



## Background and Purpose

The E-ledgers Institute (ELI) provides support and expertise to organizations interested in piloting the E-ledgers methodology on a pro bono basis. As mutually agreed upon by the pilot organization and ELI, the purpose of this report is to summarize the objectives, design, processes, and insights from the completed pilot project for the pilot organization, ELI, potential pilot organizations and partners, and the general public.

## Project Objectives

Yorkshire Water (YW) partnered with ELI to test whether the E-liability approach would provide greater decision usefulness and carbon reduction to YW and its value chain, compared to existing approaches.

The aim of the pilot was to apply the E-liability approach to establish the specific emissions embedded in treated water. The pilot also involved collaboration with Feralco Group, a supplier of ferric sulphate—a coagulant widely used in the water treatment process. The pilot therefore sought to:

- Use E-liability principles to calculate emissions associated with a cubic megaliter (MI) of treated water from an individual water treatment works.
- Understand the relative contribution of ferric sulphate to overall treatment works emissions and determine whether it offered a significant opportunity for carbon reduction.
- Evaluate the E-liability approach in improving the accuracy of value chain data and realizing opportunities for carbon reduction that conventional methodologies might not identify.

## Project Design and Scope

YW is a British water supply and wastewater treatment company, covering the county area of Yorkshire. As a business operating in a regulated sector, YW is required to report enterprise-level greenhouse gas (GHG) emission totals and has financially incentivized regulatory carbon performance targets. Additionally, YW is committed to achieving net-zero by 2050.

Feralco is a Swedish chemical business operating in the UK as Feralco UK Ltd. Feralco manufactures water treatment and process chemicals, including ferric sulphate procured by YW. Piloting E-liability in partnership with Feralco enabled access to supplier-specific, primary data—critical for the E-liability approach, as it gives a level of accuracy and transparency that industry average emissions factors do not provide. In addition, this provided Feralco with an understanding as to how E-liability might inform decarbonization-related decision-making within their procurement and production processes.

Currently, YW undertakes an enterprise-level assessment of total embedded emissions allocated to a cubic megaliter (MI) of water (tonnes CO<sub>2e</sub>/MI) using a standardized water sector tool: the Carbon Accounting Workbook (CAW). However, this tool does not capture site-level variances nor take a full allocation approach, and so the resulting data has limited decision-usefulness. Across YW's network of water treatment works, treatment inputs and processes (e.g., chemical procurement, energy usage) differ according to location-specific

drivers, such as local environmental conditions which influence raw water quality in that catchment area, or quality requirements for treated water. The scope of this pilot therefore applied the E-liability methodology to consider the cradle-to-gate emissions associated with clean water treatment at a single treatment works in West Yorkshire. This presented opportunities to enable site-specific emission reduction actions and inform YW's longer-term planning to meet its net-zero by 2050 target.

The project was sponsored by YW's Head of Commercial and delivered by colleagues within the Sustainable Business, Innovation, and Commercial teams. The project also engaged colleagues working at the pilot water treatment works, who provided site-specific operational information and data, as well as internal stakeholders working in energy, facilities, procurement, and operational teams. ELI provided advisory support throughout.

Following the initial process mapping and hotspot assessment, Feralco was invited to join the pilot and test the E-liability approach to the production and transportation of the ferric sulphate supplied to the YW pilot site.

## Process and Results - Yorkshire Water

### Data Collection and Emissions Calculation

YW's analysis focused on calculating the emissions embedded in a cubic liter of treated drinking water at a water treatment works located in West Yorkshire, using a cradle-to-gate boundary.

The first task was to undertake process mapping and emissions hotspot assessment. The cradle-to-gate boundary was defined as the point at which the raw water is received at the treatment works, to the transmission of cleaned water to a service reservoir/main for human consumption. This included waste products generated from the water treatment process, such as wastewater and refuse/recycling.

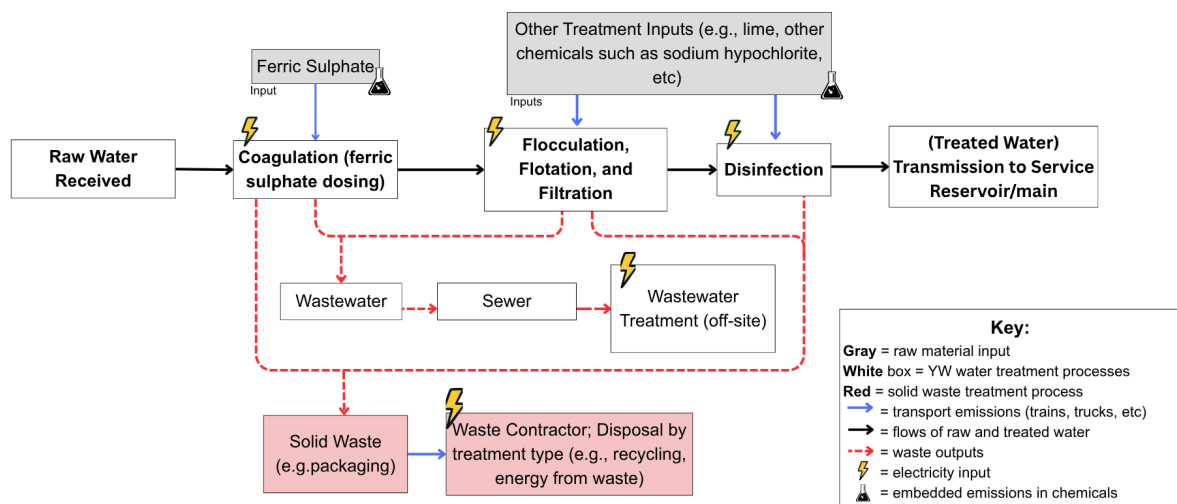


Figure 1: Simplified diagram of the production process and key inputs at the water treatment works.

Raw water quality variability and variances in production volumes impact the usage of electricity and chemicals usage across each individual production stage, so emissions were assessed and allocated to output units (a cubic liter of treated drinking water) across a 12-month period (2024-2025 financial year) to account for this variability.

Site-specific primary data was obtained from a variety of sources. Electricity data was sourced from the works' metered usage on a half-hourly basis and multiplied by the UK grid electricity emissions factor, then allocated to the processing of raw water at the site for the relevant financial year. Primary data on chemicals usage, wastewater, and waste materials was obtained from YW's ERP, procurement, and operational systems, as well as engagement with suppliers.

The raw water catchment at the water treatment pilot site is gravity-fed into the treatment works, so there were no emissions associated with this stage.

Emissions from chemicals were determined by usage across the 12-month period using best available emissions factors (e.g., emissions factors identified by a water sector workshop held in 2023 and codified in CAW). In the case of ferric sulphate, emissions data was initially obtained from a cradle-to-gate lifecycle assessment (LCA) produced by the European Inorganic Coagulants Producers Association (INCOPA).

Wastewater arising from the water treatment process and general site facilities is sent to the sewer. The volume of wastewater discharged to sewer is measured on site, and the calculated emissions value includes all operational emissions sources arising from wastewater treatment, including energy, fuel use, and wastewater-related emissions from nitrous oxide and methane gasses.

Water treatment also generates a relatively small amount of solid waste (e.g., packaging) on-site. Emissions data was obtained from YW's waste contractor and included transport from the water treatment works and emissions arising from the volume of waste disposed of by treatment type (e.g., recycling, energy from waste).

Other site-specific overheads, such as general consumables and repair and maintenance services, were estimated based on spend and service-type using UK government GHG emissions factors.

## Analysis and Results

Applying the E-liability approach enabled YW to identify emissions hotspots at the product-level produced at the water treatment works that were not visible in enterprise-level assessments. In particular, the pilot revealed that ferric sulphate (highlighted in red in Figure 2) was a material input used within the treatment process, contributing approximately 9% of total emissions associated with the treatment of one cubic litre of drinking water.

While electricity use was the largest overall contributor (66%), this was already known from previous corporate-level emissions assessments, and YW already has programmes underway to drive emissions reductions from electricity use. YW therefore chose to focus on ferric sulphate through the pilot, as this represents a harder-to-abate emissions hotspot, given there are limited options to reduce chemical usage.

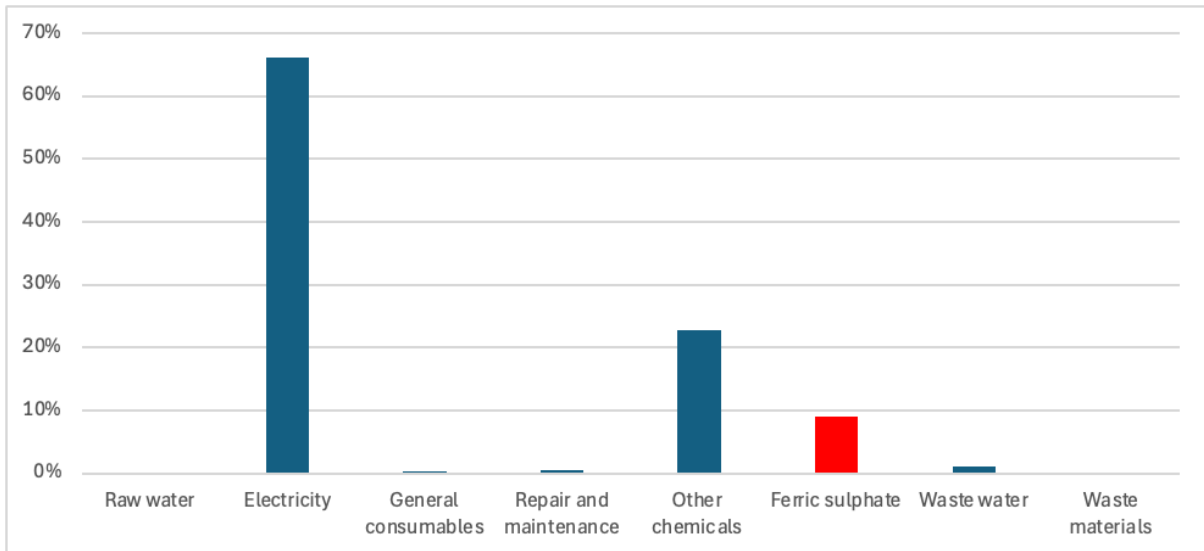


Figure 2: Results of the emissions hotspot analysis at the pilot water treatment works.

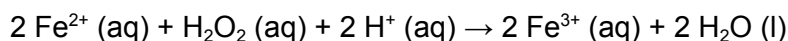
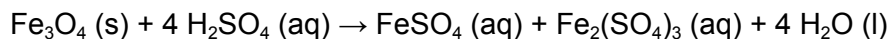
As a result, YW invited Feralco, one of YW's key suppliers of ferric sulphate, to participate in the pilot to more accurately determine the embedded emissions in the ferric sulphate that YW purchased and opportunities for reduction.

## Process and Results - Feralco

### Data Collection and Emissions Calculation

To calculate the emissions per ton of ferric sulphate (kg CO<sub>2e</sub>/ton), Feralco began by mapping the cradle-to-gate value chain for manufacturing ferric sulphate in its UK operations, which supply YW's water treatment sites.

The process for manufacturing ferric sulphate (Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>) consists of dissolving magnetite ore (Fe<sub>3</sub>O<sub>4</sub>) in sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) and oxidizing the ferrous iron (Fe<sup>2+</sup>) in the ore to ferric iron (Fe<sup>3+</sup>):



The manufacturing process requires the use of magnetite, sulphuric acid, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), electrical energy, and steam. For these inputs and manufacturing activities, primary data on usage was drawn from the site-specific bill of materials.

The emissions calculation in the first iteration used emissions factors from the Ecoinvent database and other similar sources, due to data availability and timing challenges.

Transport was also calculated and allocated to outputs. For inbound logistics, Feralco considered the shipping format (e.g., diesel-fueled truck, ship) and distance associated with each raw material supplied. Similarly, outbound logistics relies on diesel trucks, each carrying 28 tons per shipment from Feralco's UK distribution site in Widnes and the specific water treatment works that YW selected for this pilot.

### Analysis and Results

The results of the pilot showed that Feralco's site-specific emissions were around 10% higher than the INCOPA LCA average, the standard emission factor used by the water

sector. In turn, this increased the emissions per MI of treated water by YW by 0.94% (compared to the CAW baseline). This was mainly due to longer transport distances for raw materials relative to the INCOPA average—though this remains within the expected margin of error.

The pilot also gave Feralco visibility of the carbon ‘hotspots’ within its ferric sulphate supply chain and identified potential carbon reduction opportunities. In particular, the three key contributors to embedded emissions were:

- Sulphuric acid ( $H_2SO_4$ ) – this is the major contributor, totalling around 48.5% of the emissions embedded in the ferric sulphate, and was the focus of further analysis.
- Hydrogen peroxide ( $H_2O_2$ ) – this is the second largest contributor. However, further analysis was not undertaken due to limited sourcing options in the UK and safety considerations.
- Transportation – as inbound logistics were already optimized, outbound transport of finished products to YW was assessed.

When considering Feralco’s procurement of sulphuric acid, a key opportunity was identified to substitute the current product with a low-emissions alternative. The alternative sulphuric acid is produced as a by-product from copper mining, rather than from fossil fuel-based processes. As a result, its embedded carbon content is approximately 87% lower than that of the standard sulphuric acid used in the INCOPA baseline.

In parallel, Feralco assessed opportunities to reduce transport-related emissions. These included switching from conventional diesel to Hydrotreated Vegetable Oil (HVO), alongside operational efficiencies such as increasing YW’s on-site stockholding to reduce delivery frequency. In isolation, these measures presented the potential to reduce transport emissions by between 75-90% relative to the INCOPA baseline.

When combined with the adoption of low-emissions sulphuric acid, Feralco estimated the total emissions reduction achievable across product manufacture and transport at 40-50% versus the INCOPA baseline.

In the context of the individual water treatment works included in this pilot, these innovations would translate to around a 2.9% reduction in emissions per megalitre of treated water. Notably, this reduction would not be visible using current conventional calculation methodologies, which rely on industry-average LCAs rather than supplier-specific data.

## Key Insights, Challenges, and Next Steps

This pilot demonstrated that supplier-specific, transaction-level emissions data can reveal material decarbonization opportunities that are not visible using conventional industry-average methodologies. Through targeted supplier engagement and application of the E-liability approach, YW and Feralco identified opportunities that could reduce emissions at an individual water treatment works by 2.9% per MI of treated water and by up to 40-50% for Feralco’s sulphuric acid product versus the INCOPA baseline. These outcomes directly support YW’s regulatory performance commitments and its ambition to achieve entity-level net zero by 2050, while strengthening the role of suppliers in delivering emissions reductions.

### Learnings and Insights

**Stronger collaboration and delivery capability:** The pilot strengthened collaboration between YW and Feralco, as well as new cross-functional connections across sustainability, commercial, and operational teams. This collaboration has established a repeatable

supplier-engagement model that integrates emissions performance into procurement and operational decision-making.

**Improved visibility of emissions hotspots:** Application of the E-liability approach provided clearer visibility into emissions within drinking water treatment than is possible using conventional industry-average LCA methodologies. Ferric sulphate was identified as contributing approximately 9% of emissions per megaliter of treated water. Supplier-specific analysis using the E-liability approach indicated emissions associated with this input are approximately 10% higher than industry-average estimates, highlighting transport and upstream production as priority areas for decarbonization that would not have been identified through standard LCA-based reporting.

**Material decarbonization opportunities identified:** The pilot identified three key decarbonization levers which, in combination, can deliver a material reduction in YW's clean water emissions:

1. Low-emissions sulphuric acid substitution: Up to an 87% reduction in embedded emissions compared to the sulphuric acid used in the INCOPA baseline.
2. Transport decarbonization: A potential 75-90% reduction in distribution emissions between Feralco's UK distribution site and YW's water treatment works through a switch to HVO and operational efficiencies, subject to feasibility assessment.
3. Mass-balance allocation approach: When combined, these measures equate to a 40-50% reduction at the product level versus the INCOPA estimate. Because sulphuric acid from multiple suppliers is blended within shared infrastructure, emissions reductions would be allocated to YW using a mass-balance approach within Feralco's ERP systems.

These interventions together could translate to a 2.9% reduction in emissions per MI of treated water at the pilot site.

However, realizing these opportunities will require further assessment of their commercial and operational feasibility. The financial costs and benefits have not been studied in any detail, nor has risk sharing or strategic implementation been considered.

**Actionable, procurement-relevant emissions data:** Unlike conventional LCAs, which provide a cradle-to-grave, averaged view of environmental impacts, the E-liability approach delivers a transaction-based, cradle-to-gate perspective that directly links emissions to specific suppliers, materials, and logistics choices. This enables procurement-led interventions and supplier-specific decarbonization actions, rather than reliance on sector-wide assumptions.

The pilot therefore had direct strategic relevance given the introduction of the UK water sector's regulatory GHG minimization performance commitment, linked to financial incentives and penalties. As a result, supplier-led emissions reductions can directly influence YW's regulatory and financial performance.

### Methodological Challenges and Data Limitations

While the pilot delivered valuable insights, several data and methodological constraints remain:

- Supplier emissions estimates continue to carry uncertainty due to reliance on secondary datasets (e.g., Ecoinvent) rather than fully verified, product-specific primary data.

- Engagement from other chemical suppliers was limited, reflecting broader sector challenges in accessing granular and consistent emissions data.
- Capital-related emissions were excluded due to asset age and the absence of appropriate proxy data.
- Energy-related emissions lacked sufficient granularity due to limited sub-metering across treatment stages and the use of grid-average electricity emission factors in place of supplier-specific data.
- Analysis was conducted manually in Excel, reflecting the early maturity of GHG data systems.

These limitations do not undermine the overall findings but highlight the importance of continued investment in data quality and systems as the approach scales.