PHW Microbiology Single-use Plastic Project – Annex L – Case Studies

As part of the final project report, Revolution-ZERO introduced four case studies on assessing and reducing single-use plastic. These have been sectioned into separate pages to be shared individually.

To support understanding of the impact of emissions and better communication, a table of CO_2e in real-life situations has been included.

Emissions Equivalents

Activity	CO_2e
Hour of using an average-efficient laptop	10 g[1]
Laundry load washed at 40C, tumble dried	2 kg[1]
Dry powder inhaler (estimated 200 doses)	4 kg[2]
5-watt low energy bulb for one year	15 kg[1]
London to Glasgow and back (train)	64 kg[1]
Using a smartphone (a year's typical usage of 195 minutes a day)	69 kg[1]
London to Glasgow and back (small efficient petrol car)	237 kg[1]
Metered dose inhaler (estimated 200 doses)	100 kg[2]
Insulating a loft (outlay for a detached house)	400 kg[1]
Hip replacement or knee surgery	1 tonne[1]
Heart bypass operation	2.3 tonnes[1]
A new build house (three-bedroom terrace, bricks and mortar)	32 tonnes[1]
Installation of a 100-kW wind turbine (saves 2619 tonnes after 20 years)	134 tonnes[1]

[1] Berners-Lee, M 2010, *How Bad Are Bananas?*
[2] https://www.nice.org.uk/news/article/nice-encourages-use-of-greener-asthma-inhalers

Case Study 1: Evaluate, Urinalysis

One of the key challenges we found during this programme was the disconnect between procurement data and actual quantity and type of waste as categorised by plastic type actually produced. It was suggested, during the group workshop, that we **take an approach by quantifying single-use items by costed intervention** such as urinalysis. As part of this case study the initial idea owner, Eleanor Cooper, performed a preliminary audit as a phase I start of a larger piece of work. In this case study, all items used in urinalysis were collected, logged and weighed with plastic type identified. While some of the item weights may be inaccurate, the emissions work below shows the potential for auditing different work streams.

Estimated emissions table for all annual urinalysis tests in PHW labs

Product	Material	Total Weight across all tests (kg)	CO_2e across all tests (kg)
Boric Acid Tube	Polypropylene/polystyrene	546	2,839
Specimen Bag	Polyethylene	234	1,193
Agar Plate (standard and antibiotic)	Polystyrene	2340	14,508
Blue Sterile Loop	Polystyrene	61	372
Orange/White Sterile Loop	Polystyrene	1950	11,895
Saline lid	Polypropylene	78	406
MALDI-TOF Pipette Tips	Polypropylene	21	109

It was estimated that the total number of tests carried out annually was 78,000, of which, 26,000 did not reach the inoculation stage.

In addition to the main plastic consumables, **future work should consider all single-use items which are used over multiple tests**. This would include separate weights and quantities for different materials and supporting items such as packaging and waste systems.

Other items supporting urinalysis

- Packaging, including a bag for the loops and wrapping for the agar plates
- Paper request forms
- Orange waste disposal bags with plastic zip ties
- Plastic disposable jars for used sterile loops
- Glass bottle for saline solutions
- Sometimes an additional test tube lid is used

When carrying out calculations, the project made some assumptions, which are listed below.

Urinalysis assumptions

- Where a range of quantities can be used, an average or usual number was taken
- The standard and antibiotic agar plates have been combined for this work. For each item, only the weight and material of the petri dish was taken into account
- It was estimated that the total number of tests carried out annually was 78,000. Of these, 26,000 do not reach the inoculation stage

As a next phase of this work, **we suggest quantifying these by what could be reduced, reused or recycled and also qualifying the overall waste by weight and carbon impact**. Moving forwards, **this type of approach should be carried out across all interventions which are costed and identifiable, not just across the laboratory**. Cost centres could be transformative in the obtainment of the real-world data relating to waste and relative real time. This work could start with the most frequently carried out tests and would allow labs to measure annual progress.

We strongly **recommend this approach is adopted as an initial pilot for urinalysis with a view to rolling out across NHS Wales healthcare settings**. As the project team struggled to find publications with accurate figures on laboratory emissions, this work could be useful for wider stakeholders.

Case Study 2: Reduce, Packaging

One of the major new findings from this work, which came out of the first workshop, was the realisation that **packaging plays a major role in laboratory work streams and practices**. Though we were unable to quantify this fully, a new method to address this has been identified in case study 1. It was realised that there is significant room for reduction in plastic packaging across the NHS micro labs' footprint.

The first strategy to apply in this is to **question what sort of packaging is needed and what numbers of items need to be packaged in a single encased unit**. For example, one tube in plastic packaging, five tubes in plastic packaging or 100 tubes in plastic packaging. By addressing this and questioning these, it appears that significant reductions can be made. It is suggested that **packaging limitations are implemented at procurement level once further audit of the workstreams and packaging systems has been made**. While the quantity and type of packaging is decided by suppliers, we recommend that **procurement teams in labs lead by requesting change from suppliers**.

This type of reduction approach is at the top of the resource hierarchy and is likely to make a major impact on both waste and emissions with likely cost benefits as well. In the LCA master table, carbon savings were estimated from a 50% reduction in packaging. The table below shows the impact on the four highest emission items. As the product quantities are hard to accurately record in procurement data, the quantities and emissions are likely to be higher.

Enhanced packaging practices impact for highest quantity items

Product	Total CO_2e (kg)	CO_2e reduction (kg)
Agar (contained in Petri Dish)	188,960	546
Microbank vials	99,275	294
Sodium hydroxide	54,216	160
Pipette tips	44,217	157

Case Study 3: Reuse, Masks

The third case study relates to the next step down in the resource hierarchy which is that of reuse of items. The lead organisation already has significant experience of this working within Wales, having completed a formal study and report in March 2022. The potential reduction in plastic waste is considerable given that masks can be reused up to 40 times, repurposed at end of functional clinical life and then recycled after that, avoiding waste and also saving carbon. **Typical carbon savings for switching from a single-use to a reusable mask is 10g per mask, with 3.5g waste saving**.

During a workshop, PHW staff estimated the number of masks used per year in labs. Revolution-ZERO used these estimates to calculate emissions for all masks used in a year, shown in the table below.

Emissions and waste savings from switching to reusable masks

Product	Quantity	Total Weight (kg)	Total CO_2e (kg)	Carbon savings (kg)	Waste savings (kg)
Masks	365,000	1278	6,496	3650	1278

Taken across Wales laboratories, where we estimated 365,000 masks were used, **switching to reusable masks could result in savings of 3650 kg of carbon and 1278 kg of waste on an annual basis**. The economics of this still need to be refined, however this provides a useful workable case study, which could potentially be implemented in the near future.

Case Study 4: Recycle, Pipette Tips

The final case study relates to one of the largest procurement derived sources of waste for NHS Wales, which is pipette tips made from polypropylene. Key issues with pipette tips relate to contamination of the material during use, and hence decontamination if they need to be reprocessed.

There are, however, emerging innovators within the UK, such as LabCycle and Automedi, who were interviewed during this process. LabCycle, in particular, has a laboratory focussed solution **where they can process and decontaminate pipettes, reducing them back to the raw material ready for remanufacture into pipettes**. This provides a unique opportunity to go from like-to-like products, which is a more efficient use of recycling than changing product outputs.

The timeline for being ready for deployment across Wales has been estimated to be 2024 according to the manufacturer, LabCycle. **We recommend ongoing horizon scanning in this space given the waste prevention opportunity this can provide**. Revolution-ZERO has estimated the reduction in emissions from mechanical recycling of pipette tips. As the product quantities are hard to accurately record in procurement data, the quantities, emissions and emissions savings are likely to be higher.

Emissions savings from recycling pipette tips

Product	Quantity	Total Weight (kg)	Total CO_2e (kg)	CO_2e reduction from recycling (kg)
Pipette Tips	3,478,392	8696	44,217	24,349