

Modelling carbon in waste streams

Rachel Espinosa – Strategic Advisory Lead
Ioanna Kyriazi – Consultant

NLWA Waste Prevention Exchange 2022
2nd March 2022

© Ricardo plc 2017

Recycle

Emission



Climate
change

Business

Environment

Industry

www.ricardo.com

Energy
saving

Ricardo's Carbon Management experience



Supporting the UK Government

Calculation of BEIS emission factors



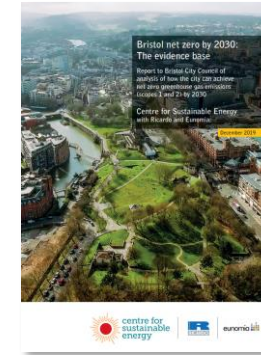
Supporting public bodies

Contribution to The Committee on Climate Change's Net-Zero report

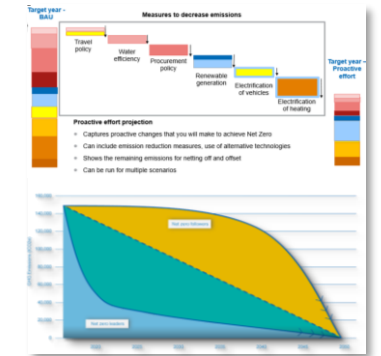


Supporting Local Authorities and cities

Helping the city of Bristol towards carbon neutrality by 2030

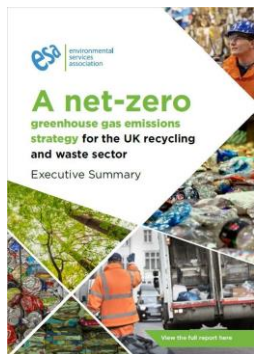


Producing emission projections and trajectories

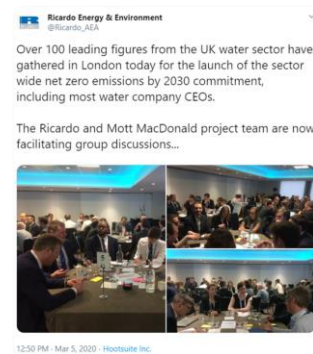


Supporting industry sectors

Developing the recycling & waste sector's net-zero roadmap



Developing the water sector's net-zero roadmap



Developing the Scotch Whisky Assoc's net-zero roadmap



QAS Independent auditor for carbon offsetting services



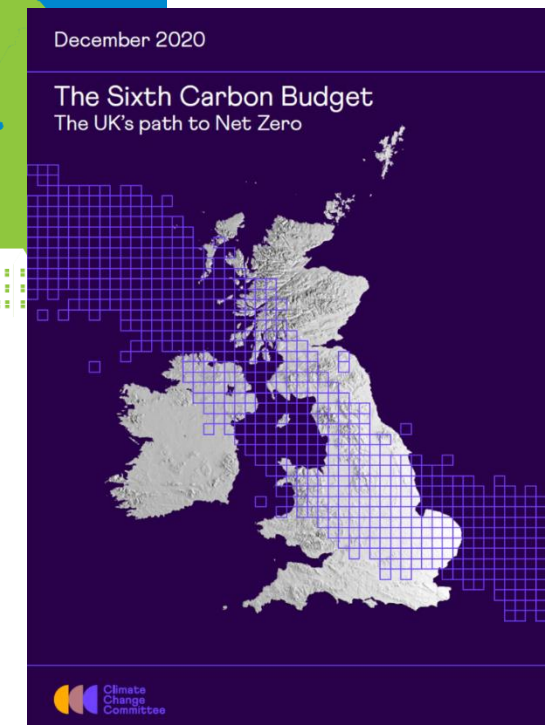
Carbon footprinting and verifying services



UK Net Zero Agenda

- 2019 Climate Change Act set GHG emission reduction target for the UK of 100% by 2050 (Net Zero target).
- The Committee on Climate Change (CCC) establishes five-year national carbon budgets to achieve this target.
- The Sixth Carbon budget is the first to be announced since the 2019 Amendment to the Climate Change Act.

- PPN 06/21 Suppliers Carbon Reduction Plans:
 - Published on the supplier's website
 - Signed off at an appropriate level within 12 months of the date of the procurement
 - Confirms the supplier's commitment to achieving Net Zero by 2050 (at the latest)
 - Details the supplier's Greenhouse Gas emissions
 - Details the environmental management measures that can be applied in the delivery of the contract.





31st July 2019

Basingstoke and Deane Borough Councillors declare climate crisis



Climate emergency declared by Belfast City Council

🕒 2 October 2019

Suffolk county councillors vote to declare a 'climate emergency'

Surrey declares climate emergency as campaigners stage "die-in"

BY RUTH HAYHURST ON JULY 9, 2019 • (22 COMMENTS)

Warwickshire County Council has declared a climate emergency.

By Oliver Williams

Friday, 26th July 2019, 12:54 pm

'Climate emergency' declared in Leicestershire

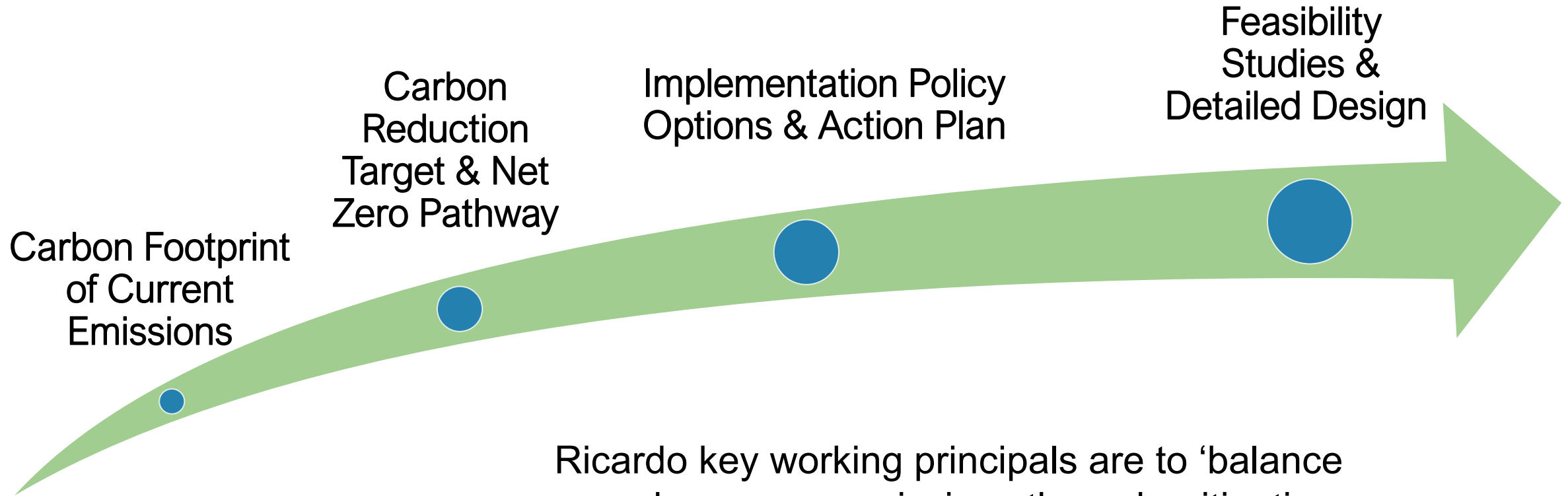
The authority aims to become carbon neutral by 2030

Machynlleth declares 'climate emergency'

By Steffan Messenger
BBC Wales Environment Correspondent

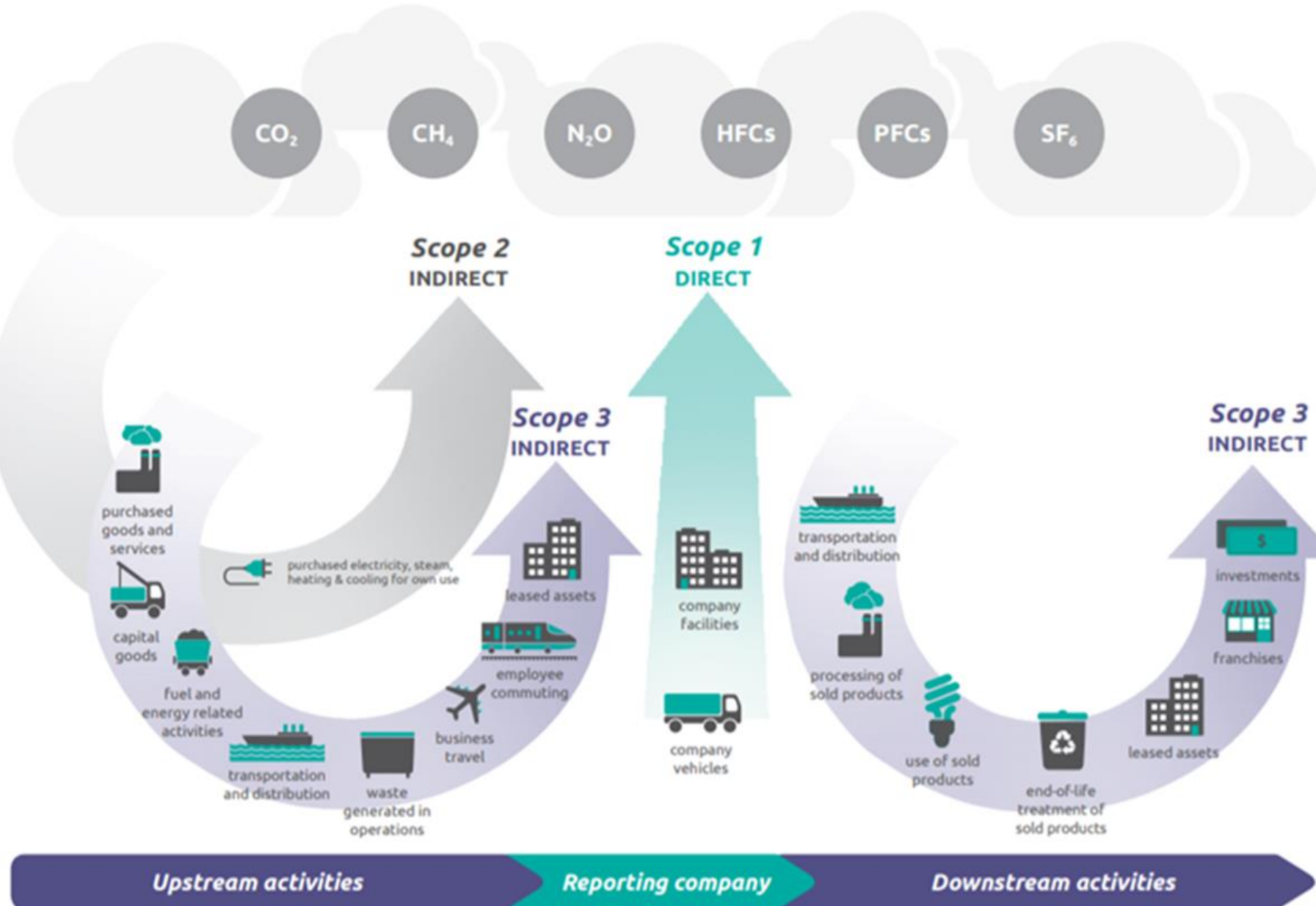
🕒 24 January 2019

Action on Waste Services



Ricardo key working principals are to ‘balance greenhouse gas emissions through mitigation measures and removal from atmosphere, within your local authority boundaries, over time’.

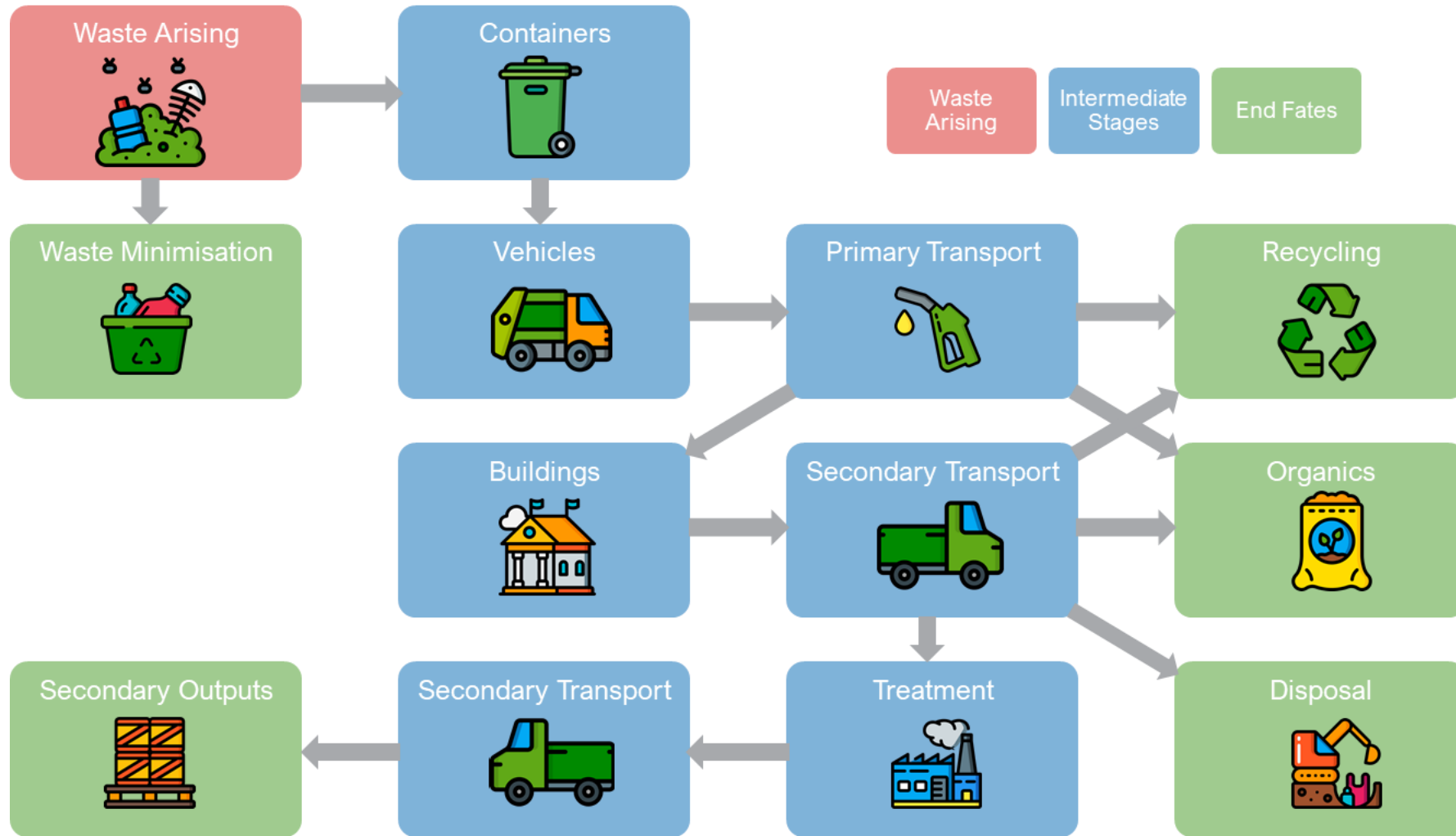
Carbon Footprint of Waste Services



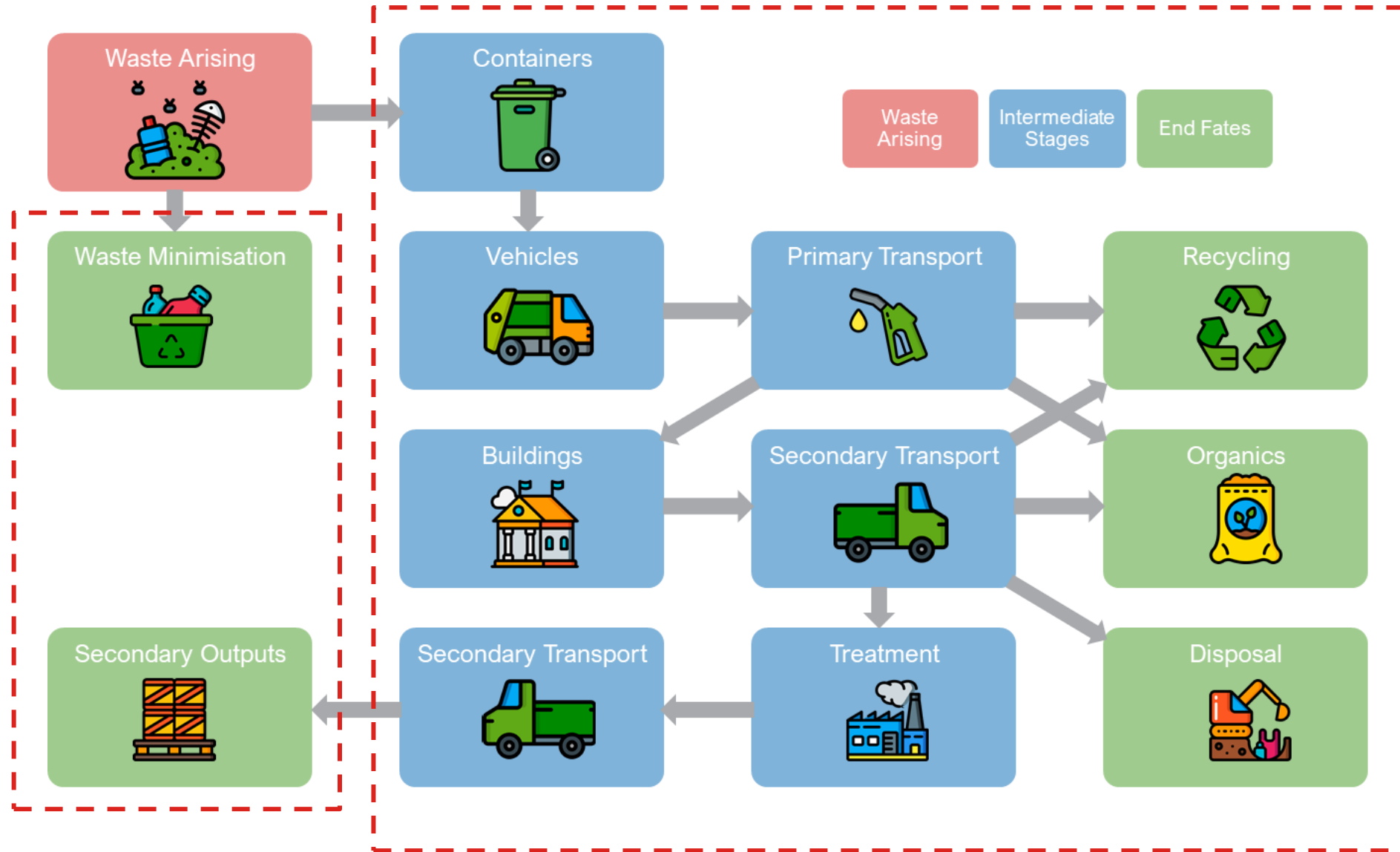
Measuring Scope 3: Other indirect GHG emissions - is optional but demonstrates leadership.

Avoided emissions – when an activity leads to avoiding emissions that would otherwise have occurred elsewhere e.g through reuse or recycling.

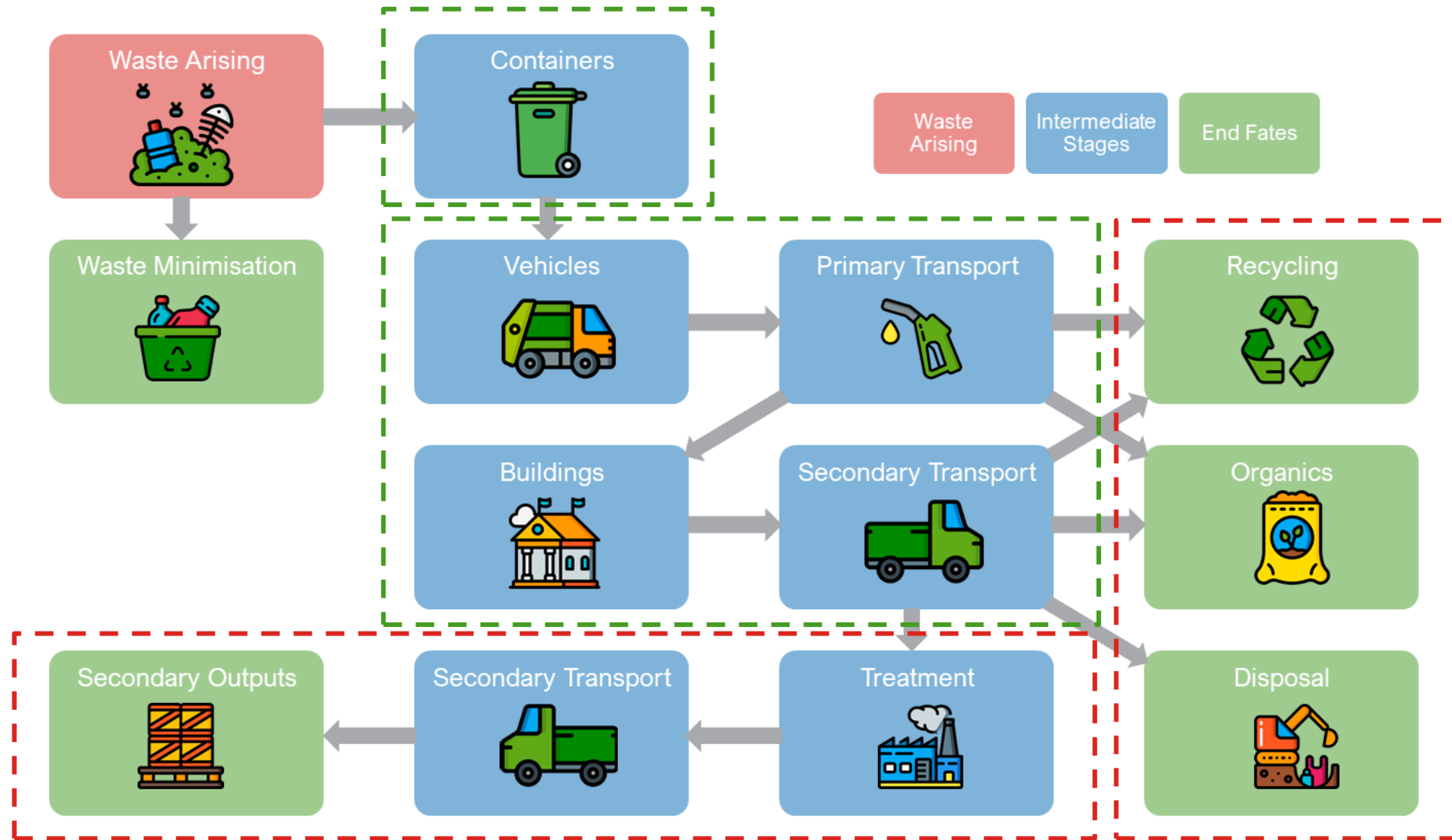
Whose carbon is it anyway?



Wholly contracted out service = Scope 3



In-house service



Data and Modelling Carbon Emissions

- Data discrepancies:
 - Different data sources provide different values.
 - Inconsistencies: Different councils and countries use different material categories.
- Destinations: are not always known.
- Emission Factors:
 - No widely accepted metric.
 - Processing factors vary significantly.
 - Published emissions factors for waste management do not allow reporting in Scope 1, 2 & 3.
- Scope: Organisations find it hard to define their boundaries.
- Operational data is often confidential.
- Tools are based on Life Cycle Assessment data that is often old e.g. WRATE, the tool that can provide data for processes and operations, is more than 10 years old.
- Most processes need tailored Life Cycle Assessments for each facility.



GHG modelling tools and metrics



Carbon Waste and Resources Metric

EpE Tool

- Created in 1992 by EpE working group: Séché Environnement, Suez and Veolia + others
- Updated regularly
- Transparent data entry and calculations

Ricardo Updates

- Added functionalities to select:
 - between IPCC Assessment Reports - AR 4 or 5
 - a time horizon for GWP – 20, 100 or 500 years
- Emissions factors



Scope	Methodologies
Direct emissions (Scope 1)	BEIS Conversion Factors
	Ecoinvent
	National Atmospheric Emissions Inventory (NAEI)
	Inter-governmental Panel Climate Change (IPCC)
Indirect emissions (Scope 2)	Protocol for quantification of GHG emissions from waste management activities
	Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME)
Avoided emissions (Scope 3)	BEIS Conversion Factors
	Scottish Carbon Metric



Protocol for the quantification of GHG emissions from waste management activities

Waste Management Activities

- Transport & collection
- Sorting / transfer / recycling
- Anaerobic digestion
- Composting
- Waste derived fuel
- MBT
- Landfill
- Thermal Treatment

	Used quantities kWh
CNG Energy	307,417,261
Diesel (average biofuel blend) Energy	7,414,517,127
Petrol (100% mineral blend) Energy	3,793,699,854
Gas oil Energy	5,445,737,468
Marine gas oil Energy	2,530,238

	Produced and sold quantity kWh
Sold energy production area	
Electricity Energy	5,071,800,267

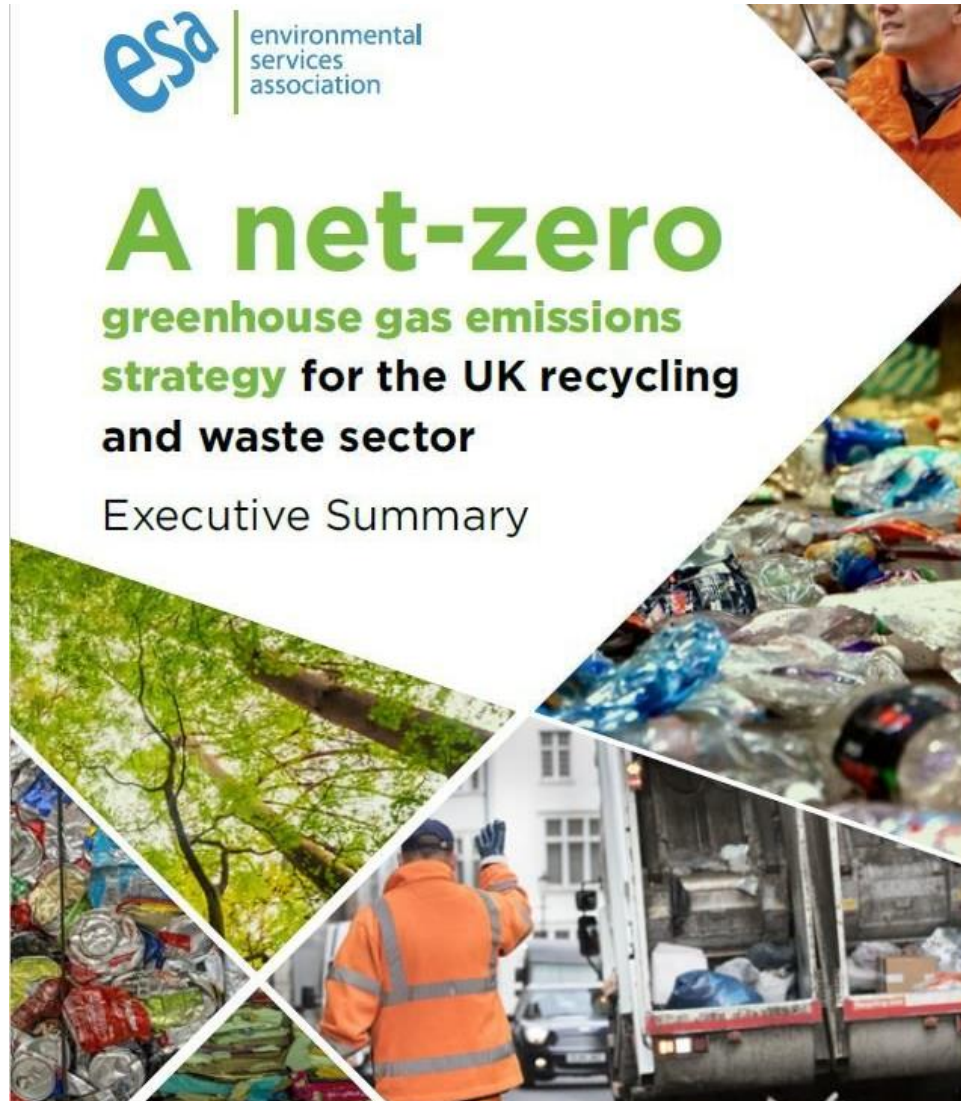
Incinerated waste type	Incinerated quantity Tonnes
Hazardous (EfW) Weight	133,168
Clinical Waste (EfW) Weight	60,038
Combustible (EfW) Weight	1,040,051
WEEE (EfW) Weight	744
Glass (EfW) Weight	132
Residual MSW (EfW) Weight	5,861,945
Residual C&IW (EfW) Weight	2,310,618
Metals (EfW) Weight	4,409
Rubble (EfW) Weight	38,075
Fines (EfW) Weight	12,315
Paper (EfW) Weight	2,777
Dense Plastic (EfW) Weight	2,301
Hazardous (EfW) Weight	51,504
Soil (EfW) Weight	284
Textiles (EfW) Weight	217
Combustible (EfW) Weight	1,888
Food (EfW) Weight	53,132
Wood (EfW) Weight	1,650,436

EpE Tool Data Outputs

ACTIVITIES	DIRECT EMISSIONS in tonnes CO2e (scope 1)		INDIRECT EMISSIONS DUE TO ENERGY in tonnes CO2e (scope 2)		AVOIDED EMISSIONS in tonnes CO2e	
Transport and collection	Fossil fuel consumption	-	Electricity consumption	-		
Sorting - Transfer	Fossil fuel consumption	-	Electricity consumption	-	Recycling of secondary materials	-
	Emissions from fluorinated gases	-			Recovery of solid recovered fuels	-
Anaerobic Digestion	Fossil fuel consumption	-	Electricity consumption	-	Heat recovery from biogas	-
	AD process	-			Electricity recovery from biogas	-
	Direct emissions from biogas combustion	-			Agronomic use of compost	-
Composting	Fossil fuel consumption	-	Electricity consumption	-	Agronomic use of stabilat	-
	Composting process	-			Agronomic use of compost	-
Waste-derived fuel preparation	Fossil fuel consumption	-	Electricity consumption	-	Recovery of solid recovered fuels	-
MBT	Fossil fuel consumption	-	Electricity consumption	-	Recovery of solid recovered fuels	-
	Biodrying	-			Recycling of secondary materials	-
	Stabilization	-			Agronomic use of compost	-
	Anaerobic Digestion	-			Heat recovery from biogas	-
	Composting	-			Electricity recovery from biogas	-
	Refining	-				
Landfilling	Fossil fuel consumption	-	Electricity consumption	-	Heat recovery from biogas	-
	Methane emissions	-			Electricity recovery from biogas	-
	Direct emissions from biogas combustion	-				
Thermal treatment	Fossil fuel consumption	-	Electricity consumption	-	Electricity recovery from waste	-
	Thermal processes	-			Heat recovery from waste	-
		-			Recycling of secondary materials	-
		-			Recycling of bottom ash	-
				Recycling of slag	-	
Total		-		-		-

Modelling UK Waste Sector Emissions

Recycling and Waste Net Zero policy context



In 2020/21 Ricardo calculated the first detailed study to quantify Greenhouse Gas emissions from the UK Recycling and Waste Sector.

This forms the baseline for the Environmental Services Association's Net Zero Strategy.

Target: Net Zero by 2040

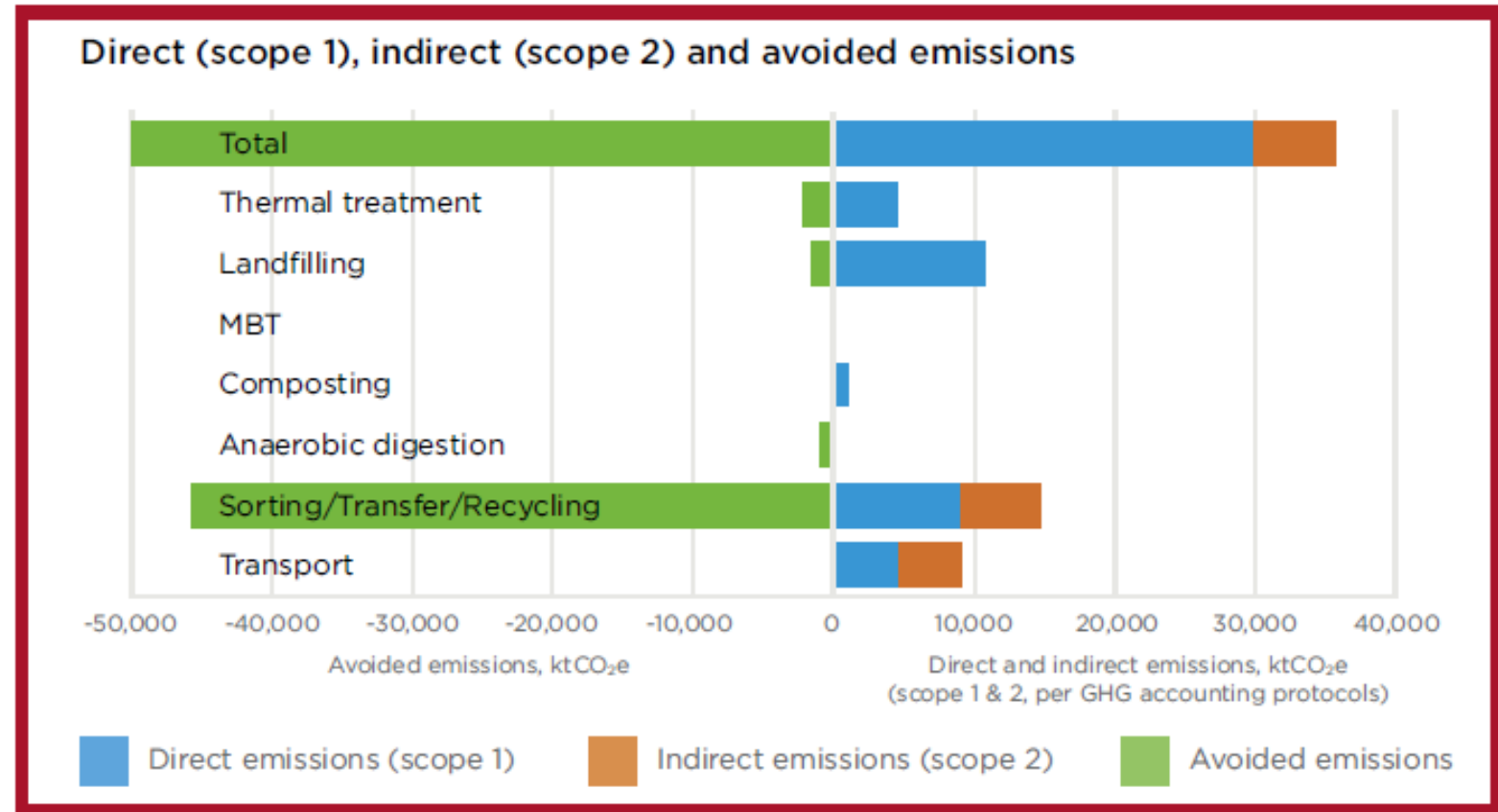
UK Waste Sector GHG Emissions (Tonnes CO₂eq)













Inclusions

- Municipal Solid Waste
- Commercial & Industrial
- Construction & Demolition
- Hazardous & Clinical

Recycling & waste management activities

- Collection and transportation
- Transfer stations
- Mechanical pre-treatment (dismantling)
- Sorting, recycling and material recovery
- Physicochemical treatment
- Biological treatment (composting, in-vessel composting, anaerobic digestion)
- Landfilling
- Thermal treatment
- Mechanical biological treatment (MBT)

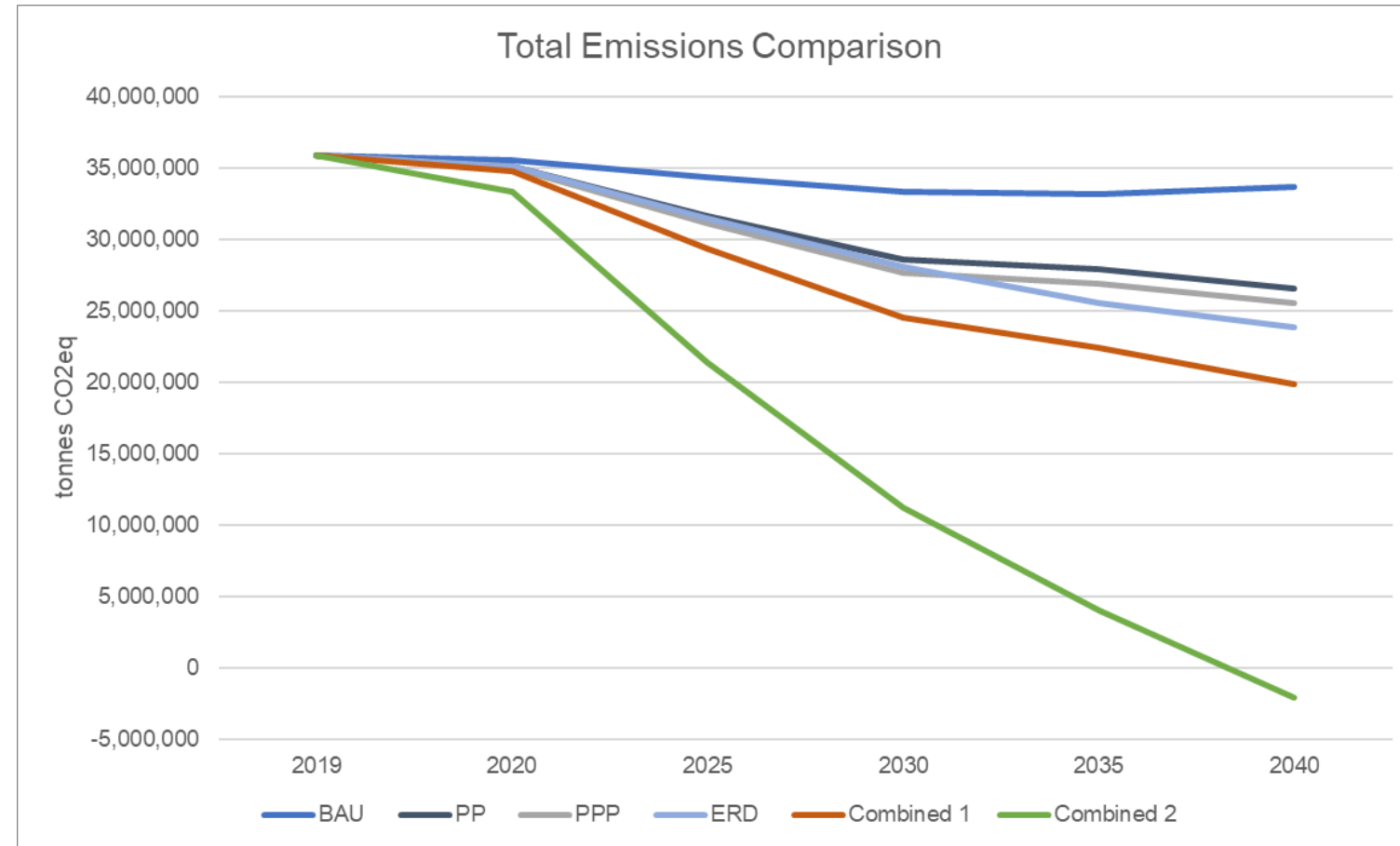


Ambitious Measures to Reduce Emissions		Tonnes CO ₂ eq	Reduction 100%
	Landfill methane capture	- 35,814,498	20.9%
	Waste processing facilities transition from fossil fuels to electricity	- 7,483,172	20.8%
	CCUS at EfW Plants	- 7,462,804	15.3%
	Full National Grid decarbonisation by 2040 (beyond current projections)	- 5,486,869	9.4%
	Transport & WTS vehicles transition from diesel to zero emissions sources	- 3,361,981	7.9%
	Efficiency savings at recycling reprocessing plants	- 2,812,844	7.7%
	Food waste collections (C&I + HHLD)	- 2,761,013	6.7%
	Divert plastics from EfW plants	- 2,396,789	5.6%
	Waste prevention measures	- 2,021,572	4.8%
	Extended Producer Responsibility	- 1,708,281	0.4%
	Deposit Return Scheme	- 138,004	0.3%
	Landfill biodegradable ban	- 108,378	0.2%

Ricardo's Net Zero Gap Analysis Tool



- Project emissions under Business as Usual (BAU)
- Test different carbon mitigation scenarios
- Simulate future emissions pathways
- Combine multiple alternative scenarios, resulting in a Net Zero trajectory
- Apply to an organisation's own estate, across a city wide area or defined operation
- Quantify carbon mitigation measures and their impacts
- Annual or five yearly milestones








Comparing the carbon impacts of HWRC and Kerbside Collected materials

- Ricardo was commissioned to examine the carbon impacts of collecting various waste streams at HWRCs compared with the impacts of collections via kerbside collections.
- Work included the development of a bespoke tool that allows users to vary inputs such as tonnes collected and distances travelled, complete the necessary calculations and summarise the outputs.
- Model includes emissions from drop-off/collection, transfer, processing, treatment and disposal.
- Results report emissions from fuels separately to allow for reporting of scope 1 and 2 emissions and emissions are also reported separately per stream, material, stage and tonne.
- Tool assisted Oxfordshire with planning their approach towards net zero.
- February 2022 phase 2: expand the model to allow a broader scope, greater flexibility and the comparison of various scenarios in time.

**Get in touch to find out
how we can help you.**

Rachel Espinosa

 +44 (0) 1235 753 498
 rachel.espinosa@ricardo.com
 ee.ricardo.com

Ricardo Energy & Environment
The Gemini Building
Fermi Avenue
Harwell, Didcot
OX11 0QR