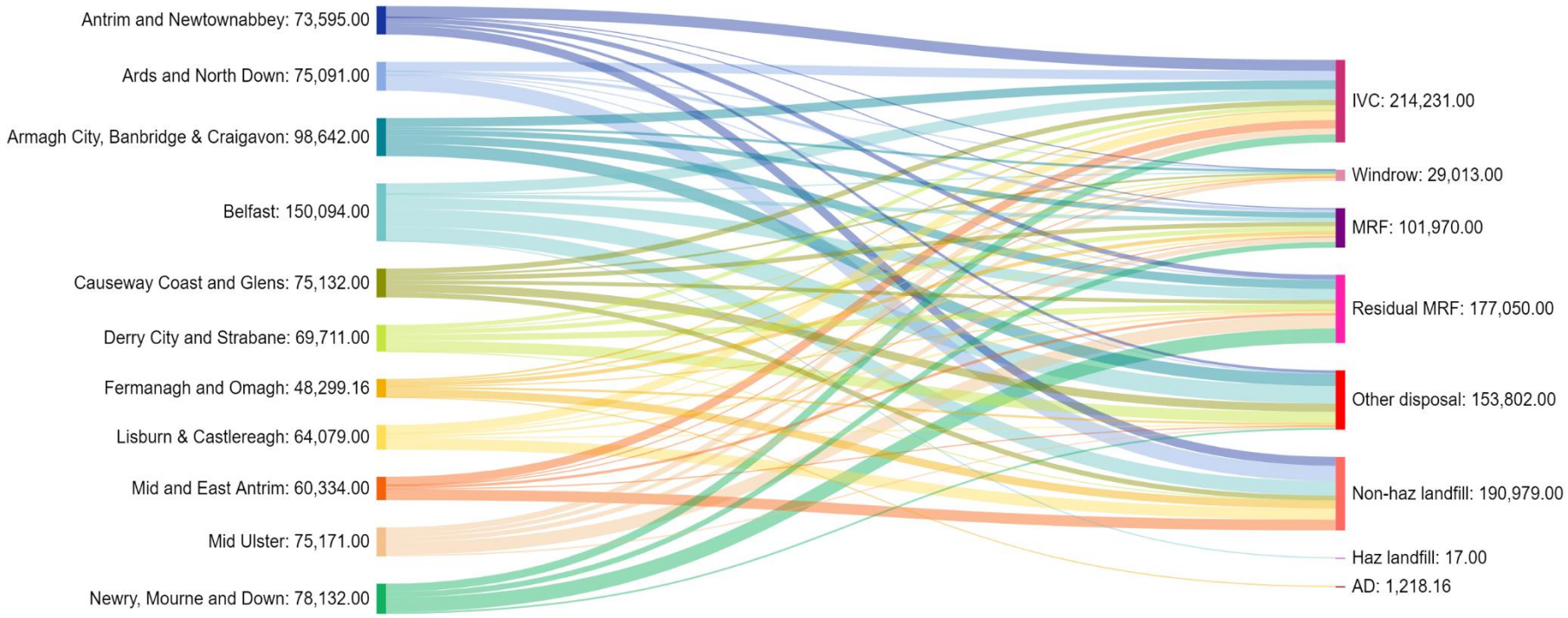

Figure 7 All district council collected waste in Northern Ireland by primary treatment type (tonnes)[173]

[173] WasteDataFlow; Resource Futures analysis

5.1.3 Final destinations of waste

A detailed analysis of data from WasteDataFlow was conducted to determine the full journey, from primary treatment to final destination, of waste collected by district councils. Individual Sankey diagrams for each district council are provided in Appendix B.

The way data is reported can make it difficult to trace precise waste pathways. For example, the data suggests that after high quality materials are extracted from mixed recyclables at MRFs for onward recycling, the rejected materials are sent to residual waste treatment facilities such as landfills or incinerators. However, Stakeholder C noted that rejects from these MRFs typically undergo further sorting at residual MRFs before being sent for final disposal.

District councils report some of their waste as being sent to an unspecified category of "other disposal".[174] No further details are available about the composition of this waste. The data suggests that some of this undergoes further recovery, recycling and disposal, while a proportion remains unaccounted for. This missing quantity has been categorised as "unspecified fate" in this analysis. Via WasteDataFlow's helpdesk function, it was found that the tonnages going to "unspecified fate" may reflect, in part, process losses. For instance, road sweepings sent to dewatering facilities lose moisture, and consequently tonnage. Given the uncertainty, tonnages reported under "other disposal" and "unspecified fate" represent gaps in reporting.

When comparing municipal waste data across council areas, Stakeholder C observed that it is important to take into account that some councils collect significant amounts of commercial waste and others do not.[175] This affects the quantity and types of waste. Other factors that commonly play a role are the level of deprivation (higher deprivation tends to equate to lower levels of engagement with recycling schemes); the share of rural population (rural areas produce more organic waste); and the types of collection service provided (such as separate or mixed recycling collections).[176]

The analysis in this section and Appendix C, therefore, provide a baseline understanding of waste generation and management trends, rather than a detailed comparison of waste management performance.

The analysis showed that:

- Newry, Mourne and Down sent the highest proportion of mixed recyclables to MRFs. This was lowest for Mid and East Antrim. This reflects the dominance of mixed recycling collections in the former area, and of separate collections in the latter.

[174] Reported under WasteDataFlow Q65: How many tonnes of waste were disposed of by any other method not covered elsewhere? (See Table 14 in Appendix A for full list of questions analysed.)
[175] Belfast (27%) and Causeway Coast and Glens (13%) collect the highest proportions of non-household waste, with Ards and North Down (7%) and Mid Ulster (7%) collecting the lowest. This includes residual waste classified as commercial and industrial, construction and demolition, and other materials for recycling and reuse.
[176] Insights from Resource Futures, based on extensive experience of waste composition analysis across the UK.

- Newry, Mourne and Down sent the greatest share of residual waste to residual MRFs, while Fermanagh and Omagh sent the lowest.
- Of the waste sent to residual MRFs, Antrim and Newtownabbey saw the largest share being recovered for recycling (60%). However, the authority also sends significant quantities of overall waste collected directly to non-hazardous landfills.
- Ards and North Down sent the highest proportion of waste directly to non-hazardous landfills, followed closely by Belfast, which suggests that there is scope for these areas to increase recycling through changes to collections or increased recovery at MRFs.
- Belfast was the only authority that sent waste to hazardous landfill (17 tonnes).
- Antrim and Newtownabbey sent the most organic waste to IVCs (around 28,700 tonnes) and Fermanagh and Omagh sent the least (around 4,900 tonnes).
- Overall, organic waste tends to be sent for composting rather than AD in Northern Ireland. Fermanagh and Omagh was the only area to make use of AD facilities for organic waste, and it used this method for a minority (1,218 tonnes) of its organic waste management.
- Belfast reported the greatest proportion of "other disposal". Of this, 77% was recovered.[177]

5.1.4 Waste mapping: primary treatment

Primary treatment locations are the first or interim stages of waste flow, where district council waste is pre-treated or processed in preparation for subsequent or final treatment. The locations of primary treatment facilities were mapped to identify the proportions of district council collected waste treated in Northern Ireland, sent to other UK locations, or exported to locations outside the UK (EU and non-EU).[178]

On the maps, treatment facility locations (broken down by district, or rest of the UK as a whole) and the quantities of waste they handle are shown using pie charts (Figure 8). The size of the pie chart represents the quantity of waste. The map shows that:

- Nearly all waste undergoes primary treatment within Northern Ireland. Of the quantities reported via WasteDataFlow, only 0.06% is sent to other locations in the UK, primarily for "other disposal" (482 tonnes), with a small share (4 tonnes) to hazardous landfill.
- No district council generated waste from Northern Ireland is sent outside the UK for primary treatment.
- Facilities located in Lisburn and Castlereagh, Causeway Coast and Glens, and Antrim and Newtownabbey treat most waste. Two of these border Belfast district area.

[177] Details of the recovery method are not provided as part of the reporting in WasteDataFlow.
[178] WasteDataFlow data was used as the source for waste mapping.

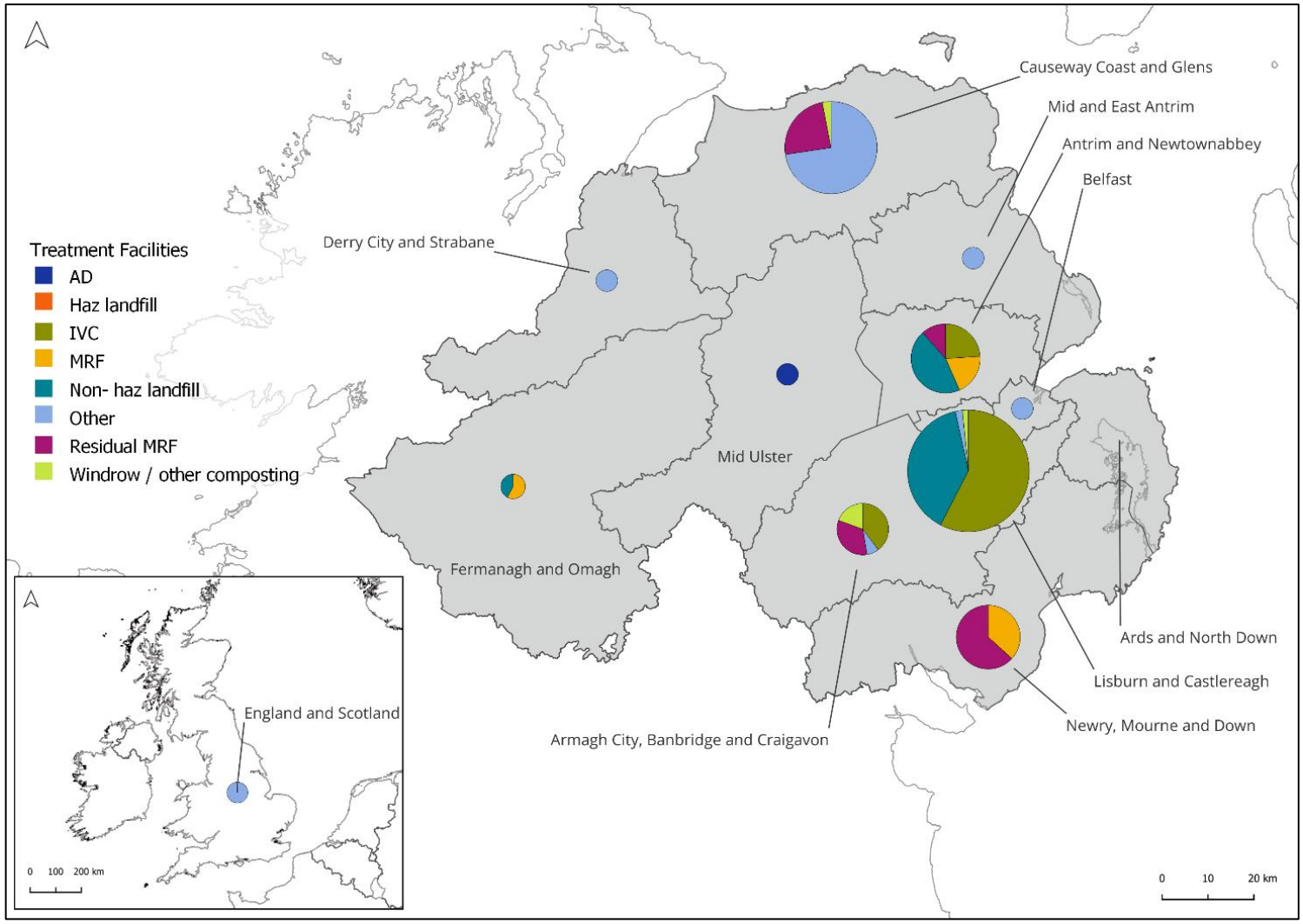

Figure 8 Primary waste treatment locations in Northern Ireland

5.1.5 Waste mapping: final treatment of recyclables and reusables

This section assesses the final destinations of materials collected by district councils for recycling and reuse. These are assumed to be either the last stops or the point at which national reporting systems stop tracking the waste flows originating in the country. Stakeholder C observed that destinations reported as final may sometimes include the primary point of sorting, or the waste exporter, instead of the destination to which the waste is exported. The stakeholder noted that NIEA is aware of the issue and encourages those reporting to note the export destination.

Recycling: The materials reported as sent for recycling include a) those collected at the kerbside or brought to HWRCs for recycling, and b) those recovered from residual waste at MRFs. Figure 9 shows the amount of recycling originating from each source. Certain district councils, such as Belfast, recover a greater share from residual waste than others. It is hard to draw conclusions regarding waste management performance from this data. In general, separately-collected recyclables that have not been part of the residual waste stream result in higher value recycling as they are less contaminated by items such as food or sanitary waste typically found in residual waste streams. This is important in supporting the development of markets for secondary materials.[179,180]

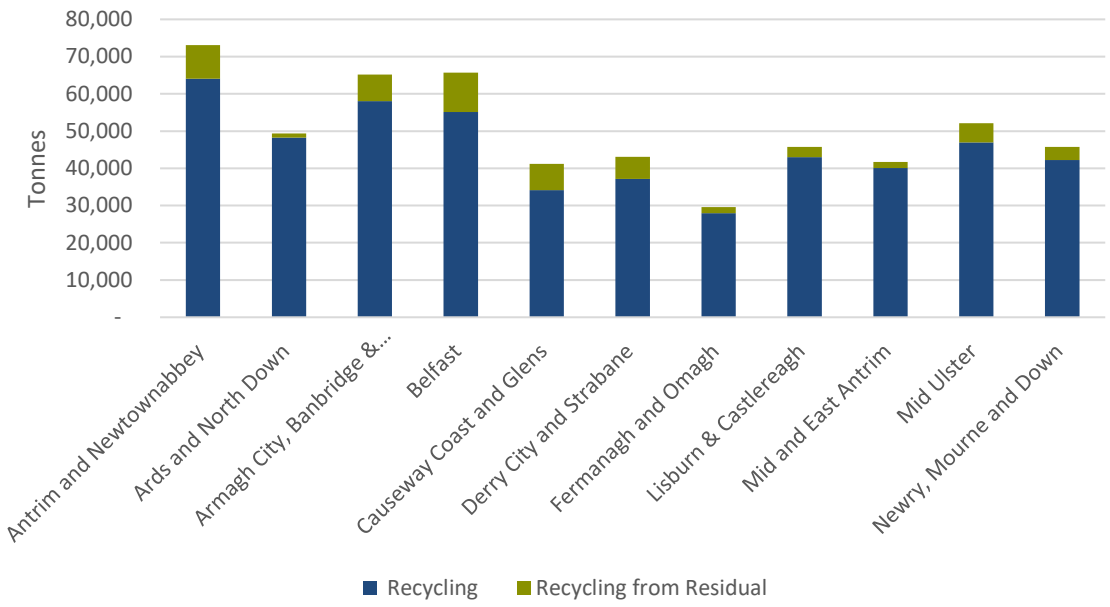

Figure 9 Recycled waste derived from recycling and residual collections in Northern Ireland[181]

[179] Zero Waste Europe (2020) Harmonisation of waste separate collection across Europe
[180] OECD (2022) Global plastics outlook: Economic drivers, environmental impacts and policy options – Chapter 4: Trends in the secondary plastics markets
[181] WasteDataFlow; Resource Futures analysis

Figure 10 shows the quantities of these materials sent to final destinations in Northern Ireland, the rest of the UK, and EU and non-EU locations. No further details on destinations were available from WasteDataFlow. Some waste is reported as being sent to unspecified destinations. The data shows that:

- The majority of waste collected by councils was treated or processed within Northern Ireland.
- Mid Ulster exported the largest share to beyond the UK. A majority of this was sent to the EU.
- Armagh City, Banbridge and Craigavon, and Newry, Mourne and Down sent the highest quantities to non-EU locations.
- Belfast sent the highest proportion of waste to other locations in the UK for recycling.
- There are some data gaps, with a small share of materials reported as sent to unspecified locations from Antrim and Newtownabbey (415 tonnes), Lisburn and Castlereagh (113 tonnes), Mid and East Antrim (2 tonnes) and Belfast (0.01 tonnes).

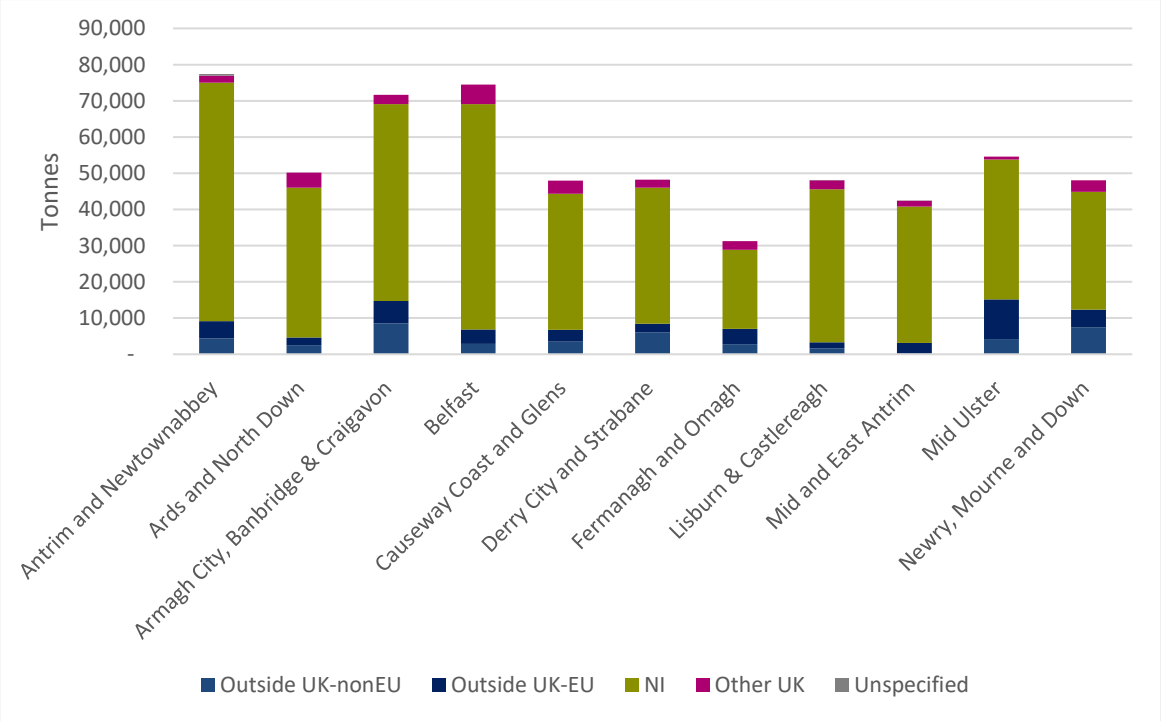

Figure 20 Final destinations of materials collected for recycling in Northern Ireland[182]

[182] WasteDataFlow; Resource Futures analysis

Reuse: Figure 11 presents data on the final destinations of materials sent for reuse. Overall, the tonnages sent for reuse are very small compared to recycling quantities. They mainly comprise textiles (85%, 3,771 tonnes), along with smaller quantities of bicycles (15%, 554 tonnes), books, furniture, electrical and electronic equipment, paint, bric-a-brac and wood.

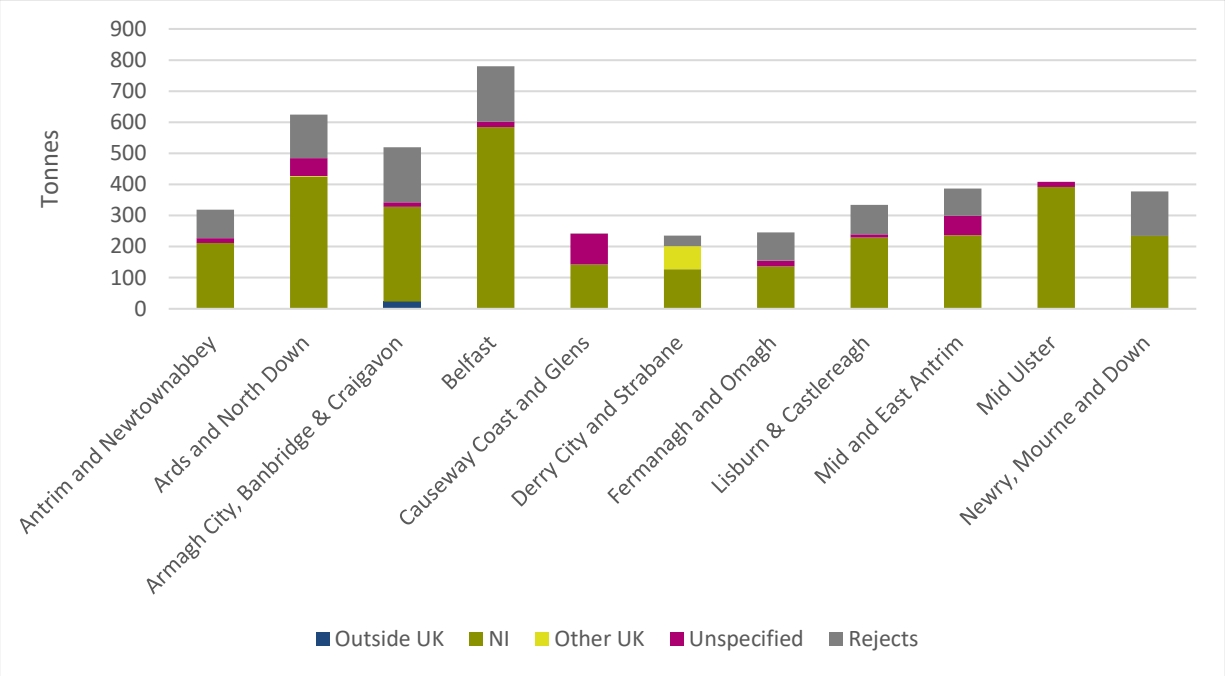

Figure 31 Final destinations of materials collected for reuse in Northern Ireland[183]

The data shows that:

- Some materials collected for reuse were rejected and sent for recycling, incineration, or landfilling. As a proportion of the total material collected for reuse, Newry, Mourne and Down (38%) and Fermanagh and Omagh (37%) produced the highest shares of rejects.
- Mid Ulster, and Causeway Coast and Glens produced less than 1% rejects.
- A majority of items sent for reuse were retained for this purpose within Northern Ireland. Most were textiles.
- Armagh City, Banbridge & Craigavon was the only authority to export reusable items beyond the UK. This was all textiles and was sent to locations in the EU.
- No non-EU locations were reported as reuse destinations for any council origin waste. However, textiles initially exported to the EU may be traded and re-exported to other parts of the world. The EU exports a large quantity of textiles each year to Asia and Africa, where some is reused or recycled, and some ends up in landfill.[184]

[183] WasteDataFlow; Resource Futures analysis
[184] European Environment Agency (2023) EU exports of used textiles in Europe's circular economy

- There are some data gaps, with most district councils (except Derry City and Strabane and Newry, Mourne and Down) reporting some proportion of reusable items sent to unspecified locations (recorded as 'Other/Exempt' or 'Charity/Exempt'). This ranges between 14.8 tonnes from Antrim and Newtownabbey to 99.6 tonnes from Causeway Coast and Glens.

5.2 Transboundary waste flows

The import and export of waste to and from Northern Ireland is regulated by the NIEA.[185] The UK plan for shipments of waste states that imports and exports of waste for disposal are prohibited in most cases, except for hazardous waste generated in and moving between Northern Ireland and the ROI.[186] Movements of waste for recovery and recycling are permitted, in line with the principles of the Basel Convention (see section 4.1.4).

Data for waste received and removed from sites which report to the NIEA under a licence or permit condition for the period 2017 to 2021 was compiled through direct request to DAERA. The dataset quantifies the amount of inbound waste, including household and commercial waste, received at each facility each year by waste type, using European Waste Catalogue (EWC) classifications, and by place of origin. For waste removed from sites, the dataset quantifies the amount of outbound waste by EWC code and destination. For waste transferred within Northern Ireland, area information is provided at council level, whereas imports and exports are defined only by 'Republic of Ireland', 'Other UK', and 'Other world'. This indicates a lack of granularity in reporting of transboundary waste movements at this level. It should be noted that the end destinations of household waste reported through WasteDataFlow as leaving Northern Ireland are classified as 'Rest of UK', 'EU' and 'Rest of world'.

5.2.1 Waste imports or waste received

As shown in Table 7, the majority of waste received at permitted sites in Northern Ireland is domestic, but around 12% originates from the ROI. Less than 2% of waste is received from elsewhere in the UK, of which the majority is mixed municipal waste. Only a trace amount is received from the rest of the world, of which the largest share is waste wood. Transboundary waste received increased between 2017 and 2021, with an increase in the quantities arriving from the ROI, rest of the UK and rest of the world.

[185] DAERA (2021) The transfrontier shipment of waste
[186] Department for Environment, Food and Rural Affairs (2021) UK plan for shipments of waste

Table 7 Waste (household and commercial) received by origin area 2017-2021[187]

Origin of received waste	Tonnes and % of total waste received				
	2017	2018	2019	2020	2021
Northern Ireland (%)	91.7%	90.6%	89.7%	88.7%	86.6%
Northern Ireland (tonnes)	5,132,995	5,778,289	5,769,736	5,626,426	6,250,740
Republic of Ireland (%)	7.3%	7.7%	9.0%	9.8%	11.5%
Republic of Ireland (tonnes)	405,869	492,804	575,911	624,053	830,574
Other UK (%)	1.1%	1.6%	1.4%	1.2%	1.7%
Other UK (tonnes)	59,084	99,374	87,407	77,456	123,101
Other world (%)	0.0%	0.1%	0.0%	0.3%	0.1%
Other world (tonnes)	51	4,051	721	18,531	10,273
Total (%)	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Total (tonnes)	**5,597,999**	**6,374,517**	**6,433,774**	**6,346,465**	**7,214,688**

Figure 12 provides a breakdown of the types of waste (by EWC code) received from the ROI in 2021. The description of each EWC code is provided in Table . Around 26% was from separately collected fractions of municipal waste, of which the majority was food waste sent for composting. 24% of the waste received was from the mechanical treatment of waste, sent for various recovery processes.

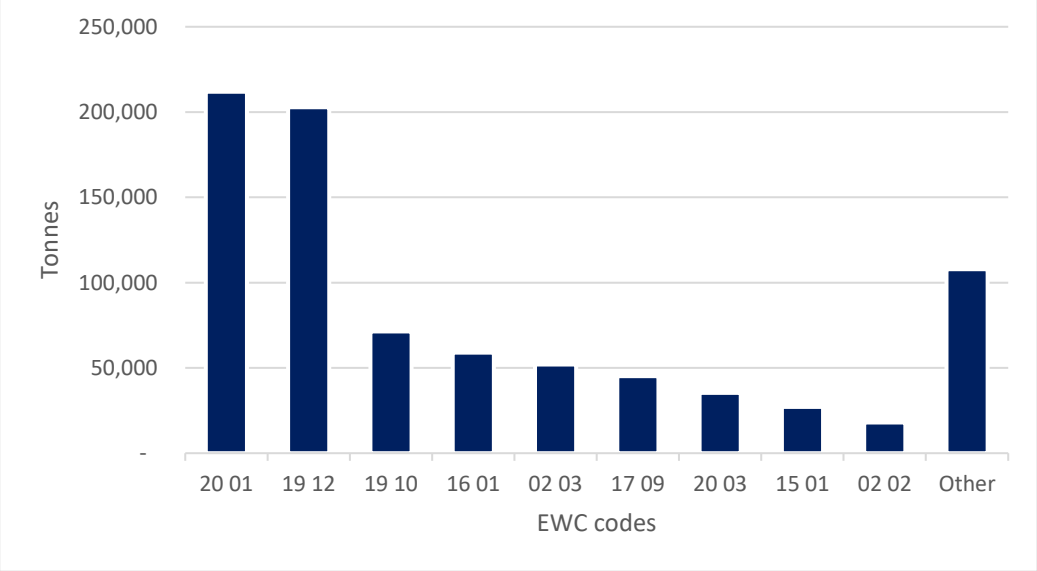

Figure 42 Waste received from the Republic of Ireland in 2021[188]

[187] DAERA; Resource Futures analysis
[188] DAERA; Resource Futures analysis

Table 8 EWC code legend for Figure 4 with descriptions

EWC code	Description
20 01	Separately collected fractions of municipal waste
19 12	Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising)
19 10	Wastes from shredding of metal-containing wastes
16 01	End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle maintenance
02 03	Wastes from fruit, vegetables, cereals, cocoa, coffee, yeast, tea and tobacco preparation and processing
17 09	Other construction and demolition wastes
20 03	Mixed municipal waste
15 01	Packaging (including separately collected municipal packaging waste)
02 02	Wastes from the preparation and processing of meat, fish and other foods of animal origin

5.2.2 Waste exports or waste removed

Table 9 shows that while the majority of waste originating in Northern Ireland is removed to destinations within Northern Ireland (72-75%), there has been an increase in the proportion of waste sent to the rest of the world, rising from 17% in 2017 to 19% in 2021.

Table 9 Waste (household and commercial) removed by destination area 2017-2021[189]

Destination of removed waste	Tonnes and % of total waste removed				
	2017	2018	2019	2020	2021
Northern Ireland (%)	75.1%	75.1%	75.1%	74.6%	72.0%
Northern Ireland (tonnes)	2,701,038	2,859,655	3,006,000	2,908,288	3,109,954
Republic of Ireland (%)	2.1%	2.2%	2.4%	2.1%	2.4%
Republic of Ireland (tonnes)	76,027	82,237	96,594	82,919	105,662
Other UK (%)	5.7%	6.1%	6.3%	6.5%	6.2%
Other UK (tonnes)	203,365	231,430	252,470	252,097	267,234
Other world (%)	17.1%	16.7%	16.2%	16.8%	19.4%
Other world (tonnes)	614,215	636,244	646,910	654,992	837,100
Total (%)	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Total (tonnes)	3,594,644	3,809,566	4,001,974	3,898,295	4,319,950

[189] DAERA; Resource Futures analysis

Figure 13 gives a breakdown of waste (by EWC code) sent to the rest of the world from Northern Ireland in 2021. The relevant EWC code descriptions are provided in Table 10. 67% was from the mechanical treatment of waste, which includes significant quantities of refuse-derived fuel (RDF) intended for incineration.[190]

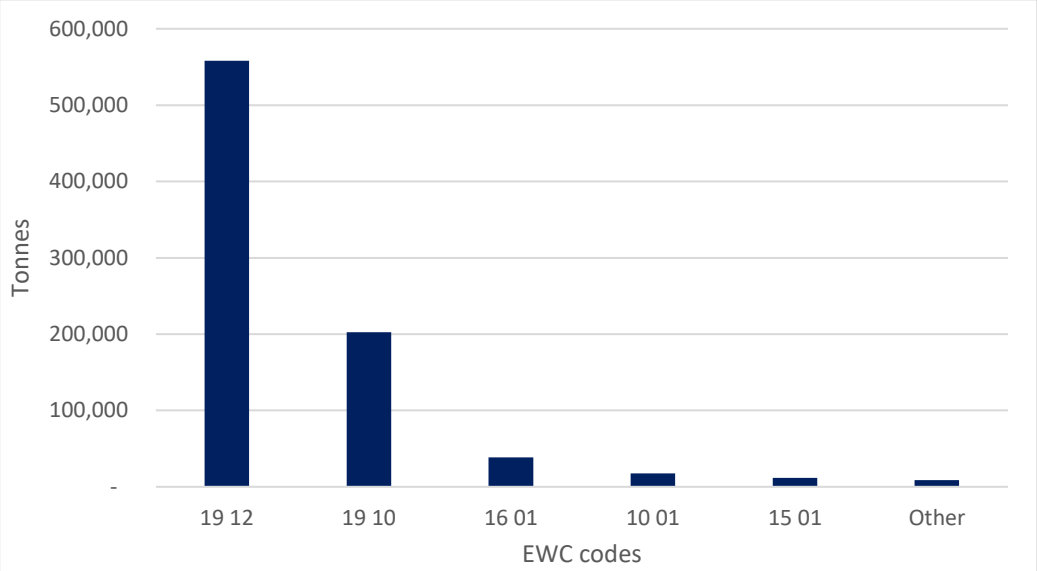

Figure 13 Waste sent to the rest of the world (tonnes), by type[191]

Table 10 EWC code legend for Figure with descriptions

EWC code	Description
19 12	Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising)
19 10	Wastes from shredding of metal-containing wastes
16 01	End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle maintenance
10 01	Wastes from power stations and other combustion plants
15 01	Packaging (including separately collected municipal packaging waste)

More granular data on destinations of exported waste in 2022-23, by waste type, were published by DAERA in response to a Freedom of Information request.[192] This data is illustrated in Figure 14.[193] It shows that the majority of waste was exported as RDF to Scandinavia, a region which has in the past invested heavily in energy from waste (incineration) facilities. This situation is likely to change in the coming decade. As part of its transition to a low-carbon, circular economy, Denmark has committed to

[190] RDF is a form of combustible waste which has been shredded and pre-treated, and is typically sent for incineration.
[191] DAERA; Resource Futures analysis
[192] DAERA (2023) Details of imported and exported waste for Northern Ireland for 2022/23
[193] DAERA also publishes yearly data RDF exports: DAERA (2023) Export Records for RDF Shipped from Northern Ireland

reducing its incineration capacity by 30% between 2020 and 2030.[194] Sweden is also looking at how to reduce its emissions from waste incineration.[195]

Figure 14 also shows that a significant tonnage of waste (115,185 tonnes) was sent to the ROI, of which 60% was solid recovered fuel (SRF), a more refined waste-derived fuel. The rest was a mixture of materials including shredded clinical waste, mechanically treated waste and oil waste.

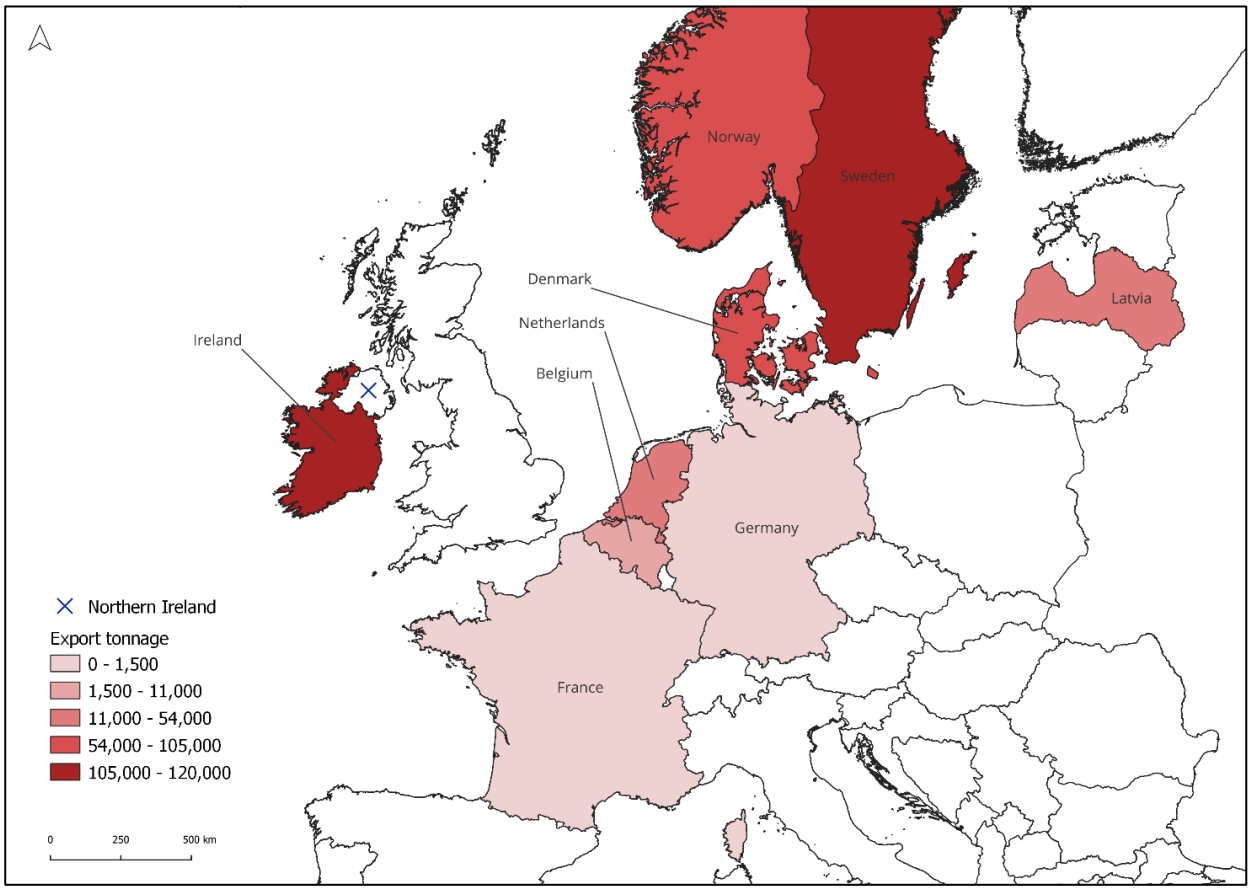

Figure 14 Waste exports from Northern Ireland, 2022-23

5.3 Illegal waste flows

Information on illegal waste flows in Northern Ireland is limited. Gaps in information were supplemented where possible through interviews and desk based research.

[194] Ministry of Environment of Denmark (2021) Action plan for circular economy
[195] Ministry of Environment of Sweden (2020) Sweden's long-term strategy for reducing greenhouse gas emissions

5.3.1 Illegal dumping within Northern Ireland

Information in WasteDataFlow on illegal waste disposal is limited to the number of reported fly-tipping incidents and the quantity of fly-tipped waste cleared by district councils. Reporting by district councils is voluntary and the approach is not standardised.[196] According to Stakeholder D, at present different councils take different approaches to reporting fly-tipping data. The draft Environment strategy for Northern Ireland includes an action to improve and standardise the process for data recording on fly-tipping and other forms of illegal disposal.[197]

According to Stakeholder D, under agreements between the NIEA and seven out of eleven district councils, incidents involving less than approximately 20m^3 of non-hazardous waste are dealt with by councils, while larger waste crime incidents, and any involving hazardous waste, are dealt with by the NIEA. The NIEA does not publish data on the waste it clears.

If fly-tipping is not reported, occurs on private land, or is cleared by private waste management companies, it goes unrecorded. Incidents of illegal landfilling or burying of waste only tend to appear in the public domain when they appear in the media. An investigative article by *The Detail* in 2016, based on Freedom of Information requests, official reports, and direct questions to public authorities, reported two million tonnes of illegally disposed waste since 2006, and the burning of 400,000 tyres at recycling plants between 2009 and 2015.[198]

Table 11 presents data on fly-tipping incidents in 2021-22, as reported by district councils via WasteDataFlow. No information is available on waste types. Stakeholder D noted that many items fly-tipped would have been accepted for bulky uplifts by district councils, or at local HWRCs. The illegal disposal of tyres is a particular problem in Northern Ireland.

Table 11 District council fly tipping data, 2021-22

District council	Quantity of fly-tipped material cleared (tonnes)	Number of incidents reported
Antrim and Newtownabbey	101	658
Ards and North Down	14	227
Armagh City, Banbridge & Craigavon	-	755
Belfast	7,764	4,672
Causeway Coast and Glens	-	341
Derry City and Strabane	23	2,591
Fermanagh and Omagh	15	194
Lisburn & Castlereagh	30	-
Mid and East Antrim	-	463
Mid Ulster	-	69
Newry, Mourne and Down	-	-

[196] The legislative review did not identify any requirements on public authorities to report illegal waste disposal.
[197] Northern Ireland Executive (2021) Draft environment strategy for Northern Ireland
[198] Campbell, C (2016), Waking up to waste: How Northern Ireland's waste problem could leave a toxic legacy, The Detail

Belfast recorded the highest number of fly-tipping incidents (4,672) as well as the largest quantity of fly-tipped material (7,764 tonnes). This was significantly higher than other authorities, with the second highest quantity of waste cleared by Antrim and Newtownabbey (101 tonnes). No data was reported by Newry, Mourne and Down, and data appears to be incomplete for six out of eleven district councils.

Another important form of illegal disposal is the intentional or unintentional misclassification of waste. This can involve, for example, the misclassification of hazardous waste as non-hazardous, and its subsequent disposal in non-hazardous landfill.[199] Data was not found on the extent of misclassified waste. The introduction of mandatory digital waste tracking is expected to make it easier to address this problem.[200]

5.3.2 Transboundary illegal dumping

Information on illegal transboundary movements of waste is even more limited. Stakeholders D and E suggested that more waste moves illegally from the ROI to Northern Ireland than vice versa, though no data was available to confirm this. According to stakeholders D and F, waste fuel laundering from the ROI to Northern Ireland poses a significant problem. Fuel is smuggled across the border due to differences in duty rates.[201] Criminals will remove the marker dyes from red/green diesel, which is not intended for use in road vehicles, to sell as fuel to motorists and the residual waste is often dumped.[202] HM Revenue and Customs (HMRC) works with the NIEA to tackle this issue. More information on illegal transboundary movements of waste is provided in section 5.4.

5.4 Drivers of illegal waste activity

5.4.1 Drivers of domestic waste crime

5.4.1.1 Overview

Northern Ireland faces many of the same conditions that drive illegal waste activity in the rest of the UK, particularly when it comes to fly-tipping. However, when it comes to more serious and organised waste crime, the political and governance situation in Northern Ireland, and the land border with the ROI, have created additional opportunities. [203,204]

[199] Chartered Institution of Wastes Management (CIWM) and the Environmental Services Association (ESA) (2017) A guide to the misclassification of waste and how you can avoid it
[200] Chartered Institution of Wastes Management (CIWM) (2023) Position statement: Digital waste tracking
[201] UK Parliament (2011) Committee announces inquiry into fuel laundering and smuggling
[202] Agenda NI (2012) Fuel laundering waste crime in Northern Ireland
[203] Brennan, C (2016) The enforcement of waste law in Northern Ireland: Deterrence, Dumping and the Dynamics of Devolution
[204] Interview with Stakeholder D.

The issue of serious waste crime in Northern Ireland has faced greater scrutiny since 2013, when large-scale illegal activity was discovered at the Mobuoy site, near Derry/Londonderry. Over 1 million tonnes of waste was dumped near to the Faughan River, which supplies drinking water to the city.[205] The environment minister at the time commissioned Christopher Mills, a former Director of the Welsh Environment Agency, to review drivers of waste crime in Northern Ireland and make recommendations for strategies to tackle them.[206]

This section looks at the drivers of waste crime in Northern Ireland, the solutions that have been proposed, and the extent to which those solutions have been implemented.

5.4.1.2 Drivers

The following **drivers of fly-tipping** were identified by drawing on a recent UK-wide review by Defra, along with stakeholder interviews to understand their relevance in Northern Ireland.

- **Barriers to accessing HWRCs**, such as a lack of storage facilities, a lack of vehicle ownership, cost of disposal, and perceived queues. These barriers often disproportionately affect people from low-income households.[207] They affect Northern Ireland less than other parts of the UK, as HWRCs in Northern Ireland tend to accept a broader range of wastes, including trade waste if it originates from households, without additional cost.[208]
- **Insufficient awareness of regulations** related to the duty of care on those holding waste, and waste carrier licences. Citizens do not understand their duty of care. Without the knowledge that they should check whether waste carriers are certified, and that they should be asking for waste transfer notes, citizens are vulnerable to illegal operators.[209]
- **Difficulty identifying and prosecuting offenders.** People are unlikely to report fly-tipping to authorities or act as a witness, which makes it difficult for authorities to catch and identify offenders. Furthermore, district councils often lack the resources to investigate and impose sanctions.
- **District council responses to fly-tipping may be perceived as legitimising the crime by collecting the waste quickly**. District councils may feel the need to do this to prevent an area being seen as a legitimate space for fly-tipping, to reduce the environmental and amenity impacts of waste, and to investigate the crime quickly. For this reason, fly-tipping investigation tape was introduced in London boroughs.[210]
- **Fly-tipping is profitable**, which encourages individuals and organised crime networks to become established in waste operations.

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[205] Tetra Tech (2023) Mobuoy Remediation Project - Remediation Options Appraisal
[206] Mills, C (2013) A review of waste disposal at the Mobuoy site and the lessons learnt for the future regulation of the waste industry in Northern Ireland
[207] Purdy R et al. (2022) Fly-tipping: Drivers, deterrents and impacts
[208] Interviews with Stakeholder C and D.
[209] Purdy R et al. (2022) Fly-tipping: Drivers, deterrents and impacts
[210] LGC Idea Exchange (2022) Our innovative interventions cut fly tipping by 42%

- **A lack of data** makes it difficult to develop strong responses to the issue.

Some of these drivers, particularly the profitability of waste crime, and the difficulty in identifying and prosecuting offenders, also lead to organised waste crime of a larger scale. The Mills report, along with other investigations which took place in the wake of the Mobuoy revelations, identified the following **drivers of serious and organised waste crime:**

- **Maladministration by public authorities and regulatory deficiencies**.[211, 212] A lack of regulatory structure and weak enforcement prevent a robust response to criminal activity, which criminals can easily exploit. [213]
- **Insufficient checks when issuing waste management permits, licences and registrations.** The 'fit and proper person' test, designed to assess the suitability and competence of a person looking to become a waste carrier, or to manage a site, is not sufficient to screen out criminal actors. The Mills report noted that the test fails to consider any unofficial intelligence linking actors to criminal activity, and has outdated provisions related to technical competency. It also highlighted a need to monitor financial provision.[214]
- **A waste carrier registration system which is insufficient to track waste flows,** meaning it is easy to move and conceal waste. The use of season tickets is particularly problematic.[215]
- **It is easy for criminals to advertise their service online.** Online platforms allow unregistered companied to advertise their services without scrutiny. This issue applies across the UK.[216] It is estimated that over 284,000 businesses could be operating in waste transportation without registration in the UK.[217] Online platforms generally do not conduct background checks, with 74% of waste collection adverts on Gumtree from unregistered companies.[218] Advertising while unregistered is not illegal.
- **Fines are insufficient to deter crime.** The polluter pays principle, where the person responsible for the damage must pay for it, is not applied through any legislation to those convicted of waste crime. Fines are set according to the Proceeds of Crime Act 2002 (POCA), which aims to recover the profit gained by the offender from the illegal activity.[219] Such fines cannot be set at a level that also covers clean-up operations. A 2018 independent review of waste crime in the UK found that POCA fines presented an insufficient deterrent.[220] This was echoed by a 2022 report

[211] BBC (2023) BBC Radio 4 podcast reveals officials 'broke the law' over secret million-tonne dump
[212] LetsRecycle (2013) Organised waste crime damaging N. Ireland
[213] Brennan, C (2016) The enforcement of waste law in Northern Ireland: Deterrence, Dumping and the Dynamics of Devolution
[214] Mills, C (2014) A review of waste disposal at the Mobuoy site and the lessons learnt for the future regulation of the waste industry in Northern Ireland
[215] Mills, C (2014) A review of waste disposal at the Mobuoy site and the lessons learnt for the future regulation of the waste industry in Northern Ireland
[216] Purdy, R (2023) Waste crime: how online advertising platforms are facilitating illegal dumping
[217] Purdy, R (2023) Waste crime: how online advertising platforms are facilitating illegal dumping
[218] Purdy, R (2023) Waste crime: how online advertising platforms are facilitating illegal dumping
[219] Proceeds of Crime Act (2002), Part 4
[220] Noel, L (2018) Independent review into serious and organised crime in the waste sector

by the House of Commons Committee of Public Accounts.[221] The Mills report found that the deterrent was even weaker in Northern Ireland, with POCA fines typically lower than in the rest of the UK.[222] Media reporting on a case in 2022 suggested that fines were still too low and did not cover the profits gained from illegal dumping.[223]

5.4.1.3 Potential solutions

The 2014 Mills report made a large number of recommendations with a view to strengthening the legislative framework and its enforcement.[224] Following the Mobuoy revelations, the Northern Ireland Assembly called for a public inquiry into illegal waste disposal in 2014. However, this was ruled out by the Minister of Agriculture, Environment and Rural Affairs in 2020. The Minister stated that the focus was on implementing the recommendations in the Mills report.[225,226]

On request, DAERA provided information on the implementation of the twelve 'key recommendations' in the Mills report. (This does not cover every recommendation in the report.) A summary of this is provided in Table 12, below. Most actions relate to the period from 2014 to 2016, though some are noted as ongoing.

No evidence was found that legislative changes had been made in response to the Mills report, nor that changes had been made to waste reporting and monitoring systems. However, the NIEA is currently exploring electronic waste tracking systems in collaboration with Zero Waste Scotland. In 2023, a fine of £236,554 was issued to a person who had kept and disposed of waste in a manner likely to cause pollution and without a licence, along with a sentence of three years' imprisonment if this was not paid within three months.[227]

[221] House of Commons Committee of Public Accounts (2022) Government actions to combat waste crime
[222] Mills, C (2014) A review of waste disposal at the Mobuoy site and the lessons learnt for the future regulation of the waste industry in Northern Ireland
[223] Bradfield, P (2022) Critics challenge DAERA over deterrent value of £1k NIEA fine for illegal dumping of 14,000 tonnes of controlled waste in south Armagh, News Letter
[224] Mills, C (2014) A review of waste disposal at the Mobuoy site and the lessons learnt for the future regulation of the waste industry in Northern Ireland
[225] Blackwood et al (2020) The cross-cutting nature of a public inquiry into illegal waste disposal in Northern Ireland, EJNI Briefing No.2
[226] BBC (2020) Mobuoy dump: Minister rules out public inquiry
[227] Dennis, P (2023) £236,554 confiscation order issued for waste criminal in NI, Circular

Table 12 Actions taken in response to the Mills report[228]

Recommendation	Actions taken
The Department should make the outcome of a waste sector that complies with the law, protects the environment and underpins resource efficiency, a priority.	Waste identified as a priority within the Department, and restructuring carried out.
Develop a comprehensive strategy, with a detailed action plan, to achieve this outcome, which initially focuses on preventing waste crime.	Operational waste strategy developed, with aim of achieving a compliant and crime-free waste sector.
Create a new single Directorate within NIEA, to bring together the existing regulatory and enforcement teams along with a new Intelligence Unit, to achieve this outcome.	New Assessment Unit set up; monthly operational meetings held between teams responsible for inspection, permitting and enforcement.
Adopt and develop the concept of "intelligent regulation" in order to be sufficiently adaptive to deal with a range of operators, from the criminal to the compliant; and consider employing in-house legal expertise and a waste industry analyst.	Principles incorporated into NIEA vision for regulatory transformation; outcome regarding in-house expertise is unclear.
Change the current appointment and recruitment processes to allow the targeted recruitment and appointment of staff with the right aptitudes, skills and experience to carry out regulatory work. This should be supported by structured training, professional development and a defined career structure.	Skills gap analysis conducted, with the outcomes influencing a new training programme and staff induction programme.
Review in an integrated way the need for additional powers to carry out this work by means of a Task and Finish Group and involving all relevant Department units, including Planning, with legal support and input from the Police Service Northern Ireland. Includes reviewing exemptions in the waste management licensing regime,[229] and crime-proofing new legislation.	Task and Finish Group submitted a report to the chief executive of the NIEA. Exemption review group established to develop evidence for legislative change.
Make it harder for waste to fall into the hands of criminal operators by strengthening the duty of care provisions, fit & proper person test and systems for monitoring and analysing waste flows—including a mandatory electronic tracking system for waste transfer notes, and an urgent overhaul of the NIEA's waste data collection.	Exemption review group established to develop evidence for legislative change. Joint local/central government group established to oversee robust and transparent waste management and

[228] Information provided directly by DAERA, September 2023
[229] DAERA (n.d.) Waste management licensing exemptions

Recommendation	Actions taken
	monitoring. NIEA currently supporting Zero Waste Scotland on initial project scoping related to electronic waste tracking.
Limit the number of waste authorisations to the number necessary to meet Northern Ireland's projected waste needs and create the necessary new strategic waste infrastructure which can be more easily regulated and monitored.	Exemption review group established to develop evidence for legislative change.
Make changes to the current planning enforcement policy to no longer allow the granting of retrospective planning permission for sand and gravel workings.	Department for Infrastructure published guidance in 2016, clarifying enforcement powers and responsibilities of district councils with regard to planning permission.[230]
Work through the Department of Justice to persuade the judiciary of the seriousness of waste crime, not just to the environment but to the economy of Northern Ireland, and to encourage them to ensure that sentencing for these offences is comparable to that of the rest of the UK. Includes using POCA to increase the financial penalties for waste crimes, and raising public awareness.	The Department of Environment submitted a response to the Department of Justice consultation on "The Law on Unduly Lenient Sentences". Ongoing efforts to convey the seriousness of waste crime to the courts. Ongoing engagement with HMRC.
Create a new sanction in the legislation to make the polluter pay to remediate or remove illegally deposited waste. In the meantime, explore making more use of the Environmental Liability (Prevention and Remediation) Regulations (NI) 2009 to make polluters pay.	The NIEA liaised with the Attorney General's Office; both agreed to examine the usefulness of the Environmental Liability Regulations and the appropriateness of civil action.
Ensure that the Department works more closely with other government departments and agencies in Northern Ireland, with the other environment agencies in the UK and Ireland and through relevant European organisations and initiatives, in order to combat waste crime and create a resource efficient Northern Ireland. Includes crime-proofing new legislation.	The NIEA developed coordination mechanisms with their counterparts in the rest of the UK focused on waste crime; international law enforcement agencies including Interpol; Police Service Northern Ireland; and other government agencies including HMRC.

[230] Department for Infrastructure (2016) Overview of planning enforcement responsibilities

5.4.2 Drivers of transboundary waste crime

There is little publicly-available information on illegal waste exports from Northern Ireland. However, it is important to note that unlike in England and Wales, exporters in Northern Ireland are required to submit Annex VII forms (similar to a waste transfer note) to the Environment Agency, meaning that waste exports from Northern Ireland are better monitored.[231]

Section 5.3.2 demonstrated the limits on data tracking of exported data. Once the waste leaves Northern Ireland, it may be re-exported by a range of brokers, part of a major global industry which encompasses both legitimate organisations and serious and organised crime.[232] The Northern Ireland based exporter usually has little knowledge of the final destination of their waste.

Drivers of illegal waste exports are largely economic, and include:

- **Access to cheap disposal in destination countries.** Under the Basel Convention, waste should only be exported for environmentally-sound management. However, there are strong economic incentives for high-income countries to export waste for management in lower-income countries, particularly where governance is weak. Waste exported with the right intentions may be mishandled by organised criminals involved in the global waste trade.[233]
- **Insufficient scrutiny when issuing packaging export recovery notes (PERNs).** PERNs are used as evidence that packaging waste has been exported for recycling. The current PERN system has been criticised for a lack of transparency and opportunities for fraudulent issuing.[234] This is particularly problematic in the case of exports of mixed recyclables. Plastics commonly contain more than 30% of non-target material,[235] and these are dealt with in some countries by open incineration and dumping. Planned amendments to the PERN regulations at UK level include increased reporting to improve transparency, and new operator competence tests to improve performance, reduce fraud and increase confidence in the system.[236]
- **High landfill costs and the closure of landfill sites in the ROI** drove an increase in transboundary illegal disposal in Northern Ireland in the early 2000s.[237] However, landfill fees have not increased in the ROI since 2013,[238] and Stakeholder D confirmed that this incentive has decreased over time.
- **The introduction of 'pay as you throw'** (also known as 'direct variable charging', DVC) in the ROI could become a driver of illegal disposal. A survey of district council representatives from

[231] United Kingdom Government (2018) Independent review into serious and organised crime in the waste sector
[232] Circular (2023) A criminal waste – what is going on with waste crime?
[233] Circular (2023) A criminal waste – what is going on with waste crime?
[234] UK Government (2022) Reforms to the Packaging Waste Recycling Note (PRN) and Packaging Waste Export Recycling Note (PERN) System and Operator Approval Consultation Document
[235] Non-target materials are those which are not targeted for recycling by the recipient waste management company.
[236] Ecosurety (2023) Understand changes to the PRN/PERN system
[237] Reid, L (2004) Illegal NI dumps had waste from South, The Irish Times
[238] Commission on Taxation and Welfare (2021) Information note on landfill levy in Ireland

across the UK, including Northern Ireland, found evidence of concern that without a centrally-coordinated approach, DVC could drive illegal disposal across district council boundaries.[239] The same risk exists across the ROI-Northern Ireland border. However, Stakeholder E noted that weight-based DVC, where waste is weighed at the point of collection and when it is received at facilities, also makes illegal disposal harder, as it enables additional tracking of waste data.

- **Different fuel duty rates in Northern Ireland and the ROI** leads to fuel laundering, as discussed in section 5.3.2.[240] Red/green diesel is laundered from the ROI to Northern Ireland, owing to lower duties in the ROI. The dye is removed and then the fuel is sold as standard road diesel. The by-products of this dye removal process, which are hazardous, are often placed into large containers and illegally dumped. According to Stakeholder E, the most severe cases have involved lorries stacked with these containers.[241]
- **Regulatory divergence following the UK's withdrawal from the EU** could further incentivise illegal waste movements between Northern Ireland and the ROI or the UK. One example of potential divergence, involving batteries regulations, is discussed in section 4.1.5. Any differences in waste regulations that make it cheaper to dispose of waste in one jurisdiction could increase opportunities for waste crime. At the same time, mechanisms for cooperation across the Northern Ireland-ROI boundary to tackle waste crime are being reduced, for example with the UK leaving the European Arrest Warrant scheme.[242]
- **Limited capacity for legal waste disposal** within Northern Ireland. Stakeholder D noted that domestic waste infrastructure, including landfills, was insufficient for future needs. With emerging waste streams, such as solar panels, batteries, and wind turbines set to increase, the risk of unsound and illegal disposal could rise—with an associated loss of valuable resources—unless appropriate infrastructure and plans are put in place.

5.5 Gaps and potential weaknesses

Section 5 went beyond the legislative review in Section 4, to build a picture of waste management in Northern Ireland in practice. It revealed a number of gaps in data reporting, as well as potential weaknesses in the waste management system. **Data gaps** include:

- There is a lack of waste flows data on commercial and industrial waste, and construction and demolition waste.
- Significant quantities of waste are sent to unspecified destinations.

[239] Eunomia (2023) EUROCHARGE – Waste collection: to charge or not to charge?
[240] Agenda NI (2012) Fuel laundering waste crime in Northern Ireland
[241] Interview with stakeholder E
[242] Gravey, V (2017) Brexit and the environment: Challenges and opportunities for the UK and Northern Ireland, Queen's University Belfast, Queen's on Brexit, Briefing paper 1

- Data on waste sent for primary treatment does not include separately-collected recyclables. This represents a gap in mapping the interim flows of material, though these waste streams do appear in final destinations data.
- Data on final destinations of waste may be inconsistently reported, for example recording the location of an interim sorting point or exporter of waste, rather than the final export location. Data on waste exports may be undercounted as a result.
- Information on the specific destinations of waste exported beyond the UK is not readily available in the public domain.
- There is no legal requirement for district councils or other entities to report waste crime data.
- Reporting methods for fly-tipped waste cleared by district councils are inconsistent, and data appears to be incomplete.
- Data on the types of waste fly-tipped is not reported.
- Data on larger scale and hazardous fly-tipping incidents cleared by the NIEA is not in the public domain.
- No data is reported or gathered on illegal disposal that is not managed by public authorities.

Potential weaknesses in waste management include:

- A significant quantity of waste collected by district councils is reported as being sent directly to landfills, without undergoing sorting to extract items for reuse and recycling.
- Some local authorities rely more heavily than others on residual waste MRFs to extract recyclable materials. This typically results in lower value recyclables than waste collected separately for recycling.
- There is scope for reuse to be scaled up, to include a wider range of materials, and to be managed in such a way as to reduce the proportion of rejects in some areas.
- In recent years, a rising quantity of waste has been brought into Northern Ireland for management.
- A majority of waste exports beyond the UK comprise RDF to feed incinerators in Scandinavia. With the destination countries seeking to reduce their emissions from waste incineration, there will be more pressure in the coming decade to reduce these exports or find alternative destinations.
- There is no requirement for exporters to track, and take responsibility for, the fate of waste beyond its first destination.
- Waste management infrastructure within Northern Ireland will be insufficient within the five to ten years, and additional infrastructure is likely to be required.

6 Best practice in waste management and illegal waste disposal

6.1 Key features of best practice

There is no single way to define best practice in waste management. Waste management systems are expected to fulfil multiple functions, including recovery of resources, safe disposal of waste, public health, environmental protection, and climate mitigation.[243] The emphasis varies by jurisdiction, depending on policy priorities as well as geographic and socioeconomic characteristics.

A fully circular economy—where materials never become waste and nature is regenerated—is generally regarded as the highest standard for waste management. No jurisdiction has achieved this to date, though many countries have introduced policies aimed at circularity and waste prevention.[244] These include measures aimed at changing product design to enable reuse, repair and remanufacturing; digitally tracking products and materials; avoiding the use of environmentally harmful substances; regenerative farming; and finding ways to reduce and recycle organic waste.[245] By moving towards a circular economy, waste quantities can be reduced, along with the environmental and public health risks associated with waste management and illegal disposal.

Looking more narrowly at waste management, best practice can be summarised as efficient and comprehensive waste collection services, high recycling and reuse rates, and low levels of waste crime. Policies and strategies may seek to achieve this through:

- Strong evidence-based leadership from a principal government agency.
- A cross-cutting strategy to see waste as a resource, benefiting economically from secondary materials.
- Developing a culture of collaboration across government, local authorities and other stakeholders.
- Effective prevention of waste crime and enforcement of legislation.
- Compliance with the Basel Convention on transboundary waste movements.
- Applying the 'polluter pays' principle to deter environmentally harmful activities.
- Efficient collections from households and businesses.
- Economic incentives such as landfill tax and 'pay as you throw' (or DVC) that support the waste hierarchy.
- A consistent approach to collections, labelling and public messaging.
- Planning policy that supports the overall waste strategy and anticipates future needs.
- Using the best available technologies and methods to treat waste while minimising nature loss, pollution and emissions.
- Ensuring workplace health and safety.

[243] Campitelli, A and Schebak, L (2020) How is the performance of waste management systems assessed globally? A systematic review, in Journal of Cleaner Production, Vol. 272
[244] Chatham House (n.d.) CircularEconomy.earth
[245] Ellen MacArthur Foundation (n.d.) What is a circular economy?

The following section looks at best practice in waste management, with a focus on recycling rates, environmentally sound waste management, and reduction of waste crime. In order to demonstrate different aspects of best practice, examples are provided from the UK and elsewhere in the world. The following case studies were selected from locations which have the following characteristics in common with Northern Ireland:

- High-income countries, or sub-national jurisdictions within them.
- At least one metropolitan area with population of 100,000 - 500,000.
- Rural areas with low population density.

6.2 Examples of best practice

6.2.1 Flanders, Belgium

Flanders has the highest waste diversion rate in Europe, at 73%,[246] and is commonly named in circular economy best practice case studies.[247]

- **Landfill and incineration restrictions** were implemented in 1998 and 2000, respectively. There are bans on both landfill and incineration of certain types of waste, including unsorted waste. Landfill levies make incineration the preferred route for final disposal of residual waste, and for items which can be recycled, levies further prioritise recycling.[248] Incineration and landfill taxes are used to fund environmental subsidies for municipalities, which enable them to better manage waste, for example by funding recycling parks.
- **DVC measures have been implemented to increase recycling.** From the 1990s, the population of Flanders became opposed to landfilling and incineration due to difficulty identifying new locations for waste treatment facilities.[249] DVC strategies were introduced to drive up recycling. Graded taxes are applied to different waste types. Residual waste is most expensive, followed by organics, then plastic bottles, metal packaging and drinks cartons. Paper and card, glass and textiles are free.
- **Digital waste tracking for DVC limits the potential for illegal disposal.** Each bin is microchipped and weighed on collection. This makes it more difficult for waste to go missing.
- **Composting is widely promoted.** Thousands of volunteers were trained to support home composting, which increased considerably.
- **Intermunicipal cooperation has increased efficiency.**[250] Municipalities in Flanders collaborate to develop regional waste management plans, which set goals and targets to be met by

[246] Allen, C (no date) Flanders, Belgium: Europe's best recycling and prevention program
[247] UNEP (2020) Belgium, on its way towards a circular economy
[248] Regions for Recycling (2014) Flanders: landfill and incineration policy
[249] Regions for Recycling (2014) Good practice Flanders: PAYT
[250] VVSG (2017) Local authorities and public service delivery in Flanders

individual municipalities as well as the region. These waste management plans are a statutory responsibility and are developed with the support of the public waste agency, OVAM.

- **There are clear responsibilities for waste data collection.**[251] There is a clear data management process which shows responsibilities along the chain, and states points for validation and assessment of progress towards targets (see Figure 15Figure).
- **There is cross-area benchmarking and collaboration.** A benchmarking tool is available for Flemish municipalities, for sharing waste management practices and results.[252] The tool demonstrates which policy indicators are linked to high performance,[253] supporting further policy development.

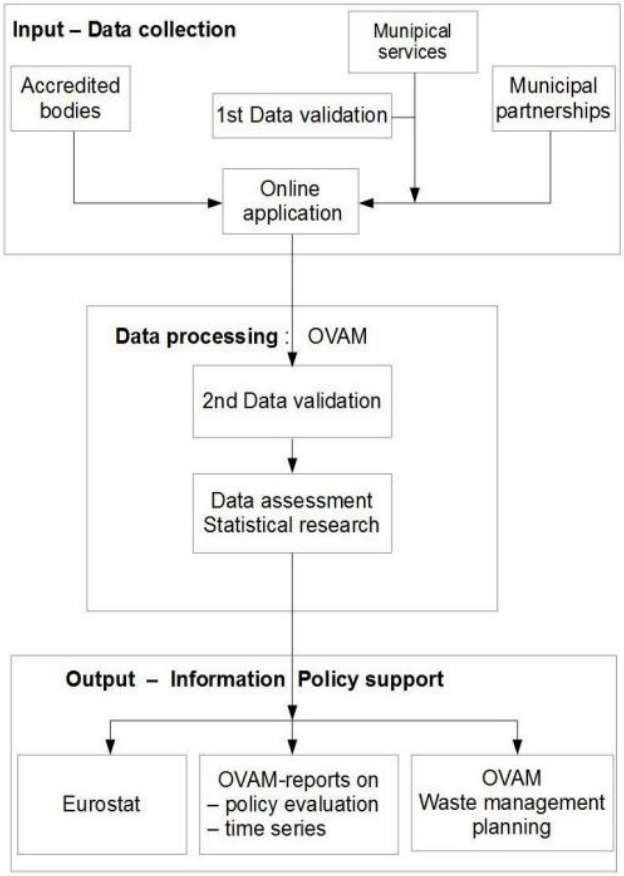

Figure 15 Data management of municipal solid waste in Flanders[254]

[251] Interreg Europe (2017) Waste management in Flanders, Belgium
[252] EURELCO (2014) Country Report - Flanders
[253] Association of Cities and Regions for Sustainable Resource Management (2022) OVAM Benchmark tool helps municipalities with their waste, materials and soil policy
[254] Interreg Europe (2017) Waste management in Flanders, Belgium

- **There is evidence that Belgium actively tackles waste crime**. In 2019, three previous directors of a company which had operated a site for waste storage and processing were prosecuted for storing over 100,000 tonnes of waste without authorisation. The managers were all sentenced to imprisonment and fines totalling €15 million, as well as ordering the removal of the waste. This penalty was given in line with Article 5 of the 2008 Waste Framework Directive, which requires "effective, proportionate and dissuasive criminal penalties" for environmental crimes.[255] In Flanders, data is routinely collected on the amount and costs of illegal dumping, and the sorting analysis of illegal dumping.[256]

6.2.2 Wales

Wales has made rapid strides to achieve one of the highest recycling rates in the world. In 2002-03 in Wales, only 10% of waste collected by local authorities was recycled or composted, making it one of the worst in Europe for waste management.[257] In 2017, Wales ranked second in the world for recycling municipal waste, with a rate of 63.8%.[258]

- **The Welsh Government invested £1 billion to support local authorities to improve waste management.[259]** Rather than representing an increase in costs, this was a transfer of costs from local authorities to central government. This allowed the latter to assert a consistent approach to recycling by enforcing a collections blueprint.[260]
- **Weight-based statutory targets** have motivated increased recycling rates, along with the threat of financial penalties against councils which miss their targets.[261]
- **Increased collaboration between the Welsh Government and councils** has assisted in making recycling methods more consistent and encouraging participation.[262]
- **Political prioritisation of improved waste management and increased recycling** has enabled Wales to surpass other UK nations.[263] The Welsh Assembly is one of the few administrations in the world to have promotion of sustainable development as a statutory duty.[264]

[255] European Commission (undated) Selected national cases on prosecuting waste crimes - Belgium
[256] European Environment Agency (2023) Waste prevention country profile Belgium
[257] Friends of the Earth (2003) Zero Waste in Wales
[258] Laville, S (2017) Wales is second best household waste recycler in the world, The Guardian
[259] Welsh Government (2022) New stats: Why is Wales an outlier in UK recycling rates?
[260] Welsh Government (undated) Collections blueprint
[261] Wales Audit Office (2018) Waste management in Wales: Municipal Recycling
[262] Wales Audit Office (2018) Waste management in Wales: Municipal Recycling
[263] Wiliams, I and Phillips, J (2022) Leading the world: a review of household recycling in Wales
[264] Welsh Assembly Government (2009) One Wales: One Planet

6.2.3 The Republic of Korea

In 1995, the Republic of Korea recycled 2% of its food waste, but it now reportedly recycles 95%.[265] It took action to change this when landfills began approaching capacity. It has since implemented a series of plans and a legislative framework that has been improved and expanded over time. Food waste is recycled into biogas, animal feed or fertiliser.[266,267]

- **Organic waste to landfill was banned in 2005, and a mandatory composting scheme introduced.**[268]
- **A 'pay as you throw' approach is used, with several methods of payment.** Some residents purchase specific bags to dispose of their food waste. The bags are collected from the kerbside most days.[269] In Seoul, large apartment blocks use machines to weigh food waste, which communicate with RFID technology on the bins to identify the residents and add to their bill.[270,271,272]
- **Large food producers bear the costs of treating their food waste.**[273]
- **The cost of recycling food waste is split between income from 'pay as you throw' systems, sales revenue from producing animal feed, and government subsidy.**[274]
- **Korea's recycling policies were evaluated yearly in the early years, and repeatedly amended to overcome problems.**

6.2.4 Germany

Germany operates a successful deposit return scheme (DRS).

- **The DRS supports both recycling and reuse.** Fees are graded to encourage higher return and recycling of single-use items, and greater reuse of reusable containers.
- **All retailers must offer takeback,** regardless of whether the product was purchased in their store.
- **Germany's DRS is the largest in the world, giving the benefit of economies of scale.**[275] It includes glass, metal and plastic items.[276] In implementing this 'all-in' DRS, Germany has normalised the return and recycling of containers, achieving high recycling rates.

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[265] Broom, D (2019) South Korea once recycled 2% of its food waste. Now it recycles 95%, World Economic Forum
[266] Kim, M (2022) South Korea has almost zero food waste. Here's what the US can learn, The Guardian
[267] UN Development Programme (2019) Food waste management in Korea: Focusing on Seoul
[268] Chrobog, CK (2015) South Korea: Cutting back on food waste, Pulitzer Center
[269] The Guardian (2022) South Korea has almost zero food waste. Here's what the US can learn
[270] RFID (radio frequency identification) is an electronic communication system involving tags and readers.
[271] Yu, K (n.d.) Pay as you throw system of Seoul
[272] Chrobog, CK (2015) South Korea: Cutting back on food waste, Pulitzer Center
[273] UN Development Programme (2019) Food waste management in Korea: Focusing on Seoul
[274] Chrobog, CK (2015) South Korea: Cutting back on food waste, Pulitzer Center
[275] EURACTIV (2021) Germany's pioneering bottle deposit scheme has lessons for the EU
[276] EURACTIV (2021) Germany's pioneering bottle deposit scheme has lessons for the EU

6.2.5 France

France has introduced an ambitious range of extended producer responsibility (EPR) policies, to incentivise waste reduction and recycling. Under EPR policies, producers are required to fund the full net cost of collecting, sorting, and treating waste.

- France has implemented EPR for twelve product categories, and plans to cover ten more in future—see Table 13.[277]

Table 13 EPR schemes in France[278]

Categories currently covered	Categories to be covered in future
Batteries (collection rate has risen from virtually nil to 49% in 20 years).	Building construction products and materials
Waste electrical and electronic equipment (WEEE) (collection rate has risen from virtually nil to 53% in 13 years)	Commercial packaging
Household packaging (recycling rate has risen from 18% to 70% in 20 years)	Toys
End-of-life vehicles	Sports and leisure items
Unused medicines	DIY and gardening items
Vehicle tyres	Motor oils
Writing paper[279]	Plastic-tipped tobacco products
Textiles and footwear	Synthetic chewing gum
Household chemicals	Single-use sanitary textiles, including pre-soaked wipes
Furniture	Fishing gear that contains plastics
End-of-life boats	
Sharp self-administration medical devices used by patients	

- **Fees charged to producers in France are 'eco-modulated'**, rewarding good practices, and penalising undesirable ones. For example, packaging EPR applies a 50% penalty to packaging which cannot be recycled, and a 100% penalty applies to packaging which cannot be recovered.[280] Implementation of EPR has led to an improvement in waste data. Producer activity is monitored to help predict volumes of waste which will need sorting in the future.[281]

[277] Vernier, J (2021) Extended producer responsibility (EPR) in France
[278] Vernier, J (2021) Extended producer responsibility (EPR) in France
[279] Landbell Group (undated) Obligated streams in France
[280] EEA (2022) France – early warning assessment related to the 2025 targets for municipal waste and packaging waste
[281] EEA (2022) France – early warning assessment related to the 2025 targets for municipal waste and packaging waste

7 Findings and conclusions

This report provides a baseline assessment of the waste management system and illegal disposal in Northern Ireland. As well as building a picture of current rules and practices, many of which are functioning as intended, it highlights gaps and potential weaknesses. These are summarised below, organised by theme.

Legislative delays and other implementation challenges: The review of Northern Ireland's waste legislation revealed a tendency for legislative updates to lag behind the rest of the UK. This applies to the introduction of new legislation, and the implementation (commencement) of legislation which has already been approved. To some extent, delays have been caused by political instability. The absence of functioning political institutions is slowing the implementation of post-EU exit legislative changes, and of strategies and plans related to waste. Policies or laws that deviate from existing policy or require cross-departmental sign-off cannot be approved under the temporary arrangements. Northern Ireland's new EIP, and its Circular economy strategy, are therefore both awaiting sign-off. In the case of the Climate Change Act (Northern Ireland) 2022, the legislation fails to mandate a timeframe for DAERA to publish its first plan for the waste sector.[282]

Impacts of EU exit: Northern Ireland has a uniquely complex legislative framework compared to the rest of the UK, owing to its continued alignment with certain pieces of EU legislation, at the same time as forming part of the UK's internal market. There is a risk of legislative divergence with the rest of the UK and the ROI. Any divergence in waste management rules and costs could create new drivers of waste crime. The reduction in law enforcement cooperation between Northern Ireland and the ROI that has already occurred since EU exit also presents challenges for tackling transboundary waste crime.

Relatively low ambition: Northern Ireland's current targets for improving waste management and reducing residual waste are in some cases less ambitious than other parts of the UK. For example, the municipal recycling rate has plateaued at around 50%, while Wales has already surpassed the 65% rate which is Northern Ireland's target for 2035. Where the Environment Act 2021 set a requirement for England to set legally-binding targets on resources and waste, there was no parallel requirement for Northern Ireland. The Climate Change Act (Northern Ireland) 2022 set a 70% recycling target for 2030 but failed to give it a suitable definition, meaning that it is likely to have already been surpassed.

In some cases, the lack of ambition aligns with the rest of the UK. These include the absence of recycling targets (or public data) related to C&I waste; and the fact that the C&D waste recovery target does not incentivise higher value material recovery (beyond crushing materials for use as aggregate).

Evidence gaps on the impacts of waste management: There are some data gaps related to the environmental and health impacts of the waste sector in Northern Ireland. These include environmental monitoring of historical landfills; the proportions of landfill gas that are captured, used for energy and

[282] The Environment Act (2021) set a time limit for publishing the first EIP.

flared; and emissions from waste incineration. There is also a lack of evidence to determine whether waste management infrastructure is disproportionately located close to more deprived communities in Northern Ireland.

Gaps in monitoring and enforcement information: The online public registers of people and organisations permitted to operate waste management facilities and transport or deal in waste do not contain details of monitoring and enforcement measures undertaken by public authorities. Monitoring of performance at district council level is also hampered by limitations to data reporting. For example, significant quantities of waste are sent each year to unspecified destinations, and there is some inconsistency in how waste exports are reported.

Potential for district councils to improve waste management: The waste flow analysis revealed significant variation in district councils' waste management practices, and some scope for improvement.[283] For example, some send relatively large shares of waste directly to landfill, without pre-sorting to extract materials for reuse and recycling. Some rely more heavily than others on residual waste MRFs to extract recyclable materials. This typically results in lower value recyclables than waste collected separately for recycling. There is also scope for reuse to be scaled up and expanded beyond the current focus on textiles.

Limited evidence base on illegal disposal: The extent of illegal disposal within Northern Ireland is unknown, meaning it is not possible to assess the scale of associated environmental and public health impacts. There is no legal requirement for public authorities to proactively identify or report data on illegal disposal. District councils report limited data on fly-tipping incidents occurring on public land, in a non-standardised manner. The NIEA, which clears larger and hazardous illegal waste sites, does not publish any data on quantities or types cleared. There may also be insufficient monitoring of the environmental and public health impacts of illegal dumps that are known to public authorities. In addition, there is limited visibility of the impacts of Northern Ireland's waste exports.

Potential risks facing Northern Ireland's waste management system: Northern Ireland is likely to come under pressure to reduce its exports of waste (RDF) as feedstock for EfW plants in Scandinavia, with the recipient countries seeking to reduce their emissions from waste incineration. At the same time, waste management infrastructure within Northern Ireland is expected to be insufficient within the five to ten years, and additional infrastructure is likely to be required. In this context, a proposed target to cut waste to landfill appears desirable, but could have unintended consequences, such as driving up incineration and thereby locking in demand for residual waste, or increasing the incentive for waste crime.

[283] As noted in chapter 5, only tentative conclusions can be drawn from the waste flow analysis. Further details on the waste management systems and local characteristics of different district council areas would be needed to refine and confirm these conclusions.

Appendix A: Methodology for waste flow analysis

A.1 Domestic waste flows

Publicly available data on domestic waste flows as reported by local authorities on the WasteDataFlow platform and DAERA's datasets on local authority collected municipal waste were used. This data pertained to the financial year 2021-22.

Local authorities report information regarding waste generation and treatment on a quarterly basis against a number of questions on WasteDataFlow. The questions analysed for the analysis in this study are presented in Table 14Table.

Table 14: WasteDataFlow questions analysed

Q19	What is the final destination of your materials sent for recycling?
Q19a	What is the final destination of your materials recovered from the residual stream and sent for recycling?
Q35	What is the final destination of your materials sent for reuse?
Q52	How many tonnes of waste were disposed of in Non-Hazardous Landfill?
Q53	How many tonnes of waste were disposed of in Hazardous Landfill?
Q58	How many tonnes of recyclables were sent to a Materials Recovery Facility?
Q62	How many tonnes of organic waste were sent for In-Vessel Composting?
Q63	How many tonnes of organic waste were sent for Windrow or other composting?
Q64	How many tonnes of residual waste were sent for sorting prior to disposal or recovery (Residual Waste MRF)?
Q65	How many tonnes of waste were disposed of by any other method not covered elsewhere?

Q19, 19a and 35 provide quantities and the final destination of materials collected by local authorities for recycling and reuse.

The remaining questions (Q52, Q53, Q58, Q62, Q63, Q64 and Q65) provide information about the quantities of different waste streams collected by local authorities and sent for their primary treatment. These reports also provide quantities of outputs from primary treatment facilities and their end fates, such as tonnage sent from a MRF for final recycling and those rejected to energy from waste facilities or landfills.

The data was analysed using the pivot table function within Microsoft Excel, where the following parameters were considered:

- Total quantity of waste input into each type of primary treatment facility
- Types and tonnes of waste outputs from each type of primary treatment facility
- Tonnes of waste collected and sent for recycling to final destinations and proportions of rejects therein
- Addresses (post codes) of the facilities to which different waste streams were sent

Facility locations were grouped as those located within Northern Ireland, the rest of the UK and outside UK. Tonnages sent outside the UK are typically identified as those sent to the EU and to non-EU locations. Where details of addresses were unknown, they were reported as such.

A.2 Transboundary waste flows

Data on transboundary waste flows was collated via direct request from DAERA. The information provides the quantity of household and commercial waste received by and removed from the various sites which report to NIEA under permit agreements. The data is allocated by site, origin and waste type (i.e. EWC code). For waste originating and transferred within Northern Ireland, area information is provided at council level, whereas imports and exports are defined only by 'Republic of Ireland', 'Other UK' (namely England, Scotland and Wales), and 'Other World'. Data for 2017 to 2021 was analysed by origin or destination location and EWC sub-chapter.

Data was supplemented by a Freedom of Information request published in March 2023, detailing the records of imports and exports from Northern Ireland. While the data for imports did not specify the country of origin by waste type, export data provided details on waste movement from Northern Ireland to outside of the UK. A heatmap was generated to visually display this information.

A.3 Visualisations

Two types of visualisations were used for this analysis.

Sankey diagrams

Sankey diagrams are used to compare amounts flowing through different stages. In this analysis they are used to depict waste flows of different quantitative values, represented by different coloured ribbons, through different stages (origin, interim stages and end destination), represented by nodes. The thickness of the ribbons represents the relative waste flow quantities, with thicker flows showing larger quantities. Sankey diagrams were developed using https://sankeymatic.com/.

Maps using geographical information systems (GIS)

The GIS software QGIS was used to display the regional treatment split and facility types.

For the map developed to show waste originating from Northern Irish local authorities (section 5.1.4), a point feature was applied to each local authority where waste processing was taking place. The attribute data of each point feature was updated to include the facility type and the total tonnage the facility received. Pie charts were produced based on this data. The pie charts have been scaled based on total tonnage, to help visualise which LA is receiving the most waste. For ease of viewing a minimum size has been set to increase the size of the pie charts that have a tonnage of below 50,000 tonnes.

A second map was produced to show which countries in Europe are receiving the highest tonnage of waste from Northern Ireland (section 5.2.2). Total tonnages were applied to each country polygon and a colour scale was applied. Darker shades of red indicate a higher tonnage of waste being received.

Appendix B: Primary treatment and end fate by local authority

Detailed Sankey diagrams for individual local authority waste flows, including primary treatment facility types and end fates of outputs from these are presented below.

Antrim and Newtownabbey

- Residual waste makes up the largest share (48%) of waste produced by the authority, with 35% of this sent to residual MRFs and 65% sent to non-hazardous landfills.
- Of the residual waste sent to residual MRFs, around 7,400 tonnes are recovered for recycling and over 4,000 tonnes go through thermal or biological recovery processes.
- Organic waste material makes up the second highest waste stream (over 28,700 tonnes). Stakeholder C noted that a significant portion of this is likely to be tonnages brought to HWRCs by tradespersons. Nearly all is sent to IVC, with a small share sent for windrow composting.
- Mixed recyclables sent to MRFs comprise the lowest proportion (3%) of all waste produced. This is also the lowest proportion of recyclable waste collected among all district councils.

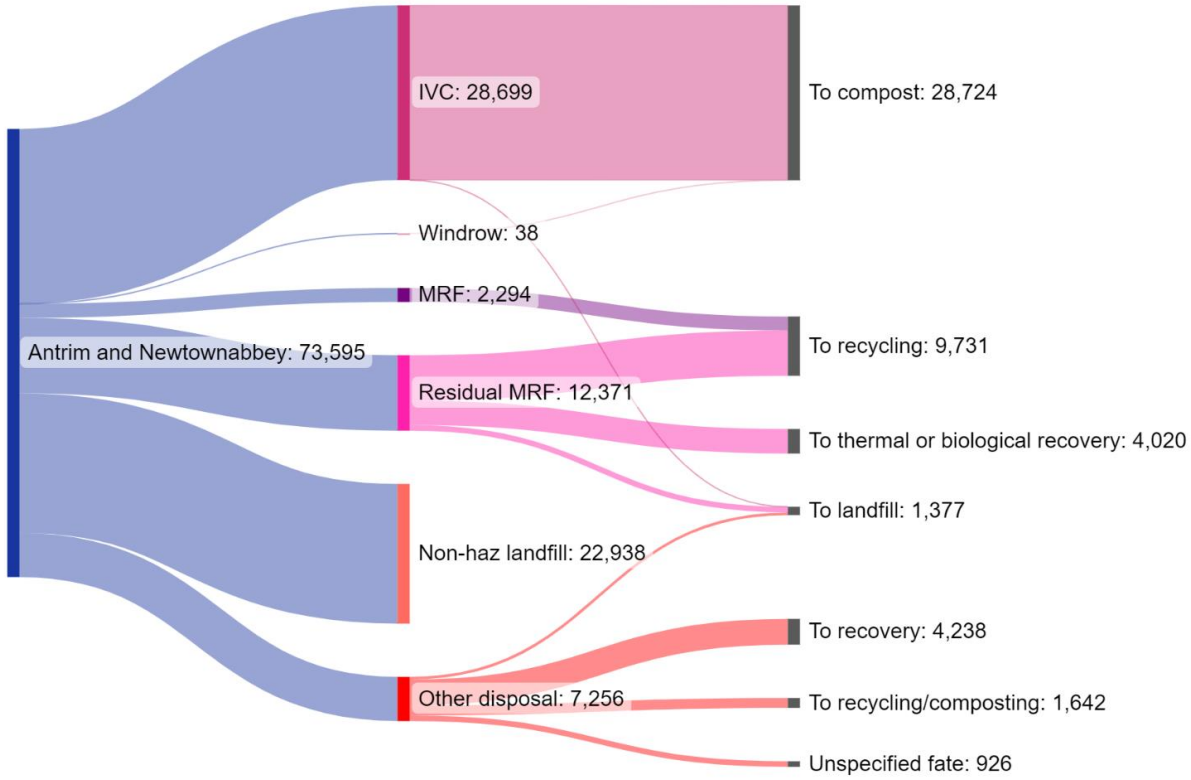

Figure 16 Antrim and Newtownabbey waste flows[284]

[284] WasteDataFlow; Resource Futures analysis

Ards and North Down:

- Ards and North Down sends a greater proportion of recyclables (11%) to MRFs compared to Antrim and Newtownabbey.
- The largest fraction is residual waste (55%), followed by organic waste (32%).
- In terms of treatment options, nearly all of the organic waste (24,317 tonnes) is processed via IVC facilities (24,121 tonnes), with only 196 tonnes composted in windrow facilities.
- Almost all (95%) of the residual waste is sent to non-hazardous landfills. Most of the rest is sent to residual MRFs and recovered for recycling, or through thermal and biological recovery processes.

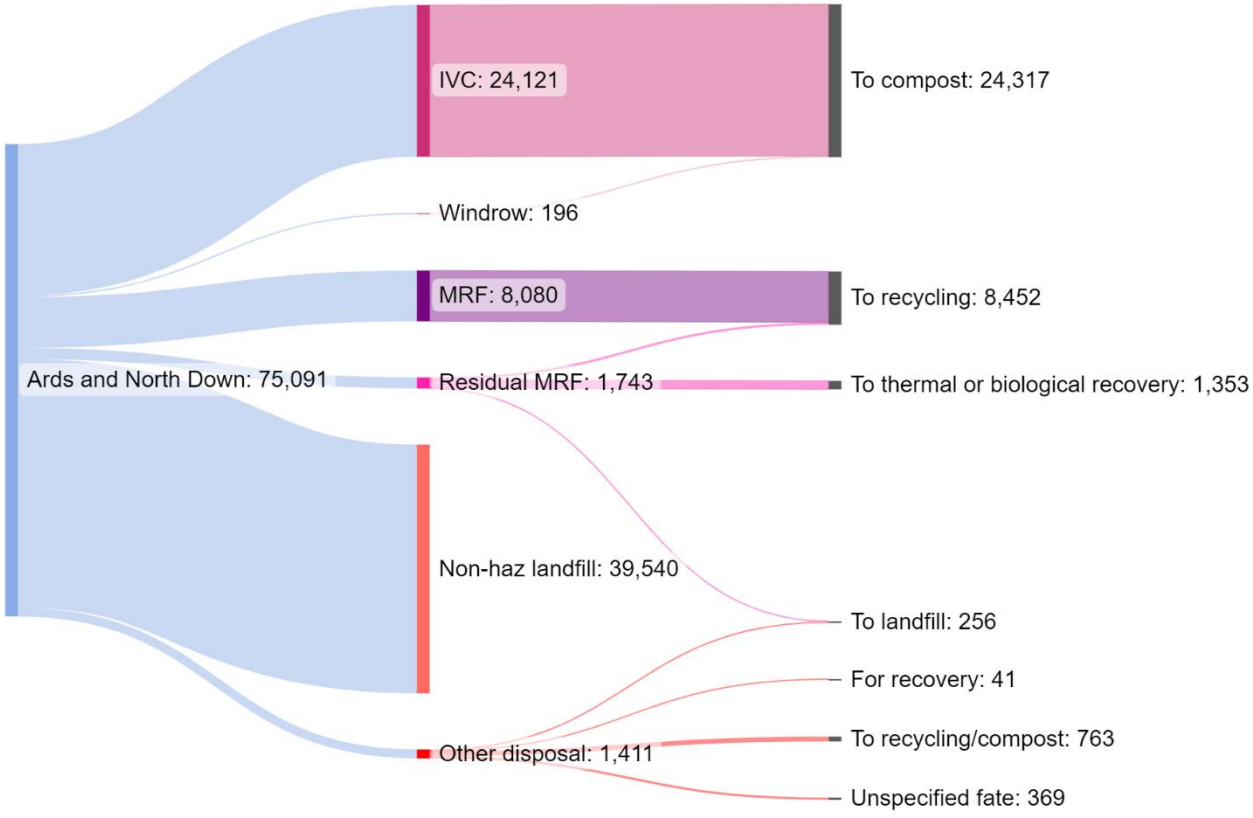

Figure 17 Ards and North Down waste flows[285]

[285] WasteDataFlow; Resource Futures analysis

Armagh City, Banbridge and Craigavon

- Waste sent for other disposal comprises the largest fraction (32%) of the waste produced by Armagh City, Banbridge and Craigavon.
- While a majority of tonnes to other disposal ends up being recovered (80%) and recycled (6%), 14% is noted as 'unspecified fate'.
- Rejects from MRFs, comprising 18% of all recyclables, are noted as being sent for energy recovery and landfills.

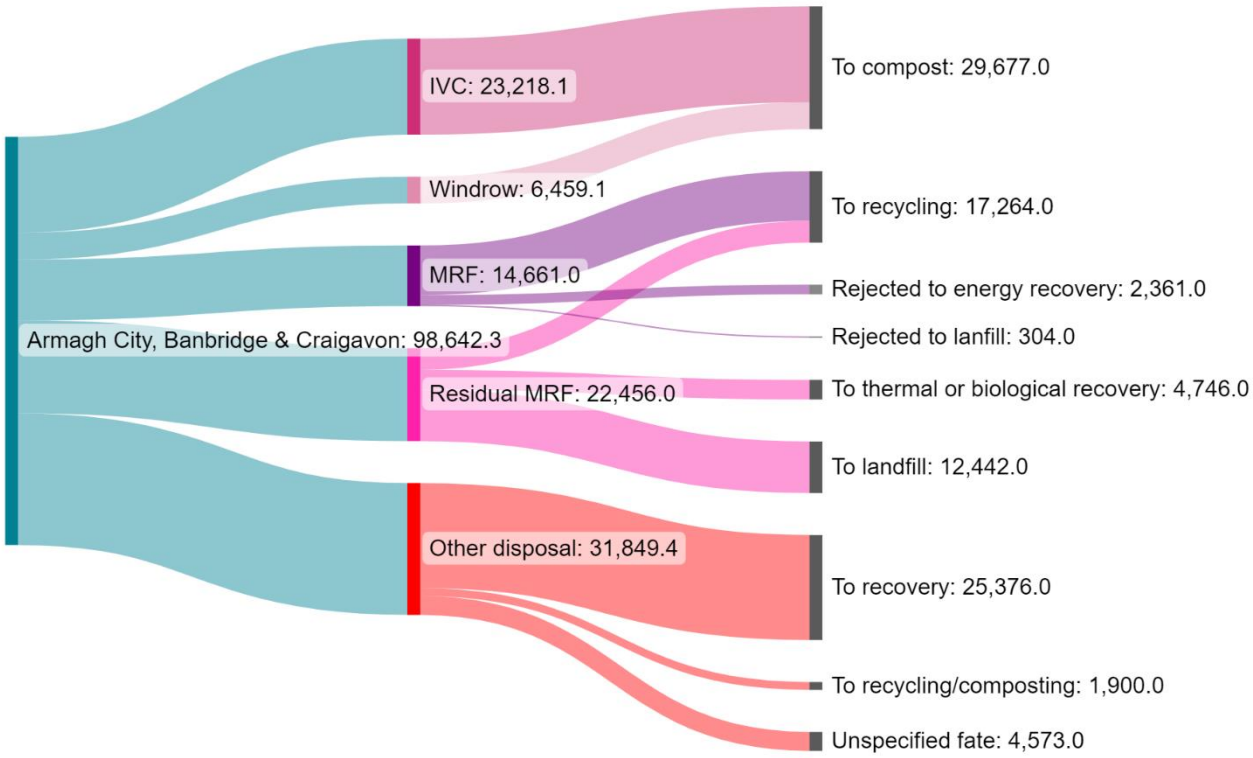

Figure 18 Armagh City, Banbridge and Craigavon waste flows[286]

[286] WasteDataFlow; Resource Futures analysis

Belfast

- The large share of waste (44%) produced by Belfast is sent for disposal processes, including residual MRF and non-hazardous landfills. This is followed by other disposal processes (31%).
- Belfast is the only authority to report hazardous waste tonnages. These make up 0.01% (17 tonnes) and are sent to hazardous landfills.
- Organic waste makes up a relatively low proportion of the authority's waste stream at 25%, compared to other authorities in Northern Ireland. These are treated at IVCs (18%) and windrow composting facilities (7%).

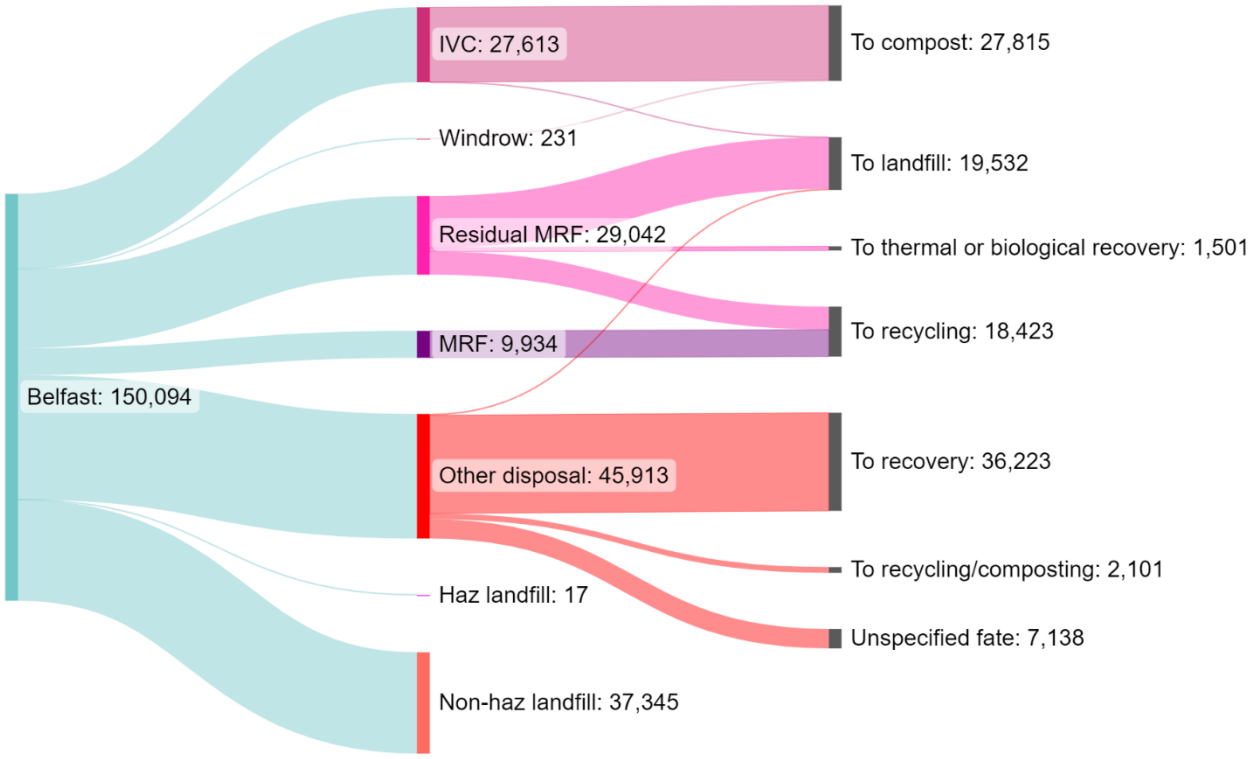

Figure 19 Belfast waste flows[287]

[287] WasteDataFlow; Resource Futures analysis

Causeway Coast and Glens

- Residual waste makes up the largest proportion (31%) followed by waste sent for other disposal (28%).
- Recyclables sent to MRFs make up 16% of the total waste generation. Of this, 19% ends up as rejects going to energy recovery and landfill.

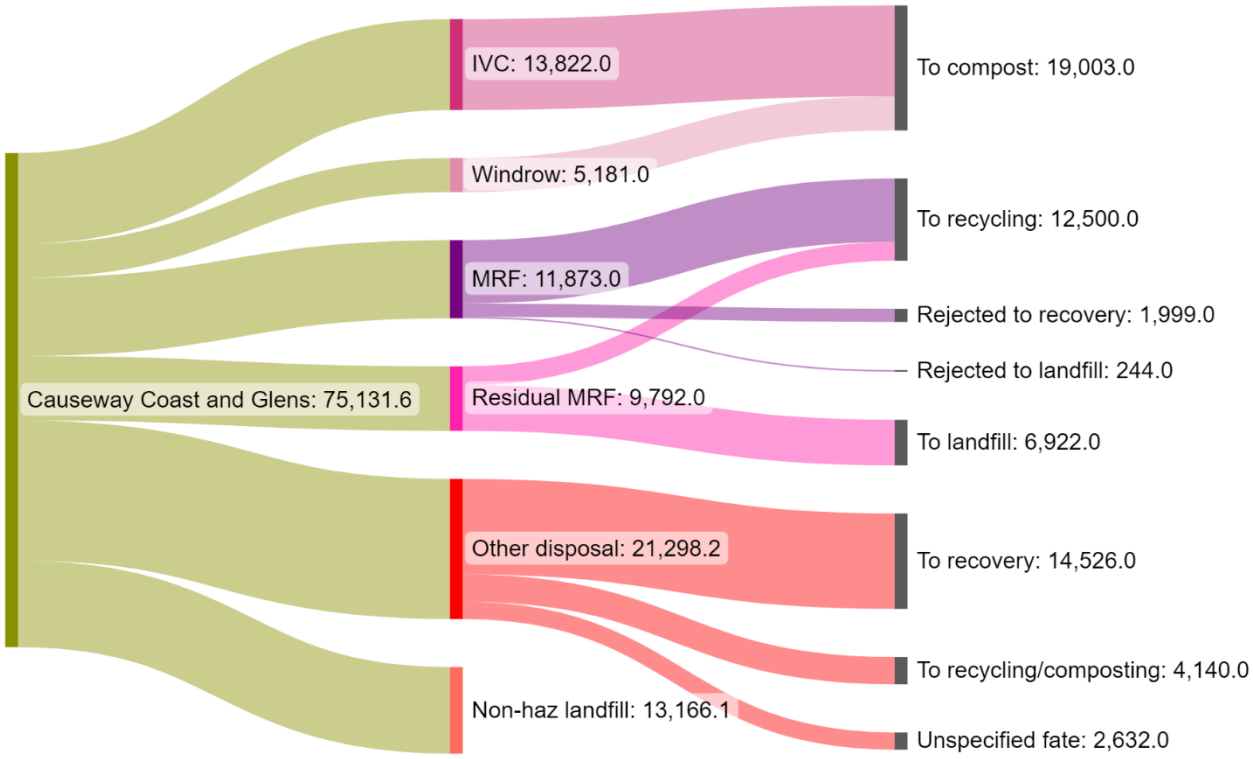

Figure 20 Causeway Coast and Glens waste flows[288]

[288] WasteDataFlow; Resource Futures analysis

Derry City and Strabane

- Waste sent for other disposal (40%) makes up the largest proportion of waste generated in Derry City and Strabane. Of this nearly 77% is recovered.
- The authority produces the largest share of waste sent to other disposal processes, compared to other district councils.

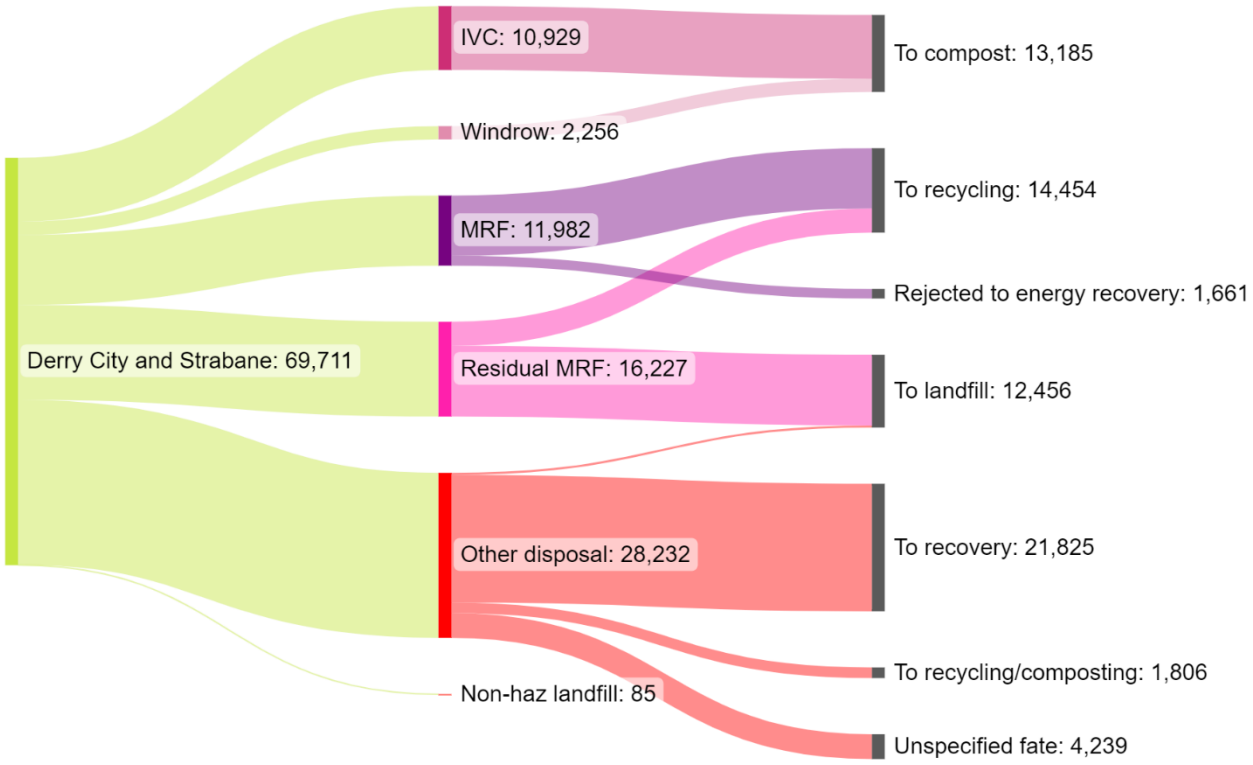

Figure 21 Derry City and Strabane waste flows[289]

[289] WasteDataFlow; Resource Futures analysis

Fermanagh and Omagh

- A majority of the waste produced by Fermanagh and Omagh comprises residual waste (46%) which is sent to non-hazardous landfills (43%) and residual MRFs (3%).
- Although only a small proportion, Fermanagh and Omagh is the only authority to send waste to AD facilities (3%). Of the remaining organic waste, 9% is sent for windrow composting with the rest going to IVC facilities (10%).

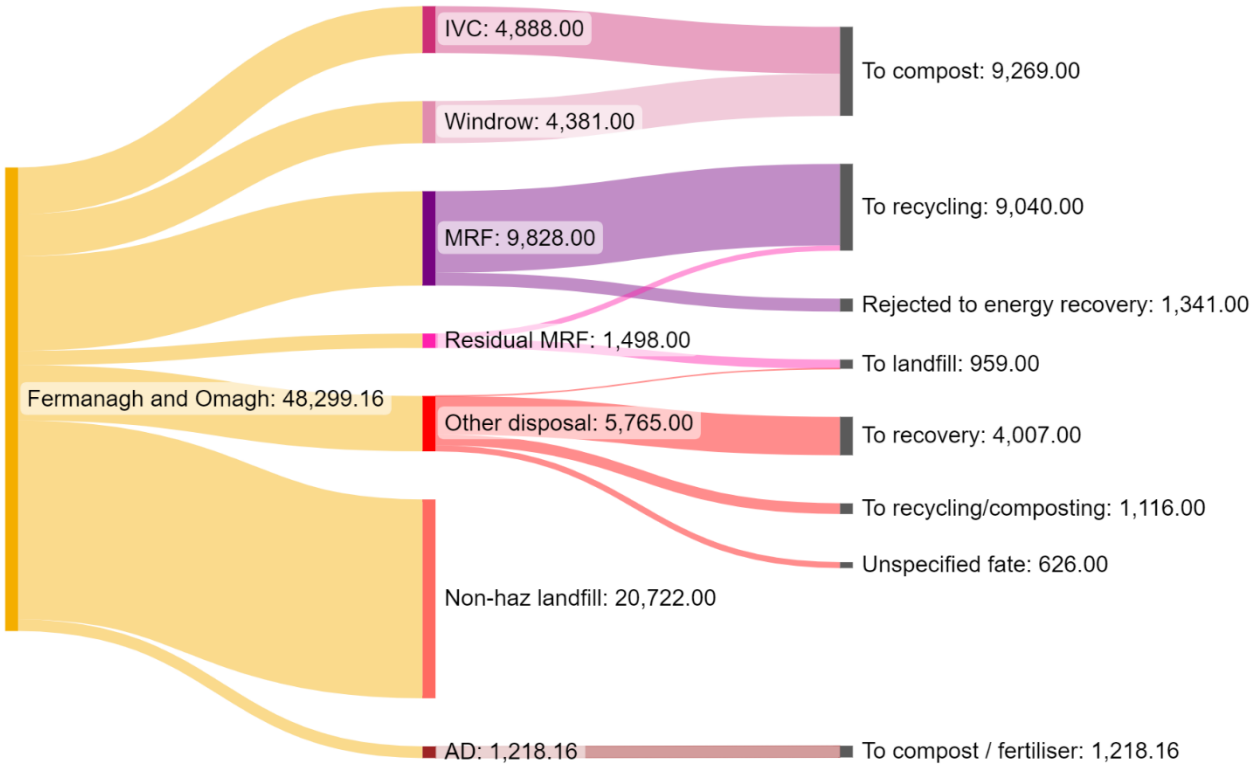

Figure 22 Fermanagh and Omagh waste flows[290]

[290] WasteDataFlow; Resource Futures analysis

Lisburn and Castlereagh

- Residual waste (55%) and organic waste (35%) are the two largest waste streams produced by Lisburn and Castlereagh.
    - Nearly all organic waste is sent to IVC facilities, where most of the residual waste (46%) is sent to non-hazardous landfills.
    - A majority of the waste sent to residual MRFs is recovered for recycling (27%) or via thermal and biological processes (61%).
- The authority produces a second lowest proportion of recyclables (7%) that goes to MRFs.

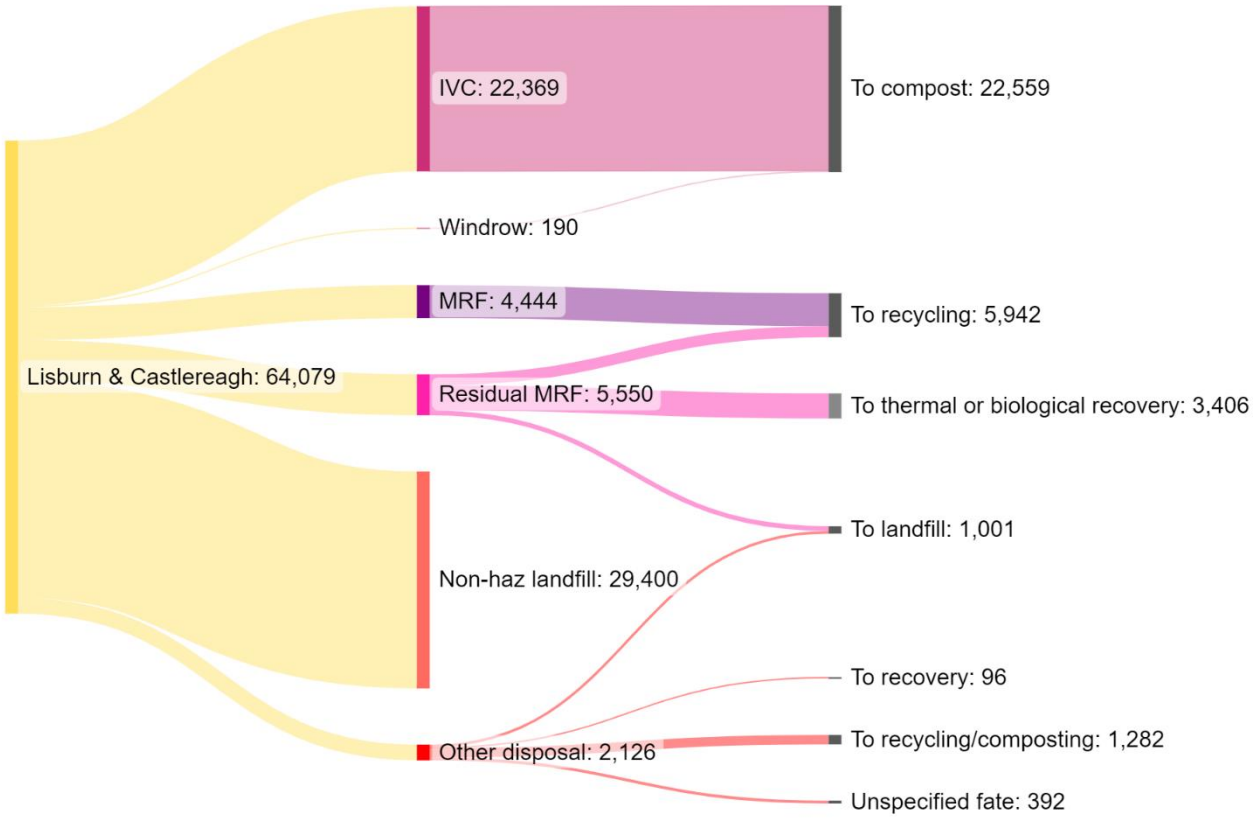

Figure 23 Lisburn and Castlereagh waste flows[291]

[291] WasteDataFlow; Resource Futures analysis

Mid and East Antrim

- Residual waste (58%) and organic waste (36%) are the two largest waste streams produced by Mid and East Antrim.
    - Nearly all organic waste is sent to IVC facilities, where most of the residual waste (46%) is sent to non-hazardous landfills.
    - A majority of the waste sent to residual MRFs is recovered for recycling (17%) or via thermal and biological processes (83%).
- The authority sends a small proportion of recyclables (3%) to MRFs.

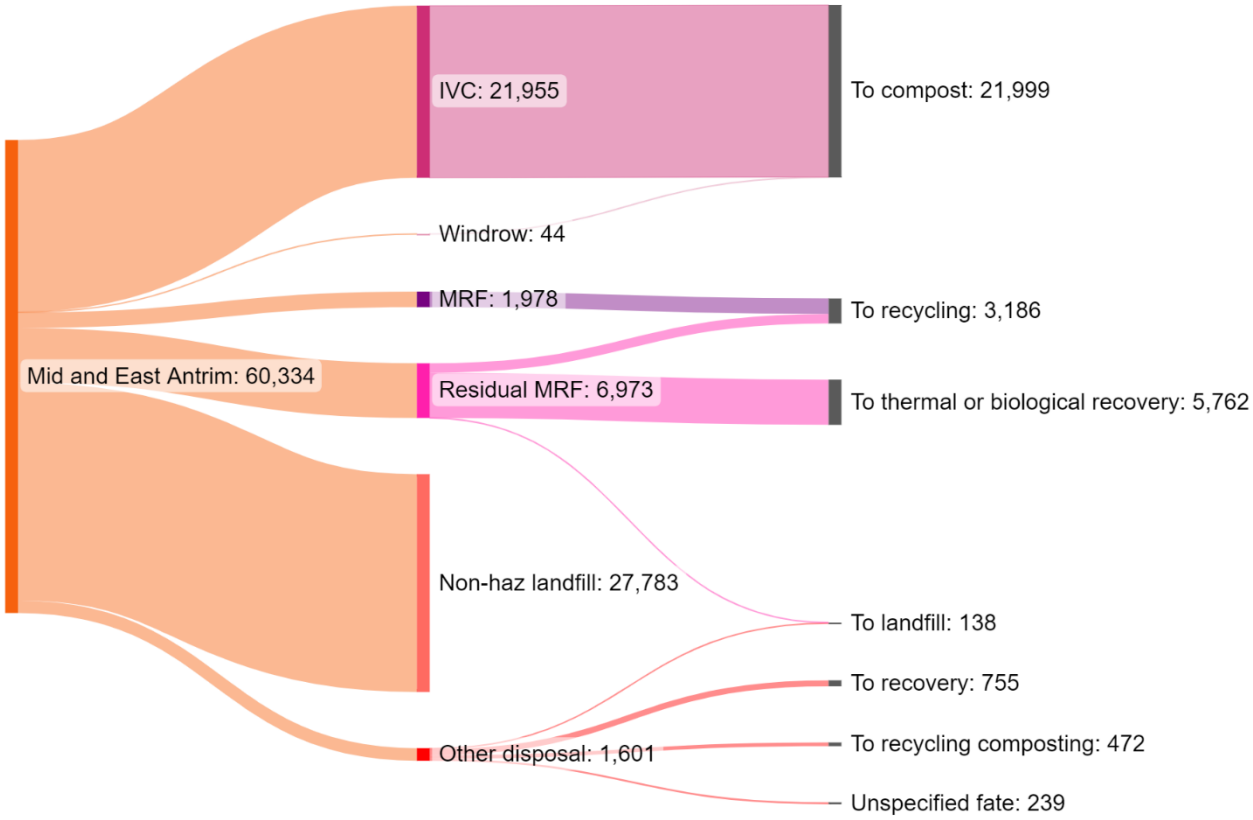

Figure 24 Mid and East Antrim waste flows[292]

[292] WasteDataFlow; Resource Futures analysis

Mid Ulster

- Although residual waste comprises 45% of the total waste produced by Mid Ulster, all of it is sent to residual MRFs.
    - A majority of this is recovered through thermal and biological processes and recycling.
    - This suggests that only 0.04% of the total waste produced by the authority is landfilled.
- The authority demonstrates high levels of recovery of waste with organics (34%) being sent to IVC and windrows composting facilities and recyclables (16%) being sent to MRFs.

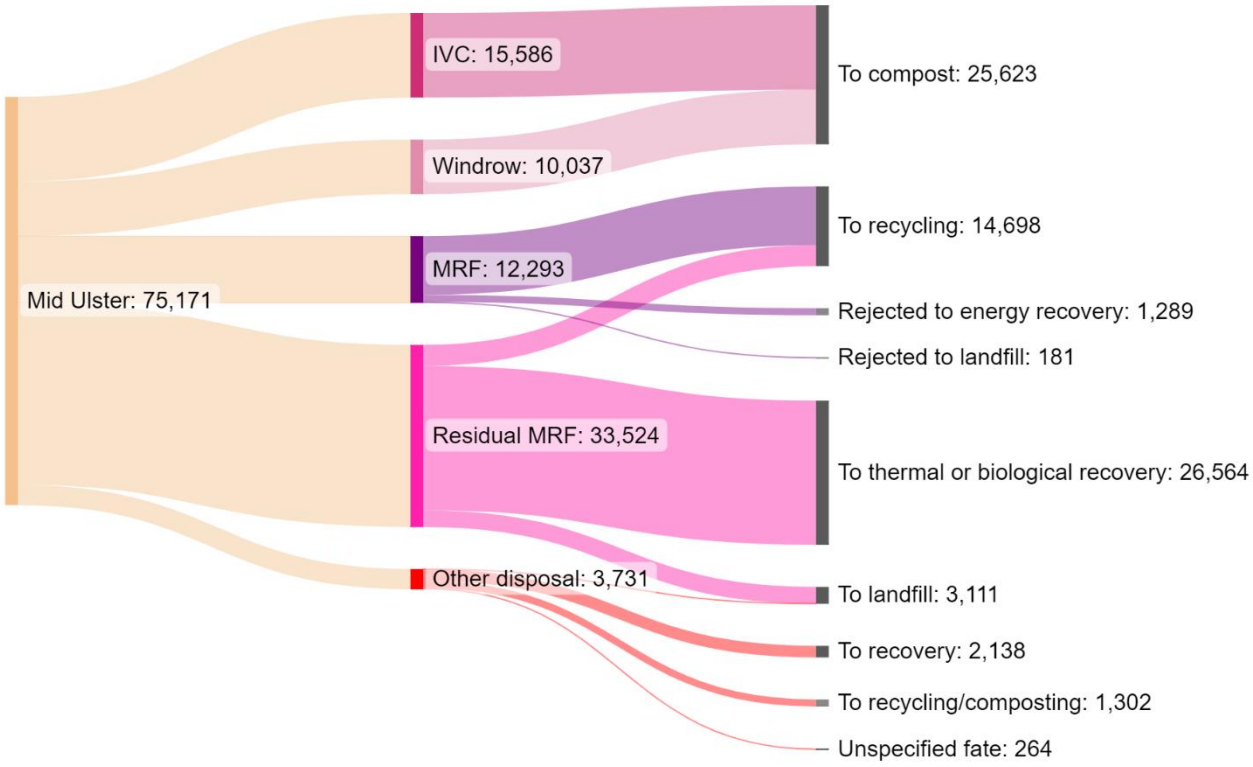

Figure 25 Mid Ulster waste flows[293]

[293] WasteDataFlow; Resource Futures analysis

Newry, Mourne and Down

- Newry, Mourne and Down produced the largest proportion of residual waste (66%) compared to other authorities.
    - A majority of this waste is recovered through thermal or biological processes and recycling.
- The authority also generates the largest share of recyclables (26%), most of which is recycled, with a small proportion being rejected to energy recovery.

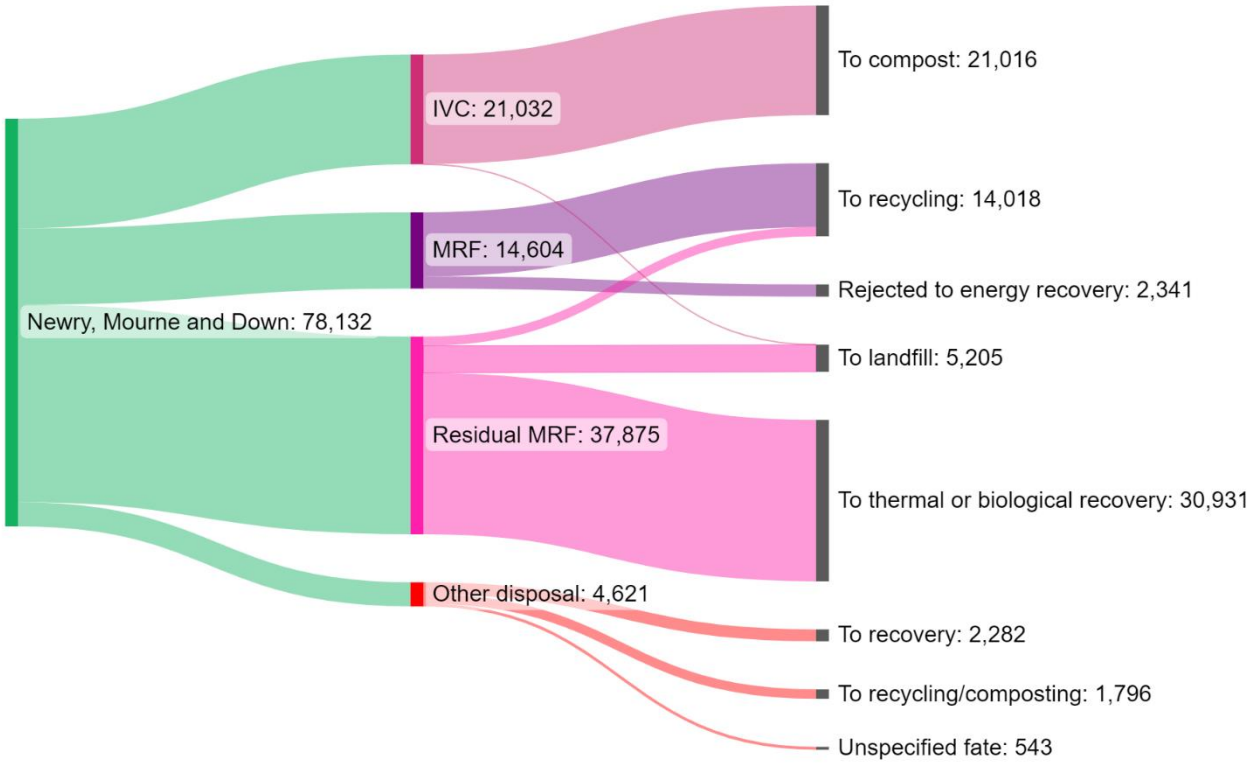

Figure 26 Newry, Mourne and Down waste flows[294]

[294] WasteDataFlow; Resource Futures analysis