LAPCAP Worked Examples

Introduction

This document goes through some worked examples based on the Local Authority Costs and Performance (LAPCAP) model. In this document we are taking an example Unitary authority and show how calculations are worked out at each stage. Some example calculations are also included that do not apply to Unitary authorities, for example calculations regarding recycling credits. These are included to aid understanding. We explain which examples this applies to.

The numbers in the calculations are meant to represent realistic values but are not meant to be a perfect resemblance of a local authority. Furthermore, when a calculation is done multiple times, only one example calculation is used. For example, if a calculation is done for all materials in a local authority, only the calculation for plastic is shown.

Note on mathematical notation: Most of the equations use only frequently used notation. Here are explanations of less commonly used notations.

Sigma notation:

$$\sum_{\text{variable}} \text{Value}_{\text{variable}}$$

This is shorthand for the sum for all values under a variable. For example if a local authority ran two schemes (called standard and communal) which serviced 80,000 and 20,000 households respectively then:

$$\sum_{\text{schemes}} \text{households}_{\text{scheme}} = \text{households}_{\text{standard}} + \text{households}_{\text{communal}}$$
$$= 80,000 + 20,000$$
$$= 100,000$$

The purpose of this equation is to aggregate and weight waste tonnages across multiple collection schemes so you can then split out material specific tonnages. It's a concise way to turn disparate scheme-level data into a single, material-broken-down tonnage for each authority.

Calculating Tonnages

Variables used in this section

- **Composition Tonnage** - Collection tonnages obtained from waste composition studies including WRAP Cymru 2023 (https://www.wrap.ngo/resources/report/compositional-analyses-municipal-waste-and-litter-wales), WRAP Synthesis 2017 (https://www.wrap.ngo/resources/report/quantifying-composition-municipal-waste) and Zero Waste Scotland 2023 (https://www.zerowastescotland.org.uk/resources/household-waste-composition-analysis#download)
- **Scheme Households** - The number of households on a scheme for a local authority, taken from the scheme data.
- **Waste Data Flow Collection Tonnages** - The collection tonnages reported in Waste Data Flow.
- **Waste from Households Factor** - An estimated proportion of collected tonnages which are from households, depending on country and waste category.

Calculations

Tonnage calculations can be summarised as the following equation:

$$\text{Collection Tonnage} = \text{Material Proportion} \times \text{Scheme Proportion} \times \text{Waste Data Flow Household Collection Tonnage}$$

This equation brings together three key factors—material composition, collection scheme coverage, and household-only tonnage—to estimate the total collected tonnage for each material. An example of this would be with four main materials—plastic, paper, glass and metal—and two collection schemes—standard kerbside and communal.

Where:

- **Material Proportion** is the proportion of the total tonnage that is made up from a certain material
- **Scheme Proportion** is the proportion of households that are on a certain scheme
- **Waste Data Flow Household Collection Tonnage** are tonnages given by Waste Data Flow which are determined to be from households from applying the Waste from Households factor.

For example, if a local authority had the following values:

Local Authority Variables	Local Authority Values	External Variables	External Values
$\text{Households}_{\text{communal}}$	30,000	$\text{Waste from Households factor}_{\text{recycling}}$	0.5

$\sum_{\text{schemes}} \text{Households}_{\text{scheme}}$	150,000	$\text{Composition Tonnage}_{\text{plastic}}$	300,000 tonnes
Waste Data Flow Collection Tonnage	500,000 tonnes	$\sum_{\text{materials}} \text{Composition Tonnage}_{\text{material}}$	6,000,000 tonnes

$$\text{Material Proportion}_{\text{plastic}} = \frac{\text{Composition Tonnage}_{\text{plastic}}}{\sum_{\text{materials}} \text{Composition Tonnage}_{\text{material}}}$$

$$= \frac{300,000}{6,000,000}$$

$$= 0.05$$

$$\text{Scheme Proportion}_{\text{communal}} = \frac{\text{Households}_{\text{communal}}}{\sum_{\text{schemes}} \text{Households}_{\text{scheme}}}$$

$$= \frac{30,000}{150,000}$$

$$= 0.2$$

$$\text{Waste Data Flow Household Collection Tonnage}_{\text{waste category}} = \text{Waste Data Flow Collection Tonnage} \times \text{Waste from Households Factor}_{\text{recycling}}$$

$$= 500,000 \times 0.5$$

$$= 250,000$$

$$\text{Collection Tonnage}_{\text{communal,plastic}} = \text{Material Proportion}_{\text{plastic}} \times \text{Scheme Proportion}_{\text{communal}} \times \text{Waste Data Flow Household Collection Tonnage}_{\text{waste category}}$$

$$= 0.05 \times 0.2 \times 250,000$$

$$= 2,500 \text{ tonnes}$$

Disposal tonnages are calculated in a similar way where we use the disposal tonnage in Waste Data Flow (only for England, Wales and Scotland), and facility proportion is used rather than scheme proportion. I.e. the proportion of tonnage going to each disposal facility. For England and Wales we take each authority's "Disposal" tonnages exactly as they appear in the latest Waste Data Flow (WDF) return. For Scotland we use the same WDF disposal table ("Disposed of by destination"), as SEPA no longer publishes a separate mass-balance at local-authority level.Northern Ireland tonnages are not included because WDF does not yet collect comparable facility-level data there.

The facility proportion is then the share of a local authority's total disposal tonnage that goes to each of the following outlet types:

- MRF – materials-recovery facility handling comingled recyclate
- Reprocessor – glass furnace, paper mill, plastics regrind plant, aluminium smelter, etc.
- MBT / Residual-MRF – mechanical-biological-treatment or residual-MRF plant treating black-bag waste
- EfW / Thermal – energy-from-waste incinerator or advanced thermal facility (gasification, pyrolysis)
- Landfill – inert, non-hazardous or hazardous landfill accepting municipal wastes
- RDF export – refuse-derived fuel exported overseas for energy recovery
- Other – any remaining disposal outlet (for example, cement-kiln co-processing)

Disposal tonnage for each facility–material combination is therefore:

$$\text{Facility Proportion}_{\text{facility}} = \frac{\text{Waste Data Flow Disposal Tonnage}_{\text{facility}}}{\sum_{\text{facilities}} \text{Waste Data Flow Disposal Tonnage}_{\text{facility}}}$$

$$\text{Disposal Tonnage}_{\text{facility,material}} = \text{Facility Proportion} \times \text{Waste Data Flow Disposal Tonnage}_{\text{material}}$$

Calculating Collection Costs

Collection costs are the £-per-tonne figures we attach to each waste stream (residual, dry recycling, food, garden, etc.) so that every local authority can be paid for the packaging they collect. We build those cost figures from the RFI and ONS data.

Variables used in this section

- **RFI Variables** - All variables under the “RFI Authority Variables” tab are values that have been provided to us through Request for Information (RFIs). These are a selected number of local authorities who have provided data on their waste programs. These local authorities were selected in order to give the best representation of all local authorities in the UK. Respondents supplied the annual spend and tonnage for each of their waste programs – i.e. the operational services that pick up household waste:
    - kerbside or communal residual
    - kerbside or communal dry recycling
    - food-waste collection garden-waste
    - collection bring sites / HWRCs
    - (where applicable)

    Every RFI authority’s spend is converted to cost per tonne for each stream. Authorities are then slotted into cost-driver groups (same country, rurality band, housing mix, predominant scheme, etc.). Within each group we take the average RFI cost-per-tonne and apply that single figure to every authority in the group – including those that didn’t fill out an RFI.

- **Household Numbers** - ONS data is the primary source for households and household type. It is the UK Office for National Statistics publishes annual mid-year household estimates for England & Wales, Scotland and Northern Ireland. ONS was not used for all local authorities. See the guidance for more information. The model uses the 2023 mid-year estimates (published spring 2024). Where ONS does not publish a figure (some small islands and newly merged councils), we keep the 2022 estimate or use the authority’s own 2023 council-tax base.

Calculations

Collection costs are calculated using RFI data. For each local authority that has submitted RFI data, a cost-per-tonne value is calculated for residual, dry recycling, food and garden costs (although the EPR for Packaging payment output for year 1 does not consider food and garden). All local authorities are then grouped based on factors that drive collection costs and given a cost-per-tonne figure which is the mean of the local authorities which have provided RFIs in their group.

For these RFI local authorities, their cost-per-tonne is calculated using the following equation:

$$\text{Cost per Tonne} = \text{Kerbside Collection CPT} \times \text{Proportion Kerbside} + \text{Communal Collection CPT} \times \text{Proportion Communal}$$

We blend the two cost-per-tonne rates into one by weighting them to match each service’s reach. The kerbside rate is multiplied by the share of households on kerbside rounds, the communal rate by the share on communal rounds, and the two results are added together. That weighted average is the single £-per-tonne figure we use for the whole collection stream.

- **Kerbside/Communal Collection CPT** - The cost per tonne calculated from the RFI for collection from kerbside/communal collections
- **Proportion Kerbside/Communal** - The assumed proportion of properties that are served by kerbside/communal rounds. These are equivalent to the proportion of regular properties and flats respectively.

These proportions are assumed because many RFI returns report a single spend figure for the whole stream. We therefore split that spend in line with the latest (2023) ONS household counts, treating the household mix as the best available proxy for how each round’s cost is shared. Regular properties are detached, semi-detached, terraced houses and bungalows; anything served by its own wheeled-bin or sack collection. All high-rise and low-rise flats, plus other dwellings that present waste to shared bins, are classed as communal.

i.e. For a worked example, imagine a unitary authority that submitted an RFI. Its reported cost items (left-hand columns) and the household data we use to weight them (right-hand columns) are shown below:

RFI Authority Variables	RFI Authority Values	Local Authority Variables	Local Authority Values
$\text{Kerbside Collection Costs}_{\text{residual}}$	£900,000	Regular (kerbside) Properties	80,000
$\sum_{\text{streams}}$ $\text{Collection Costs no Overheads}_{\text{stream}}$	£3,600,000	Flats (communal)	20,000 tonnes
Total Overheads	£2,000,000	Kerbside tonnes (residual)	20,000 tonnes
$\text{Kerbside Tonnages}_{\text{residual}}$	20,000 tonnes		
Communal Collection CPT	£50		

- RFI variables are the individual cost lines taken straight from the authority's Request-for-Information return.
- Local-authority variables are contextual data (households and tonnes) used to turn those costs into cost-per-tonne and to weight kerbside and communal rates.
- Overheads cover depot costs, vehicles, management, IT/back-office and any other indirect costs the authority allocates to its collection service.

Step 1: Allocate overheads to the kerbside residual service

Total collection overheads (£2 000 000) are split across kerbside and communal in proportion to their direct spend.

Here we are looking first just at kerbside collection costs as the same methodolgy is applied to kerbside and communal. The kerbside collection cost per tonne can be summarised by the following equation:

$$\text{Kerbside Collection CPT}_{\text{residual}} = \frac{\text{Kerbside Overheads Cost}_{\text{residual}} + \text{Kerbside Collection Cost}_{\text{residual}}}{\text{Kerbside Tonnages}_{\text{residual}}}$$

Where:

$$\text{Kerbside Overheads Cost}_{\text{residual}} = \text{Total Overheads} \times \frac{\text{Kerbside Collection Cost}^{\text{residual}}}{\sum_{\text{streams}} \text{Collection Costs no Overheads}}$$

$$= \frac{£900,000}{£3,600,000} \times £2,000,000$$

$$= £500,000$$

Step 2: Derive the kerbside cost per tonne (CPT)

$$\text{Kerbside Collection CPT}_{\text{residual}} = \frac{\text{Kerbside Overheads Cost}_{\text{residual}} + \text{Kerbside Collection Cost}_{\text{residual}}}{\text{Kerbside Tonnages}_{\text{residual}}}$$

$$= \frac{£500,000 + £900,000}{20,000}$$

$$= £70$$

(This same calculation is repeated for the communal service to get its £50/t CPT.)

Step 3: Calculate the household split

$$\text{Proportion Kerbside} = \frac{\text{Regular Properties}}{\text{Regular Properties + Flats}}$$

$$= \frac{80,000}{80,000 + 20,000}$$

$$= 0.8$$

$$\text{Proportion Flats} = \frac{\text{Flats}}{\text{Regular Properties + Flats}}$$

$$= \frac{20,000}{80,000 + 20,000}$$

$$= 0.2$$

Step 4 - Combine the two CPTs into a single stream rate

$$\text{Cost per Tonne}_{\text{residual}} = \text{Kerbside Collection CPT} \times \text{Proportion Kerbside} + \text{Communal Collection CPT} \times \text{Proportion Communal}$$

$$= £70 \times 0.8 + £50 \times 0.2$$

$$= £66$$

Calculating Disposal Costs

Here we work out the £-per-tonne cost of sending each packaging material to each disposal outlet (MRF, reprocessor, MBT, EfW, landfill, RDF export, other). Starting from the WRAP Gate Fee Survey we strip out the haulage element, deduct any material-value rebate paid by the outlet, and arrive at a net gate fee that feeds the payment model.

Variables used in this Section

- **Gate fee** – the price (£ /t) that a disposal facility charges a local authority to tip waste at its gate.
- **Gross gate fee** – the headline gate fee reported to WRAP, which still contains both haulage and any revenue the facility retains.
- **Net gate fee** – the gate fee after the facility has already taken haulage and material-sales income off the bill.
- **Material Value (LetsRecycle price tracker, avg. 2023-24)** - A per tonne material value, taken from Lets Recycle which is a typical £-pertonne revenue the outlet receives for the recovered material.
- $LA_{i\text{inc haulage}}$ / $LA_{e\text{xc haulage}}$ - The number of Gate Fee Survey responses that did or did not include haulage. Used to isolate a representative haulage cost.
- **Composition** - taken from the calculating tonnages section of the model. The proportion of disposal tonnages going to a facility that are a material.
- **Haulage** - the per-tonne expense of transporting waste from a local authority's transfer station or depot to the final disposal or processing facility. We calculate haulage for each facility type by averaging the difference between gross and net fees among the Gate fee Survey responses. This gives a representative haulage £/t for each facility, which we then deduct from the gross fee before applying any materialvalue rebate.
- **Rebate** – the slice of material-sales income passed back to the authority; calculated as the gross–net fee gap, apportioned across materials by (material value – haulage) × composition share. Rebate is applied only to MRFs and reprocessors.
- **Net disposal cost (material gate fee)** – the gross gate fee minus the material-specific rebate; this is the £ /t cost that feeds into pEPR payments.
- **MRF (materials-recovery facility)** - plant that separates comingled recyclate into individual materials.
- **Reprocessor** - glass furnace, paper mill, plastics regrind plant, aluminium smelter, etc., that converts a single material into new feedstock.
- **Net gate fee** - the gate fee after the facility has already taken haulage and material-sales income off the bill.
- **MBT / Residual-MRF** - mechanical-biological-treatment or residual MRF that extracts recyclables from black-bag waste.
- **EfW / Thermal** - energy-from-waste incinerator, gasifier or pyrolysis plant recovering energy from residual waste.
- **Landfill** - inert, non-hazardous or hazardous landfill accepting municipal waste.
- **RDF export** - refuse-derived fuel shipped overseas for energy recovery.

Calculations

A **gate fee** is the price a disposal site charges, per tonne, to accept waste at its gate. A material gate fee is that price after it has been adjusted for a specific material. This is done using the following formula:

$$\text{Net Disposal Cost}_{\text{material,facility}} = \text{Gross Gate Fee}_{\text{facility}} - \text{Calculated Rebate}_{\text{material,facility}}$$

The resulting net disposal cost is equal to the gross gate fee minus the rebate, and is applied only to MRFs and reprocessors, as other outlets do not share sales income.

$$\text{Calculated Rebate}_{\text{material,facility}} = \frac{\text{Gross Gate Fee}_{\text{facility}} - \text{Net Gate Fee}_{\text{facility}}}{\sum_{\text{materials}}(\text{composition}_{\text{material,facility}} \times (\text{material value}_{\text{material}} - \text{Haulage}_{\text{facility}}))} \times (\text{material value}_{\text{material}} - \text{Haulage}_{\text{facility}})$$

For an example local authority,

External Variables	**External Values**	**Local Authority Dependent Variables**	**Local Authority Dependent Values**
Gross Gate Fee $_{MRF}$	£85	LA $_{\text{inc haulage}}$	200
Net Gate Fee $_{MRF}$	£15	LA $_{\text{exc haulage}}$	150
material value $_{plastic}$	£67.50	$\sum_{\text{LAs inc haulage}}$ Gross Gate Fee$_{MRF}$	£20,000

		$\sum_{\text{LAs exc haulage}}$ Gross Gate Fee$_{MRF}$	£9,000
		$\sum_{\text{materials}}$ (composition$_{material,MRF}$ × (material value$_{material}$ − Haulage$_{MRF}$))	£100

The full calculation is as followed, broken down into more detailed steps below:

$$\text{Net Disposal Cost}_{plastic,MRF} = \text{Gross Gate Fee}_{MRF} - \text{Calculated Rebate}_{plastc,MRF}$$

$$\text{Calculated Rebate}_{plastic,MRF} = \frac{\text{Gross Gate Fee}_{MRF} - \text{Net Gate Fee}_{MRF}}{\sum_{materials}(\text{composition}_{material,MRF} \times (\text{material value}_{material} - \text{Haulage}_{MRF}))} \times (\text{material value}_{plastic} - \text{Haulage}_{MRF})$$

Step 1: Work out the haulage element for a MRF

$$\text{Haulage}_{MRF} = \frac{1}{LA_{\text{inc haulage}}} \sum_{\text{LAs inc haulage}} \text{Gross Gate Fee}_{MRF} - \frac{1}{LA_{\text{exc haulage}}} \sum_{\text{LAs exc haulage}} \text{Gross Gate Fee}_{MRF}$$

$$= \frac{1}{200} \text{ £}00 - \frac{1}{150} \times \text{£}9,000$$
$$= \text{£}40$$

- 200 survey responses included haulage; their average gross – net gap is £ (20 000 / 200) = £ 100 / t.
- 150 responses excluded haulage; their gap is £ (9 000 / 150) = £ 60 / t.
- The mid-point—used as our modeled haulage cost—is therefore £ 40 / t.

Step 2: Calculate the rebate that the MRF pays back on plastic

- Gross gate fee (includes haulage) = £ 85 / t
- Net gate fee (already minus haulage and any sales income) = £ 15 / t
- Gross – net gives a £ 70 /t pot that the MRF returns to councils.

This gives a total sales value of material of gross gate fee minus net gate fee (£85 − £15). We share this pot across materials in proportion to (material value$_{material,facility}$ − Haulage$_{facility}$) × composition$_{material,facility}$.

Here LA$_{inc\ haulage}$ and LA$_{exc\ haulage}$ are the numbers of local authorities that include and do not include haulage in the Gate Fee Report, respectively. Hence,

$$\text{Calculated Rebate}_{plastic,MRF} = \frac{\text{Gross Gate Fee}_{MRF} - \text{Net Gate Fee}_{MRF}}{\sum_{materials}(\text{composition}_{material,MRF} \times (\text{material value}_{material} - \text{Haulage}_{MRF}))} \times (\text{material value}_{material} - \text{Haulage}_{MRF})$$

$$= \frac{\text{£85} - \text{£15}}{\text{£100}} \times (\text{£67.50} - \text{£40})$$
$$= \text{£16.50}$$

The denominator £100 is the summed weights for every material at this facility.

Step 3: Derive the net disposal cost for plastic sent to MRF

$$\text{Net Disposal Cost}_{plastic,MRF} = \text{Gross Gate Fee}_{MRF} - \text{Calculated Rebate}_{plastc,MRF}$$
$$= \text{£85} - \text{£16.50}$$
$$= \text{£68.50}$$

Calculating Overheads

All LAs are paid the same per household for overhead costs. These costs reflect the administration, contract management and other LA costs of managing waste disposal functions. including local communication campaigns.

Variables used in this section

- **Disposal Overheads Cost/RFI Households** - For every authority that filled out the RFI, we divided the total annual overheads allocated to disposal (manager salaries, depots, fleet standing costs, IT, etc.) by the number of households it serves. We then average those £-perhousehold figures within each cost-driver group (nation, urbanity, housing mix) so every authority in the same group starts with one common "cost per household".
- **Households** - The number of households within a local authority. The primary data source is the ONS mid-2023 estimate (or NRS/NISRA 2023 for Scotland / Northern Ireland).
- **Collection/Disposal Tonnes** - Taking from the calculating tonnages section. The estimated tonnages collected split by material and stream. Which is the model's best estimate of how many tonnes of packaging each material moves through each part of the system. ** "Material" means the seven packaging categories we track: plastic, paper/card, glass, aluminium, steel, fibre-based composites, and "other". ** Stream" tells us how that material is handled: Collection streams – kerbside residual, kerbside dry recycling, food, garden, bring-site recycling, HWRC recycling, HWRC residual, etc.

Calculations

Overhead costs are calculated using outputs from the Cost per Tonne module. This covers both disposal overheads and HWRC overheads. The calculation can be summarised as:

$$\text{Overheads}_{\text{material,group,facility}} = \text{Cost per Household} \times \text{Number of Households} \times P_{\text{material group,facility}}$$

Where:

- **Cost per Household** - The overhead cost per household, pulled from the RFI. This is the average cost per household for all RFIs. It is equal to Disposal Overheads cost divided by the number of RFI households. These cost-per-household figures are averaged within each group and that single average is applied to all authorities in the group, including non-RFI ones.
- **Number of Households** - The number of households within a local authority
- **P** - Is the proportion of the local authority's total tonnage (disposal and HWRC collection) of both material m and routed to facility f. Because it is a proportion, the overhead pot is split fairly: the more plastic that goes to MRFs, the higher the overhead assigned to "plastic, MRF", and so on.

i.e. for an example local authority:

RFI Authority Variables	RFI Authority Values	Local Authority Variables	Local Authority Values	Other Module Variables	Other Module Values
Disposal Overheads Cost	£550,000	Households	100,000	$\text{Disposal Tonnes}_{\text{plastic, MRF}}$	350
RFI Households	100,000			$\text{Collection Tonnes}_{\text{plastic, HWRC}}$	17.5 tonnes
				$\sum_{\text{materials,facilities}} \text{Disposal Tonnes}_{\text{material,facility}}$	75,000 tonnes
				$\sum_{\text{materials}} \text{Collection Tonnes}_{\text{material,HWRC}}$	12,500 tonnes

Input	Value
Grouped average cost per household	£5.50
Households in local authority (ONS 2023)	100,000
All disposal + HWRC tonnes	87,500
$\text{Disposal Tonnes}_{\text{plastic,MRF}}$	350
$\text{Collection Tonnes}_{\text{plastic,HWRC}}$	17.5

Thus the per tonne disposal overheads for plastic sent to MRF are as follows:

$$\text{Disposal Overheads}_{\text{plastic,MRF}} = £5.50 \times 100,000 \times \frac{350}{87,500}$$
$$= £2,200$$

And the per tonne collection overheads for plastic collected at HWRC are as follows:

$$\text{HWRC Overheads}_{\text{plastic,MRF}} = £5.50 \times 100,000 \times \frac{17.5}{87,500}$$

$$= £110$$

HWRC Collection Overheads: Local authorities incur two kinds of costs at their Household Waste & Recycling Centres (HWRCs): the day-to-day cost of running the sites (staff, containers, site management) and the back-office overheads that support the service (depot rents, vehicles held on standby, IT, management time). LAPCAP builds both elements into the payment model.

Cost per Household: This is how the cost per household is calculated from each RFI. These cost per households are averaged over all RFI local authorities, and the same cost per household is applied to all local authorities.

$$\text{Cost per Household} = \frac{\text{Disposal Overheads Costs}}{\text{RFI households}}$$

$$= \frac{£114,000}{100,000}$$

$$= £1.14$$

Disposal Overheads:

$$\text{Disposal Overheads}_{\text{plastic,MRF}} = \text{Cost per Household} \times \text{Households} \times \frac{\text{Disposal Tonnes}_{\text{plastic,MRF}}}{\sum_{\text{materials,facilities}} \text{Disposal Tonnes}_{\text{material,facility}} + \sum_{\text{materials}} \text{Collection Tonnes}_{\text{material,HWRC}}}$$

$$= £5.50 \times 100,000 \times \frac{350}{75,000 + 12,500}$$

$$= £2,200$$

The RFI returns also list total disposal overheads. We turn these into a cost-per-household (overhead £ ÷ households served) and again average by group. For an individual council we multiply that £/household by its latest household count (ONS mid-2023, or NRS/NISRA for Scotland and Northern Ireland). We then allocate part of the resulting pot to HWRCs in proportion to how much of the council's waste passes through them, and finally split that HWRC share across materials according to each material's share of HWRC tonnage. In the worked example this adds about £110 of overhead to the small amount of plastic delivered via HWRCs, on top of the direct CPT described above. By combining a representative CPT with a fair share of overheads, the model captures the full, real-world cost of managing packaging waste that residents bring to HWRC sites.

HWRC Collection Overheads:

$$\text{HWRC Overheads}_{\text{plastic,MRF}} = \text{Cost per Household} \times \text{Households} \times \frac{\text{Collection Tonnes}_{\text{plastic,HWRC}}}{\sum_{\text{materials,facilities}} \text{Disposal Tonnes}_{\text{material,facility}} + \sum_{\text{materials}} \text{Collection Tonnes}_{\text{material,HWRC}}}$$

$$= £5.50 \times 100,000 \times \frac{17.5}{75,000 + 12,500}$$

$$= £110$$

So each tonne of plastic inherits £110 of HWRC overhead (on the small amount delivered via HWRCs) and £2200 of disposal overhead (on the bulk sent to the MRF). The same method is repeated for every other material and facility.

Combining Costs

Variables used in this section

Variable	What it covers	Data Source and Year	Why this is included
Density	Kilograms-per-cubic-metre used to convert tonnes into volume when apportioning mixed costs.	WRAP Bulk Density Report 2021.	Volume is needed to share some costs (e.g. communal-bin collections) fairly across materials.
Overheads	The "back-office" costs calculated in the previous section (management, depots, fleet standing charges, IT, etc.).	RFI survey 2023-24, scaled by 2023 household counts.	HWRC overheads are £0 in the residual-waste example because no residual tonnes enter HWRCs; they would be >0 for recycling streams that do.

Collection/Disposal cost adjustment	Extra £/t given to councils that joined the 2024-25 Flexible Plastics Trail to cover additional handling costs.	Defra notification letters 2024-25.	Applied only to participating LAs.
Net Gate Fee	The disposal cost after deducting haulage and material-value rebates. Non-zero for MaterialRecovery Facilities and reprocessors, zero for EfW, landfill, MBT, RDF export and "Other".	WRAP Gate-Fee Survey 2023-24 (plus Defra/Welsh Government supplements for reprocessors & MBT).	Only MRFs and reprocessors share sales income with councils, so only they need a net-of-rebate figure.
MF operational CPT & regulator CPT	Operational CPT – average cost per tonne to run a material facility (staff, maintenance, energy) taken from industry accounts and RFI returns (FY 2023-24). Regulator CPT – per-tonne fee that MFs must pay the new packaging regulators (England £2240, Wales £2310, Scotland £2310, NI £2310 per site, converted to a £/t rate using national MF tonnages).	Industry financials 2023-24 and Scottish/English regulator impact assessments 2023.	Covers the admin side of running and regulating MFs so the model pays the full economic cost, not just the gate fee.
Recycling Credit (RC)	The statutory payment that Waste Disposal Authorities (WDAs) make to their Waste Collection Authorities (WCAs) for dryrecycling tonnage, equal to avoided disposal cost.	Calculated with the standard formula in the Environmental Protection Act 1990 using 202324 cost data.	Shown as a positive figure for WCAs (receiving funds) and a negative figure for WDAs (deducted funds), keeping the system revenue-neutral overall.

Together, these inputs allow the model to calculate:

$$\text{Total Net Cost} = (\text{Collection Cost} + \text{HWRC Overheads} + \text{adjustment}) + (\text{Net Disposal Cost} + \text{Disposal Overheads} + \text{MF Operational and Regulator Costs} + \text{adjustment}) \pm \text{RecyclingCredit}.$$

Calculations

Local authorities are paid the sum of the total net cost, including recycling credits, for all materials that are in scope for pEPR. The final calculation can be summarised as:

$$\text{Total Net Cost inc RC} = \sum_{\text{materials}} \text{Total Collection Cost}_{\text{material}} + \sum_{\text{material,facilities}} \text{Total Net Disposal Cost}_{\text{material,facility}} + \text{Recycling Credit Payment}$$

Where:

Value	How the value is calculated	What the value means
Total Collection Cost	Collection costs + HWRC overheads + Collection cost adjustment	Gives the full cost of collecting EPR eligible packaging waste e.g. at kerbside, HWRCs and bring sites.
Total Net Disposal Cost	Net Gate Fee + Disposal Overheads + MF Opperational costs + MF Regulator costs + Disposal cost adjustment	Gives the full costs of processing and treating EPR eligible packaging waste after collection.
Recycling Credit payment	Standard EPA 1990 methodology, where WCAs receive the credits while WDAs pay them.	Ensures two-tier areas are revenue-neutral between WCAs and WDAs.

Firstly, the collection costs calculations are displayed for an example local authority with the following accompanying variables:

Local Authority Variables	Local Authority Values	Other Module Variables	Other Module Values	External Variables	External Values
Households (ONS 2023)	100,000	$\text{Collection Tonnes}_{\text{plastic, residual}}$	2,000 tonnes	$\text{Density}_{\text{plastic (WRAP 2021)}}$	0.04 T/m^3

		$\sum_{materials,streams}$ Residual Collection Cost$_{material,stream}$	£1,860,000	Collection Cost Adjustment$_{plastic}$ (2024-2025 grant for flexible palstics)	£1,580
		CPT$_{residual}$	£66	Collection Cost Adjustment$_{plastic}$	£1,580
		HWRC Collection Costs$_{plastic}$	£0		
		$\sum_{materials}$ V olume$_{material}$ for Residual	250,000m^3		

$$\text{Total Collection Cost}_{plastic,residual} = \text{Collection Cost}_{plastic,residual} + \text{HWRC Collection Overheads}_{plastic,residual} + \text{Collection Cost Adjustment}_{palstic}$$

where, Collection Tonnes$_{plastic,residual}$

$$\text{V olume}_{plastic,residual} = \frac{}{\text{Density}_{plastic}}$$

$$= \frac{2,000}{0.04}$$

$$= 50,000\text{m}^3$$

$$\text{Collection Cost}_{plastic,residual} = \text{Collection Tonnes}_{plastic,residual} \times \text{CPT}_{residual}$$

$$= 2,000 \times £66$$

$$= £132,000$$

Assuming that,

$$\sum_{materials} \text{V olume}_{material} = 250,000\text{m}^3$$

The above is approximately the volume of waste from an average medium-sized local authority collected ~10 000 tonnes of residual waste at an overall density of 0.04t/m³.

$$\sum_{materials,streams} \text{Collection Cost}_{material,stream} = £1,860,000$$

This gives a realistic order-of-magnitude residual collection cost taken from the mid-range of the 2023-24 RFI returns. Because this amount could not split by material, we assume the fairest proxy is each material's share of the volume on the vehicle. Plastic accounts for 20 % of residual volume and so receives 20 % of the mixed pot, as below:

$$\text{Collection Cost}_{plastic,residual} = \frac{\text{V olume}_{plastic,residual}}{\sum_{materials} \text{V olume}_{material,residual\ materials,streams}} \times \sum \text{Collection Cost}_{material,streams}$$

$$= \frac{50,000}{250,000}$$

$$= £372,000 \times £1,860,000$$

Therefore,

$$\text{Total Collection Cost}_{plastic} = \text{Collection Cost}_{plastic} + \text{HWRC Collection Overheads}_{plastic} + \text{Collection Cost Adjustment}_{plastic}$$

$$= £372,000 + £0 + £1,580$$

$$= £373,580$$

Here the HWRC overheads costs are £0 as there are no HWRC collection costs for a residual stream. Now, the calculations for total net disposal costs are shown for an example local authority:

Local Authority Variables	**Local Authority Values**	**Other Module Variables**	**Other Module Values**	**External Variables**	**External Values**
Households	100,000	Disposal Tonnes$_{plastic,\ MRF}$	350 tonnes	MF Operational CPT	£0.60
		Net Gate Fee$_{MRF,\ plastic}$	£12	Regulator CPT$_{country}$	£0.04

		Disposal $\text{Overheads}_{plastic}$	87,500 tonnes	Disposal Cost $\text{Adjustment}_{plastic}$	£1,540

$$\text{Total Net Disposal Cost}_{plastic,MRF} = \text{Net Disposal Cost}_{plastic,MRF} + \text{Disposal Overheads}_{plastic,MRF} + \text{MF Costs}_{MRF,plastic} + \text{Disposal Cost Adjustment}_{plastic}$$

where,

$$\text{Net Disposal Cost}_{plastic,MRF} = \text{Disposal Tonnes}_{plastic,MRF} \times \text{Net Gate Fee}_{MRF,plastic}$$
$$= 350 \times £12$$
$$= £4,200$$

The Net Disposal cost is the gate fee the local authority pays post-haulage minus the material value rebates.

$$\text{MF Costs}_{MRF,plastic} = \text{Disposal Tonnes}_{MRF,plastic} \times (\text{MF Operational CPT} + \text{Regulator CPT}_{country}) = 350 \times (0.6 + 0.04)$$
$$= £224$$

The MF Costs are the MRF's operating costs plus the new regulator levy.

Therefore,

$$\text{Total Net Disposal Cost}_{plastic,MRF} = \text{Net Disposal Cost}_{plastic,MRF} + \text{Disposal Overheads}_{plastic} + \text{MF Costs}_{MRF} + \text{Disposal Cost Adjustment}$$
$$= £4,200 + £2,200 + £224 + £1,540$$
$$= £8,164$$

$$\text{Total Net Cost inc RC} = \sum_{materials,streams} \text{Total Collection Cost}_{material,stream} + \sum_{material,facilities} \text{Total Net Disposal Cost}_{material,facility} - \text{Recycling Credit Payment}$$
$$= £1,494,320 + £642,000 = £2,136,320$$

Here recycling credit payment is 0 as the example local authority is a unitary authority so recycling credits do not apply. This is the final figure that a local authority is paid.

Example: How a Recycling Credit transfer between a WCA and WDA works

Under S.52 of the Environmental Protection Act 1990 the credit equals the WDA's avoided residual-disposal cost, when the WCA retains waste for recycling. This avoided cost is included in the WDA's total payment, who then need to pay the Recycling Credit amount to the appropriate WCA.

Step 1: Work out the Recycling Credit £/t Assume the WDA's most recent audited figures show: • Residual net gate fee (EfW + landfill) = £48/t • Disposal overhead allocated to residual stream = £12/t

$$\text{Recycling Credit CPT} = £48 + £12$$
$$= £60/t$$

Step 2: Apply the Recycling Credit to the WCA's dry recycling tonnage An example WCA collects 10,000t of packaging via its kerbside dry recycling scheme.

$$\text{Recycling Credit} = 10,000 \times £60$$
$$= £60,000$$

Step 3: Apply the credit to the WCA and WDA's payment formula

class="wide-column">Payment Element	class="wide-column">WCA	class="wide-column">WDA
Sum of Collection Costs	£1,200,000	£0
Sum of Net Disposal Costs	£120,000	£3,600,000
Recycling Credit	-£600,000	£600,000
Total Payment	£720,000	£4,200,000

The WDA's payment increases by the full £600,000 because the WCA has removed that quantity of packaging from the residual stream, and the WDA will need to pay the WCA this amount. This amount payable by the WDA is deducted from the WCA. Nationally these two cashflows cancel out, keeping the overall pEPR budget neutral while still giving WCAs a clear financial incentive to recycle.

Deductions in line with regulation 62 of the Producer Responsibility Obligations Regulation 2024

A very small deduction (averages less than 0.4%) has been applied to all LAs to ensure that total payments do not exceed the amount we are able to recover from producers using the fee formula in regulation 62 of the Producer Responsibility Obligations Regulation 2024. We are currently in the process of amending this formula so that a deduction is not required in future assessment years. Deductions have been allocated across LAs in proportion to their existing costs of managing material from each material category. This means we have to deduct a total of £5,339,603.398 across all LAs. We have done this for each LA as follows:

$$\text{Proportion of Total EPR cost} = \frac{\text{Total Net Cost inc RC}}{\sum_{\text{Local Authorities}} \text{Total Net Cost inc RC}_{\text{Local Authority}}}$$

$$\text{Deduction Amount} = £5,339,603.398 \times \text{Proportion of Total EPR Cost}$$

$$\text{Total Net Cost inc RC and Deduction} = \text{Total Net Cost inc RC} - \text{Deduction Amount}$$

Therefore, for an example local authority whose Total Net Costs including Recycling Credits are £1,500,000, where the sum of all local authorities' Total Net Costs including Recycling Credits is £5,000,000,000:

$$\text{Proportion of Total EPR cost} = \frac{£1,500,000}{£5,000,000,000} = 0.0003$$

$$\text{Deduction Amount} = £5,339,603.398 \times 0.0003 = £1,601.88$$

$$\text{Total Net Cost inc RC and Deduction} = £1,500,000 - £1,601.88 = £1,498,398.12$$