

Transformation and Improvement Department working in partnership with the Pharmacy Department at Ysbyty Glan Clwyd Hospital, North Wales, the Bevan Commission and the Centre for Sustainable Healthcare.

Sustainability Project to Reduce Dispensary Plastic Bag use in Pharmacy across Betsi Cadwaladr University Health Board

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Abstract

This report records a sustainable quality improvement project conducted during a secondment aimed at reducing plastic bag use in the pharmacy dispensaries of the acute general hospitals of Betsi Cadwaladr University Health Board (BCUHB). It identifies the key drivers for the improvement as including Welsh Government legislation, the initiatives in the NHS Wales Decarbonisation Strategic Delivery Plan 2021-2030 and the Health Board's Green Groups. It discusses the responses given by environmental organisations like Friends of the Earth and the Environment Agency to similar projects implemented in supermarkets and finds that reducing carbon emissions and removing single-use plastic that can be littered into the environment are sometimes conflicting aims that can cause issues when both aims need addressing simultaneously. It finds that optimum success can only be achieved if 'cradle to grave' carbon calculations or comparisons – life cycle metrics - of the viable alternatives are made, and that without this making a change that may appear to be the correct choice can lead to significantly increased carbon emissions. The carbon content of different materials is compared using data from an Environment Agency study, data from Circular Ecology's Inventory of Carbon and Energy (ICE) V.3.0 and information from recycled-papers.co.uk. This revealed that the LDPE (Low Density Polyethylene) 'bags for life' plastic bags which is the closest material analysed to that used in our dispensary bags contained four times the amount of embodied carbon and virgin paper had three times the amount of embodied carbon of HDPE (High Density Polyethylene) single-use conventional lightweight plastic carrier bags, and that recycled paper from an accredited source had 38% less embodied carbon than virgin paper. It was therefore considered that recycled paper would be a good alternative to LDPE plastic for dispensary bags that are taken away by patients from the hospital that feasibly could end up littered into the environment. Alternative materials like compostable plastics were considered and discussion with county council officials regarding the current practicalities of kerbside collection revealed that if compostable plastic bags are deposited into plastics recycling bins this contaminates the plastics recycling waste stream and that recycled paper was recommended as it can be easily recycled. The report discusses the need to support the national green network that incorporates hospital green groups, and the need to participate in and support the Bevan Commission's 'Let's Not Waste' campaign and the Centre for Sustainable Healthcare's 'Sustainability in Quality Improvement' programmes. It shows

that on finding a solution, that suitable recycled paper bags had recently been uploaded to the internal national pharmacy system ‘Wellsky’ and the supplier confirmed another Welsh hospital had recently started to purchase the bags. The report then discusses the challenges met and overcome during the trial period in a busy acute general hospital pharmacy department.

Background

On 29th April 2019, the Minister for Environment, Energy and Rural Affairs, Lesley Griffiths AM, declared a climate emergency in Wales. In 2023, the Welsh Senedd passed The Environmental Protection (Single-use Plastic Products) (Wales) Act that bans the sale or supply of certain single-use plastic products in Wales. Phase 2 of the Act aims to come into force in Spring 2026 and includes single-use carrier bags with limited exemptions (1). In 2021, the NHS Wales Decarbonisation Strategic Delivery Plan 2021-2030 was published which responds to the Senedd’s Climate Emergency Declaration and states NHS Wales needs to “Develop a ‘plastics in health care’ initiative to address waste in the delivery of health care – this will aim to tackle PPE, single use plastics and packaging waste” (2). It is also aligned to Welsh Government’s ambition for the public sector in Wales to be net zero by 2030, with a minimum contribution of a 34% carbon reduction by NHS Wales.

When purchasing data from Ysbyty Glan Clwyd (YGC) and Ysbyty Gwynedd (YG) hospitals is extrapolated across all three acute hospitals in BCUHB, it suggests that the pharmacy departments together used a total in the region of three hundred thousand plastic bags (of several different sizes) annually. Medicines are dispensed for inpatients, outpatients and for patients being discharged from hospital. These bags are used as a carrier for dispensed medicines for individual patients and they also help separate individual patient medication being sent from the pharmacy to a ward. In response to issues raised by the Central (YGC) Green Group, in October 2022 I was assigned a six-month, two days per week secondment with the aims of addressing several potential environmental projects. I started to investigate the alternative options to single-use plastic bags and the issue was not straightforward. I followed the Centre for Sustainable Healthcare’s (3) ‘Sustainable Quality Improvement’ (SUSQI) process of Setting Goals, Studying the System, Designing the Improvement and Measuring the Impact with the overall goal of providing sustainable value. This means designing an improvement that leads to ‘delivering care in a way that maximises positive health outcomes through best use of environmental, social and financial resources’. Success is measured by aiming to ensure that all the costs, i.e., social and environmental are considered as well as financial: the ‘triple bottom line’ as illustrated in this equation (4):

$$\text{Sustainable value} = \frac{\text{Outcomes for patients and populations}}{\text{Environmental + social + financial impacts (the 'triple bottom line')}}$$

Figure 1: Centre for Sustainable Healthcare

Source: Mortimer et al., *Future Healthcare Journal* 2018, Vol 5, No 2: 88-93



Setting Goals

Many businesses have switched from plastic carrier bag use to paper or compostable potato starch, with single-use plastic bags being an issue since at least 2008 when the Guardian newspaper reported Marks and Spencer's announcement that they would start charging food customers 5p for every plastic carrier bag they used (5). There has been a lot of research and controversy in this area. In February 2011, the Northern Ireland Assembly issued a Briefing Note (6) that analysed the different types of bags holistically, i.e., the whole life cycle, based on manufacturing, reusability, recycling and decomposition. The note summarised research at the time which showed that paper bags were several times more damaging to the environment in terms of carbon cost than single use plastic bags. It concluded by quoting the Independent newspaper article (7) regarding then unpublished Environment Agency research: *"So which bag should you use? All bags have an impact. The best solution would be to use a cotton bag several hundred times, probably using it constantly for years. If you are not going to do that, a plastic bag (HDPE) – re-used as a bin liner – is the next best option, better than paper. Avoid accepting a plastic bag unless you need one, though."*

In 2018, Morrisons Supermarkets switched to paper bag use (8), and in 2019, Boots Pharmacies moved to using brown paper bags and 100% compostable bags (9). The Guardian newspaper (10) reported that Morrisons were criticised for switching to paper bags by the Environment Agency, whose study (11) showed that across their lifecycle, paper carrier bags have a greater impact on global warming. The Environment Agency studied the life cycle of the supermarket carrier bag and compared it to other materials in their study. The lightweight plastic supermarket carrier bag (HDPE) was the least carbon intensive. Craft paper bags were included in the study. However, the switch was supported by Friends of The Earth who said *"other green issues other than climate change should be factored in"*. The majority of dispensary plastic bags in use in YGC pharmacy are made from LDPE. According to the 2006 Environment Agency study, LDPE bags need to be reused four times to reduce their global warming potential to below that of a HDPE carrier bag, and a paper bag would need to be reused three times.

In 2019, BBC News published an article (12) that reviewed the pros and cons of introducing paper bags instead of plastic bags, referring to the aforementioned studies. In conclusion they quoted Margaret Bates, professor of sustainable waste management at Northampton University who said *"the key to reducing the impact of all carrier bags – no matter what they are made of - is to reuse them as much as possible"*. It stated that, *"Despite its low durability, one advantage of paper is that it decomposes much more quickly than plastic, and therefore it is less likely to be a source of litter and pose a risk to wildlife. Paper is also more widely recyclable, while plastic bags can take between 400 and 1,000 years to decompose"*. Also in 2019, the BBC's Reality Check team (13) showed that the plastic waste the UK exported was causing damage in other countries and they were refusing to take more, and local councils were often incinerating paper and plastic waste rather than recycling it. In 2021, Treehugger.com released an article explaining that not only do plastic bags cause pollution across the world and cause the deaths of many marine animals, but they also release greenhouse gasses directly linked to global warming (14). In 2021 Treehugger.com also released an article on the recycling potential of plastic. It called LDPE plastic the *"dreaded 'single-use' soft plastic that often winds up in the ocean, where marine life tragically mistake it for food"* that can *"be recycled only once because the quality is so degraded"* during the recycling process (15).



According to the Forest Stewardship Council (FSC) UK website *“recycling paper and wood products not only makes the best use of the yield of the tree (by extending the life span of its fibres), it also reduces the amount of waste going to landfill sites”* (16). In 2020, a paper was published in the American Chemical Society Journal by Vendries, et al, (17) and their recommendations included that *“for institutional and government purchasing programs, life cycle metrics can be used as purchasing criteria and help prioritize procurement to reduce environmental impacts”* and that *“once a decision has been made to lower the carbon footprint of packaging or FSW (food service ware) and the material for the packaging/FSW has been selected, purchasing these products with higher levels of recycled content might be a sensible way to reduce its environmental impacts. Additionally, it is important to analyze the local infrastructure capacity for end of life treatment of products (such as recycling or composting facilities) where the programs are being implemented prior to committing to specific attributes.”*

One source, recycled-papers.co.uk states that *“manufacturing one tonne of 100% recycled paper emits 38% less CO2 (based on Eural figures) than paper produced from virgin fibres. The emissions saved is the equivalent to driving from Paris to Moscow in the average European car”* (18). In a Guardian newspaper article from 2013, reporter Lucy Siegle found that if the energy used to recycle a paper bag comes from a coal fired power station, then recycling is pointless from a carbon perspective. She also recommended checking percentages, aiming for 100% recycled paper content or Forest Stewardship Council (FSC) accredited products (19).

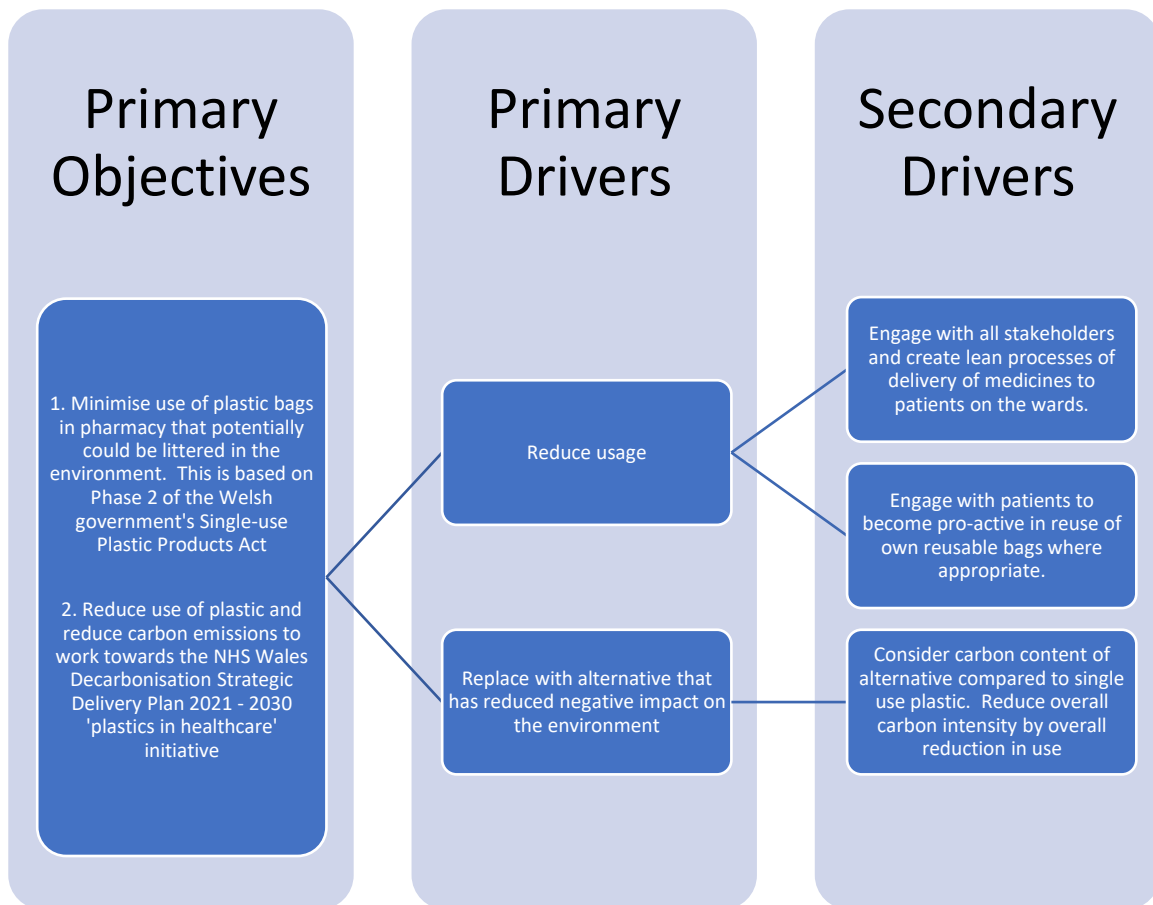
Bioplastics are compostable and compostable carrier bags have replaced plastic carrier bags in many supermarkets, including the Co-op (20) and have the European standard for compostability EN 13432. In 2015, European Bioplastics published a paper that explained the industrial compostability of these types of bags. The paper explains that certified bags are sent to industrial composting plants for disposal as organic waste (21). According to www.walesrecycles.co.uk, industrially compostable plastics cannot be recycled via kerbside collection of plastic waste; *“Industrially compostable plastics (such as some food caddy liners) need to go into a food caddy which goes for composting or garden waste, but not everybody has this option at home”* (22). So, currently most compostable carrier bags are not likely to biodegrade in a home composter and even if they did, then according to Businesswaste.co.uk, only 3% of households in the UK have a compost heap at home (23). In my request for information from Denbighshire County Council regarding recycling bioplastics, the EN13432 standard and the FSC accreditation they replied on 22/11/2022 with:

“In my answer I will refer only to the end of life suitability in relation to recycling, I have not taken into account sustainability of raw materials or environmental impact of manufacture, distribution, etc. EN13432 is a European standard for 'compostability'. The usual benefits the materials have over polythene are that they are made from renewable raw materials and that they should be highly biodegradable. It's a broad church though and just because a bag meets EN13432 it shouldn't be assumed it will break down on a domestic compost heap (although it might). In addition, they are not recyclable in the accepted sense, in fact they contaminate recycling. So, they must be kept out of recycling collections whether that is a DCC blue bin or a supermarket's plastic bag recycling scheme. At the end of its life, an EN13432 bag should be treated as residual waste, (black bin, landfill). On the other hand paper bags can usually be recycled and are supplied in various sizes. Any paper carrier bag can either be biodegraded or recycled (made into pulp) and turned back into new paper carrier bags or other items. FSC graded bags are the best most environmentally friendly grade of paper as the material is sourced from sustainable forests. However, there is one exception; the only bags that cannot be recycled are laminated paper carrier bags as the lamination process adds a film layer to the paper and bags with a metallised layer as these additions cannot be recycled together. As paper

carrier bags are usually quite strong and substantial, many companies choose to add text encouraging customers to save and reuse the bags. This may not apply to single use bags of course, which although fully compostable and recyclable, are usually less robust.”

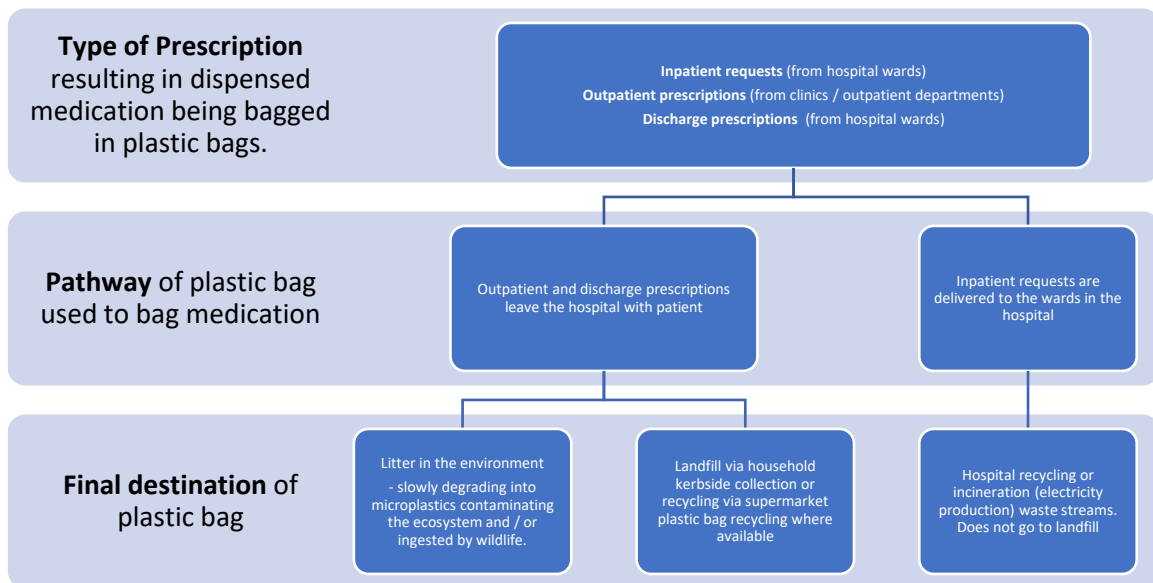
Paper dispensary bags are available to hospital pharmacies from suppliers with different types of source materials. I discussed the various arguments with stakeholders within pharmacy before discussing them with the pharmacy management team. Together we set the following goals:

- To source and introduce the use of 100% recycled and 100% recyclable paper bags, FSC certified and/or from a supplier with a clear environmental policy as a permanent replacement for the LDPE plastic bags used for medicines collected by patients to be taken home that could potentially be littered in the environment;
- To source paper bags that are ‘plain’, that may encourage people to reuse them, or with bilingual Welsh and English text for any pharmacy messages on the bag;
- To introduce paper tape to seal the paper bags in a similar way the plastic bags being replaced had a zipper method of sealing them to secure the medicines ready for collection. The paper tape would need to be of a similar quality and specification to the paper bags to enable the whole bag to be placed in the kerbside recycling bin;
- To remove LDPE plastic bags wherever possible from the internal delivery of medicines between pharmacy and hospital locations to further reduce carbon and rebalance increased financial costs caused by the introduction of the paper bags described above;
- To achieve a social, environmental and economic benefit which should happen when all the goals are met.

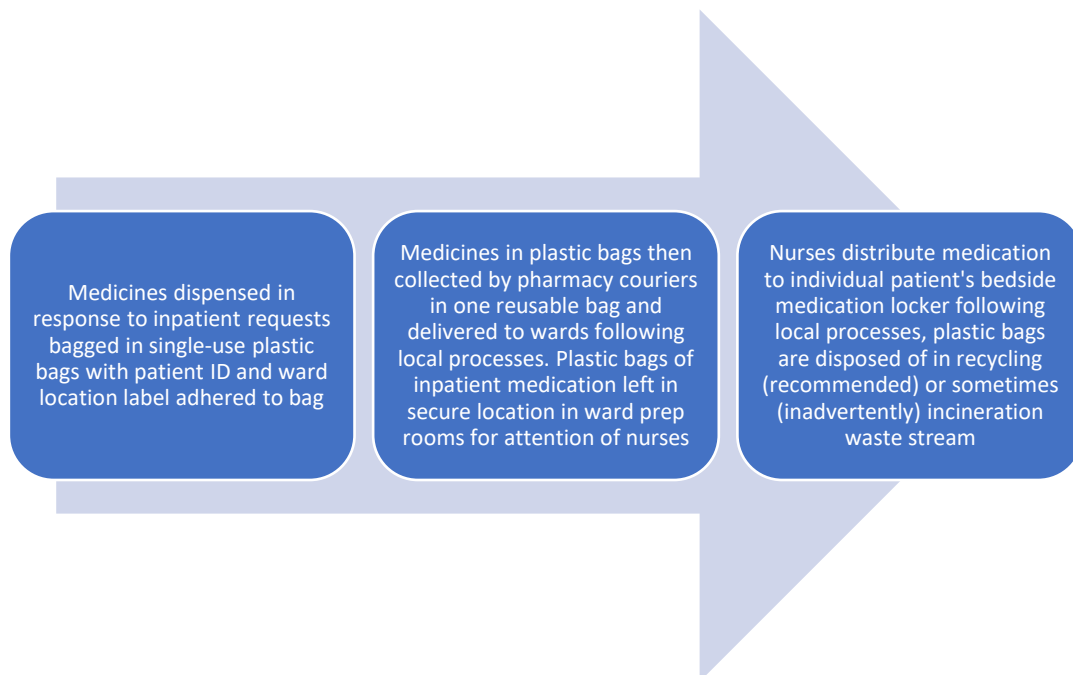


Studying the system

As discussed previously, Welsh Government legislation requires the removal of single-use carrier bags that potentially could be littered in the environment by Spring 2026 and the LDPE bags we used in pharmacy at YGC are more detrimental for the environment than the carrier bags in the legislation. The plastic bags that we used to bag outpatient or discharge medications for patients collecting and taking their medications away from the hospital had the higher potential to complete their life cycle as litter:



Inpatient plastic bags continue their lifecycle either through the hospital recycling or incineration waste streams:



Designing the Improvement

Phase 1

This involved switching outpatient and discharge medicines from being bagged in plastic to being bagged in recycled paper (because these were the most likely to be littered in the environment), and

sending single medicines to the wards without a plastic bag. In January 2023 we made our first order of recycled paper bags. We had some constructive feedback from colleagues:

- i) A bag label (which has the patient's identification and location printed) peeled off a paper bag – bag labels adhere to plastic bags far more readily – and there were concerns that a peeling label could transfer itself onto another patient's bag and therefore cause an error. This was addressed by asking colleagues making the final check to firmly push the bag label onto the paper as it adheres differently than it does to plastic, taking slightly longer to adhere, and by ensuring the type of labels being purchased were of a stickier adhesive;
- ii) Durability. In one department the process required the discharge bag containing the discharge medicines to be opened and checked several times and the paper bags were becoming torn and untidy during this process. This area became exempt from using paper, but they are updating their processes so paper can be used;
- iii) Storage on the wards. In one ward location, bags of discharge medicines were stored ready for collection by patients to take home in a small box on the ward. Paper bags were becoming compressed, crumpled and torn in the box. Again, plastic is still being used in this location, but a suitable cupboard is being sought to remedy the situation;
- iv) Storage in the department. The boxes of paper bags take up more room for the same quantity of plastic bags, and space needed to be sourced in another store room and container unit on site;
- v) The supplier could not supply a 'large' size bag. They said it wasn't economically viable to make a large bilingual pharmacy bag. We decided to continue to use plastic for the large size only until a suitable alternative could be sourced. We are in the process of negotiating the production of a bespoke 'large' bag size with our supplier.
- vi) Using up stock. Some locations had larger stores of plastic bags to use up. Feedback from colleagues in one department was that phasing in paper is taking longer, but they are now moving to 100% paper for outpatients and discharge (except for the large bag);

With the successful roll out of recycled paper bags at YGC, we are now sharing our knowledge with other sites across BCUHB to encourage the adoption of recycled paper bags, and WMH and YG have started using them.

Positive feedback from patients and colleagues included:

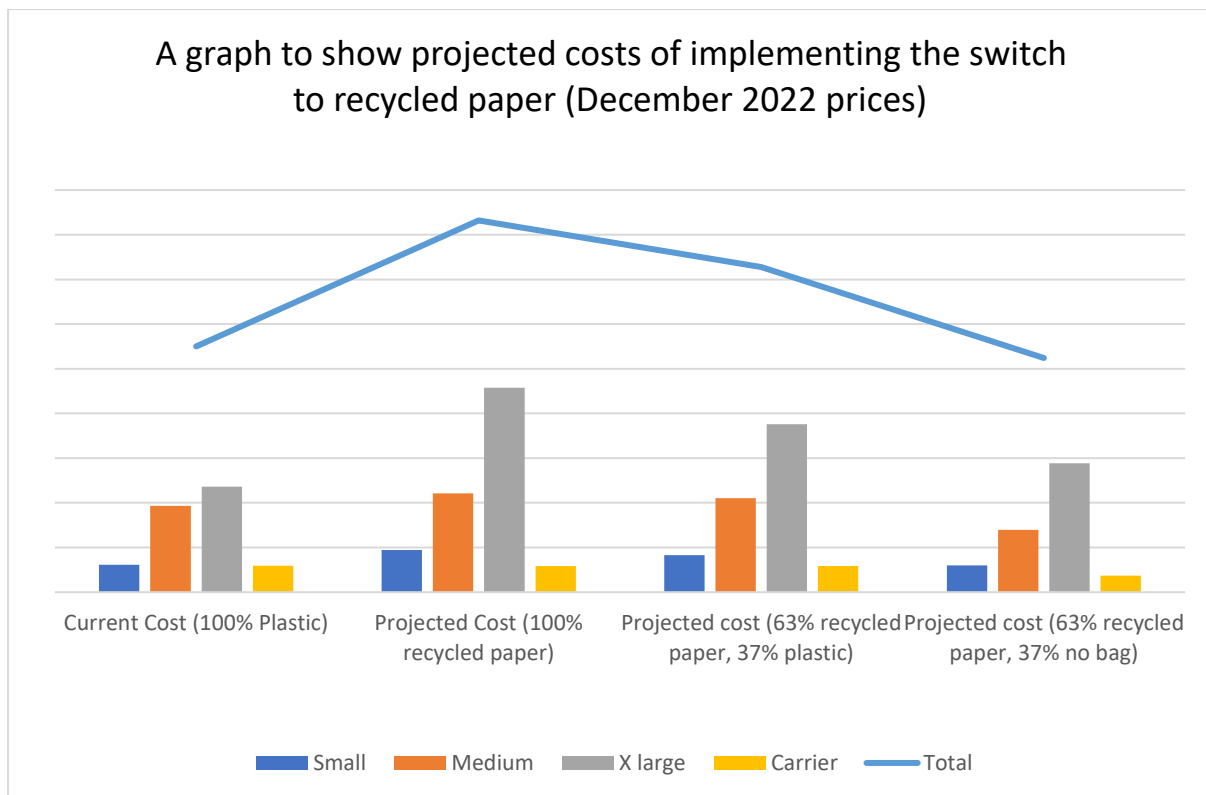
- i) Patient feedback. A patient collecting their medicines at the desk, said she thought it was the 'right thing to do to remove the plastic'. There have been no other comments reported from patients positive or negative, indicating there is an acceptance and perhaps that it is an expected step to take as other businesses have done this already;
- ii) Prior experience. Colleagues that had worked in hospitals that have already moved to paper gave reassurance that it does work because they've seen it working elsewhere and are glad to be doing their bit for the environment;
- iii) Design. Many colleagues liked the design of the paper bag and that they were bilingual;
- iv) Confidentiality. Many colleagues feel the paper bags are better than clear plastic because they afford the patient confidentiality when carrying their medicines out of the hospital.

Phase 2

This requires removing all plastic bags from inpatient and stock medicine deliveries which is proving challenging due to embedded processes at YGC, although two BCUHB hospitals -Wrexham Maelor Hospital (WMH) and Llandudno Hospital (LLGH) - have already successfully significantly reduced plastic bag use for these deliveries. The system at YGC involves an order with multiple medicines for an inpatient being sent to pharmacy to be dispensed and then delivered to the ward in a plastic bag following current delivery and storage processes. Switching to recycled paper for inpatient delivery is not recommended instead the preferred option is to send the medicines loose, in reusable delivery bags, to ensure the reduction of financial and carbon costs overall. A switch to thin HDPE bags from LDPE is an option to trial to further reduce carbon and financial costs if plastic bags cannot be removed from all parts of the system. As a team, we are currently investigating the processes surrounding delivery and storage on the wards and a solution is being researched that also aims to simultaneously reduce medicines waste and increase recycling of returned but fit for purpose medicines.

Costs

Comparing costs between recycled paper bags and plastic bags can only be done accurately after completion of the project. This is partly because the bag sizes - though similar - are different and therefore usage may be different. Recycled paper bags are more expensive, but projections forecast that the reduction in bag use by delivering medicines to the wards loose should mitigate this.



As the graph above shows (excluding large bags - currently unavailable), there was an increased cost by moving to using recycled paper bags:

- If we switched completely from plastic to recycled paper (for comparison purposes only, this was not done) costs were estimated to increase by 51%.
- Using data from the October 2023 audit below, if we replaced all bags except inpatient bags (63%) with recycled paper, costs increase by an estimated 32%.
- If the assumption is made that 37% of all bags used are for inpatients and these are eventually removed from use, then overall costs were estimated to decrease by 5%.

Costs will continue to decrease when ward stock and controlled drugs are also sent without a bag. Since the start of the study there have been fluctuations in prices and increases in inflation.

The supplier has stated that their prices can be reduced if we buy in bulk for all the Health Board's hospitals at the same time, and delivery and carbon costs will be reduced if all of our hospital sites co-ordinate their purchases and are delivered on the same transport run.

Challenges

- Conducting and implementing an improvement on this scale in the limited timeframe of an initial two day a week, six-month secondment.
- Investigating what progress had been made with this initiative by other hospitals. This was an issue at the start of the project, illustrating the importance of the 'Green Health Wales' network. Engaging and working with the Centre for Sustainable Healthcare and the Bevan Commission has also been beneficial (24).
- Sourcing and costing of 100% recycled paper bags for pharmacy. I researched products available from our suppliers and found that 100% recycled paper bags of four different sizes had recently been uploaded onto our purchasing system by another Welsh hospital (see above point regarding the need for national communication regarding progress). We asked for samples and found the supplier's Environmental Policy Statement said they "Source and promote a product range to minimise the environmental impact of both production and distribution" (25). It was a product that fit our requirements, the costs were also comparable to those of other suppliers for similar sizes of paper bag. Quotes for plain bags were obtained but cost more. Since then, other suppliers have started to offer FSC accredited 100% recycled plain paper bags and I have obtained samples to compare. Anecdotally, I tested the paper carrier bag for durability, by using it daily to carry heavy items for a week before the bottom tore open, caused due to dampness from rain.



Photo: The bag was used every day for a week before it failed in heavy rain.

- Collecting data, changing attitudes, working with multiple stakeholders, agreeing upon and changing working processes and practices that fit within the current governance framework in a very busy acute general hospital has proven challenging, but as the message has spread there is an increased awareness and motivation for change. It’s about winning hearts and minds.

Measuring success

Bag purchases (August 2023)

The table below shows YGC’s plastic bag purchases over a six-month period in 2022 before the start of the project and the same six-month period in 2023 after the start of the project.

	JAN 22 – AUG 22	JAN 23 – AUG 23
Small	19,000	15,000
Medium	43,000	34,000
Large	25,000	23,000
Carrier	1,500	0
Total:	88,500	72,000

The table above shows:

- **there is a 19% reduction (16,500) in plastic bag purchases.**

Wellsky also reports that we purchased 16,000 recycled paper bags between January and August 2023.

Bag use audit (October 2023)

I conducted a five-day audit in our dispensary to measure current bag use. Over 600 prescriptions were dispensed and the types of bags used are represented in the table below:

Prescription Type / Bag Type used	Sum of Number of bags used
CONTROLLED DRUG	33
No bag	1
Plastic	32
DISCHARGE	65
*Biodegradable	3
Paper	30
Plastic	32
GUM	1
*Biodegradable	1
INPATIENT	222
*Biodegradable	1
No bag	90
Paper	8
Plastic	123
OUTPATIENT	280
*Biodegradable	9
Paper	214
Plastic	57
Grand Total	601

*Biodegradable plastic bags for life have been retained for use for the heaviest and/or bulkiest items on the few occasions where paper is deemed unsuitable.

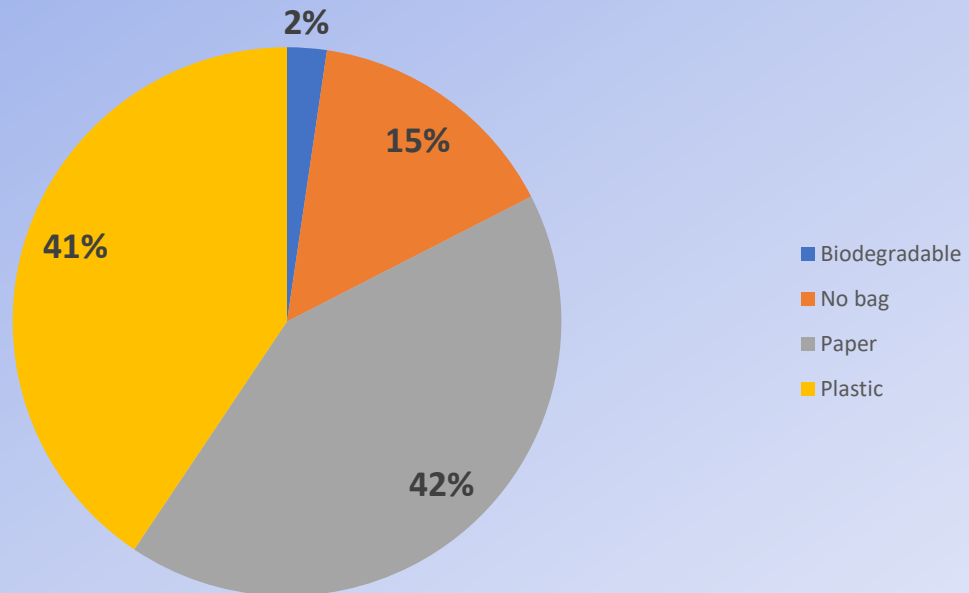
Based on the assumption that 100% of dispensary bags used before the implementation of the changes were single-use plastic bags and a bag was used for every prescription, the five-day audit data in the table above shows:

- **for inpatient medicines sent internally to the wards, there was a 45% reduction (from 222 to 123) in the use of plastic bags.**
- **for outpatient and discharge prescriptions, there was a 70% reduction (from 345 to 101) in the use of plastic bags due to the switch to 100% recycled and recyclable paper.**

The chart below represents the percentages of prescriptions bagged using different bag materials.



A chart to show percentage of type of bag material used



The chart shows that overall, (including all prescription types) there was:

- **a 59% reduction (601 to 244) in use of single-use plastic bags; this included the 15% of single medicines that were sent to the ward without a bag, 42% of outpatient and discharge prescriptions that were bagged in recycled and recyclable paper and 2% that were being bagged in the more durable biodegradable bags for life.**

Carbon Calculating

As stated previously, according to the 2006 Environment Agency study, LDPE bags need to be reused four times to reduce their global warming potential to below that of an HDPE carrier bag, and a paper bag would need to be reused three times (11); recycled-papers.co.uk states that “manufacturing one tonne of 100% recycled paper emits 38% less CO₂ (based on Eural figures) than paper produced from virgin fibres (18). Based on these assumptions using recycled paper bags for outpatient and discharge prescriptions will contain approximately 50% less embodied CO₂ than the plastic LDPE bags previously in use. Because the plastic and paper bag sizes being used are slightly different, direct comparisons for accurate carbon savings calculations are not possible so assumptions are made and figures are estimates.

Carbon savings – LDPE plastic bags removed from inpatient delivery to wards (15% on chart)

It is possible to identify the carbon savings made from the removal of plastic bags for inpatient medicines sent to the wards, by extrapolating the data for the 15% reduction (shown in the chart above), if the following assumptions are made:

1. Most bags used for single medicines sent to wards are the 'small' size; the assumption is 100% of the bags removed were small bags;
2. In the audit 90 inpatient medicines were sent to a ward without a bag – this represents a 45% reduction of bags used for inpatients; the assumption is that this is representative of current practice;
3. According to Wellsky data YGC pharmacy purchased 33,000 small LDPE bags between 1st January 2022 and 21st December 2022 before the introduction of paper; the assumption is they were all used in dispensary over a year;
4. Single-use plastic bags made from LDPE film have an emission factor of 2.6kg CO₂e/ kg according to the Inventory of Carbon and Energy (ICE) Summary V.3.0 (26).

Small plastic bag weight = 2.02g:

$$0.00202 \times 2.6 = 0.005252\text{kg CO}_2\text{e} = \underline{5.252\text{g CO}_2\text{e per small bag}}$$

Therefore:

$$45\% \text{ of } 33,000 \text{ small bags} = 14,850$$

Total estimated carbon reduction small bags per annum = 14,850 x 5.252 = 77,992.2g CO₂e = 77.99kg CO₂e

Estimated carbon savings – LPDE plastic bags replaced by 100% recycled and recyclable paper bags for outpatient and discharge prescriptions

Wellsky data also shows that between 1st January 2022 and 21st December 2022 additionally to the 33,000 small LDPE plastic bags, 53,000 medium and 36,000 large were also purchased, a total of 122,000 at YGC. There was an overall 42% reduction in plastic bag use by switching to recycled paper bags, which becomes 49.4% of the remaining plastic bags and biodegradable bags after removing the 15% using figures from the table above:

Total number of plastic bags used = 244

Total number of biodegradable bags used = 14

Total number of plastic bags replaced by recycled paper = 252

Percentage number of plastic bags replaced by recycled paper = $[252 / 510] \times 100 = 49.4\%$

The average CO₂ content reduction from removing the LDPE plastic bags and switching to recycled paper is as follows:

Small plastic bag weight = 2.02g:

$$0.00202 \times 2.6 = 0.005252\text{kg CO}_2\text{e} = 5.252\text{g CO}_2\text{e per small bag}$$

Medium plastic bag weight = 5.2g:

$0.0052 \times 2.6 = 0.01352\text{kg CO}_2\text{e} = 13.52\text{g CO}_2\text{e per medium bag}$

Large plastic bag weight = 9.12g:

$0.00912 \times 2.6 = 0.023712\text{kg CO}_2\text{e} = 23.712\text{g CO}_2\text{e per large bag}$

Total amount of carbon small bags per annum = $(33,000 - 14,850) = 18,150 \times 5.252 = 95,324\text{g CO}_2\text{e} = 95.32\text{kg CO}_2\text{e}$

Total amount of carbon medium bags per annum = $53,000 \times 13.52 = 716,560\text{g CO}_2\text{e} = 716.56\text{kg CO}_2\text{e}$

Total amount of carbon large bags per annum = $36,000 \times 23.712 = 853,632\text{g CO}_2\text{e} = 853.63\text{kg CO}_2\text{e}$

The overall estimated total amount of embodied carbon within the different sized LDPE plastic bags per annum = 1,665.51kg CO₂e. (1,743.5kg CO₂e for 122,000 bags if the 15% is factored back in).

Total estimated carbon savings

According to the audit, the total number of single-use LDPE plastic bags across all sizes switched to recycled paper (after the 15% of small plastic bags were removed) was 49.4% which equals 822.76kg CO₂e of 1,665.51kg CO₂e per annum. However, the embodied carbon of the recycled paper bags now being used has to be factored in:

As described above, 49.4% (or if extrapolated 52,932 of the 107,150) LDPE bags were replaced by recycled paper bags for outpatient and discharge prescriptions. Although no emission factor figures could be obtained for recycled paper, then as stated above, recycled paper has approximately 50% of the carbon content of LDPE plastic film. If it is assumed that a recycled paper bag is equal in size to a plastic bag, to find the total carbon in the recycled paper bags this means:

49.4% = 822.76kg CO₂e. If these bags are replaced by recycled paper bags which have approximately 50% embodied carbon of LDPE plastic, then this equals to 411.38kg CO₂e potential carbon added by the switch to recycled paper.

Total estimated annual reduction in carbon therefore equals:

- 822.76kg CO₂e (from 49.4% reduction in LDPE plastic bags)
- - 411.38kg CO₂e (from 49.4% increase by using recycled paper bags)
- + 77.99kg CO₂e (from carbon savings from inpatient medicines sent without bags)
- = 489.37kg CO₂e
- Therefore, 1,743.5kg CO₂e (122,000 bags) – 489.37kg CO₂e reduction = 1,254.13kg CO₂e, **an estimated total carbon reduction of 28%**.

According to the *BEIS carbon conversion factors 2022 full set (27)*, the emissions of an average size petrol car vehicle are: 0.17048kg CO₂e/km. The Well to Tank (WTT) emissions of an averaged sized petrol car are: 0.04885kg CO₂e/km. Therefore, the aggregated emissions factor: (0.17048 + 0.04885) = 0.21933kg CO₂e/km. The estimated annual carbon reduction of this project is 489.37kg CO₂e, which is estimated to **saving the carbon emitted (489.37kg CO₂e / 0.21933kg CO₂e/km) in a car journey of 2,231 kilometres**. (Based on a worked example by the Centre for Sustainable Healthcare).

Discussion and Conclusions

Currently YGC has made the transition to using recycled paper dispensary bags for both outpatients and discharge prescriptions and WMH and YG are now also using these bags. The overall success of the project as stated earlier is based in the following equation:

:

$$\text{Sustainable value} = \frac{\text{Outcomes for patients and populations}}{\text{Environmental + social + financial impacts (the 'triple bottom line')}}$$

Figure 1: Centre for Sustainable Healthcare

Source: Mortimer et al., *Future Healthcare Journal* 2018, Vol 5, No 2: 88-93

The project has been successful because:

Environmentally - there has been a net reduction in carbon (28%) and any bags littered into the environment will decompose, possibly leading to eutrophication, but removing the danger posed by microplastics or marine mammals being harmed by ingesting single-use plastic bags.

Socially - there has been an acceptance of the new bags from patients with no complaints. The new paper bags also offer patients' more privacy and confidentiality when collecting and transporting their medicines compared to the previous transparent plastic bags. The reduction in carbon will contribute towards the goal of net zero.

Financially - there has been an increase in costs because of the switch to recycled paper. However, when plastic bags are completely removed from the process of sending medicines to wards, this should mitigate the increase. Further initiatives like offering waiting outpatients a bag instead of automatically giving a bag aim to reduce costs to below the costs of purchasing plastic bags.

To work towards balancing the above equation the next possible "Plan Do Study Act" cycles of the project may include trialling the following:

- Buying paper bags in bulk for all BCUHB hospitals to reduce financial costs;

- Delivering paper bags to each of the hospital pharmacies on one run to reduce carbon emissions from deliveries and reduce financial costs;
- Introducing a 'large' size recycled paper bag, which is currently being negotiated with the supplier.
- Reducing the number of paper bags used for outpatient prescriptions. This means outpatients presenting a prescription at our dispensary reception desk and waiting for their prescription to be dispensed will be asked if they need a bag when completing the reception questionnaire. We trialed this recently and **in one week 50% of waiting patients said they did not need a bag; therefore 52 mostly small and medium sized bags were saved which potentially equates to around 2,700 bags saved annually.**
- Improved delivery processes to send inpatient medicines to the wards loose with the aim of further reducing the number of plastic bags used;
- Replacing LDPE plastic bags for inpatient deliveries (if plastic bags cannot be removed completely from the process) with thin HDPE plastic bags to further reduce carbon;
- Improved processes to reduce the number of plastic bags used for transport of controlled drugs.

References:

- (1) [The Environmental Protection \(Single-use Plastic Products\) \(Wales\) Act | GOV.WALES](https://www.gov.wales/environmental-protection-single-use-plastic-products-wales-act#117948)
https://www.gov.wales/environmental-protection-single-use-plastic-products-wales-act#117948
- (2) [Green Groups - NHS Wales Decarbonisation Strategic Delivery Plan.pdf - All Documents \(sharepoint.com\)](#)
- (3) [Sustainability in Quality Improvement \(SusQI\) | Centre for Sustainable Healthcare](https://sustainablehealthcare.org.uk/susqi)
https://sustainablehealthcare.org.uk/susqi
- (4) Mortimer F, Isherwood J, Wilkinson A, Vaux E. Sustainability in quality improvement: redefining value. *Future Healthcare Journal* 2018, Vol 5, No 2: 88-93
- (5) [Q&A: Plastic bags | Pollution | The Guardian](https://www.theguardian.com/environment/2007/nov/13/plasticbags.pollution)
https://www.theguardian.com/environment/2007/nov/13/plasticbags.pollution
- (6) [Comparison of Environmental Impact of Plastic, Paper and Cloth Bags \(niassembly.gov.uk\)](https://www.niassembly.gov.uk/globalassets/documents/raise/publications/2011/environment/3611.pdf)
https://www.niassembly.gov.uk/globalassets/documents/raise/publications/2011/environment/3611.pdf
- (7) [Plastic fantastic! Carrier bags 'not eco-villains after all' | The Independent | The Independent](https://www.independent.co.uk/climate-change/news/plastic-fantastic-carrier-bags-not-ecovillains-after-all-2220129.html)
https://www.independent.co.uk/climate-change/news/plastic-fantastic-carrier-bags-not-ecovillains-after-all-2220129.html
- (8) [Little green bag: Morrisons revives paper in war on plastic | Morrisons | The Guardian](https://www.theguardian.com/business/2018/jun/25/morrisons-paper-bags-plastic-supermarket-fruit-vegetables)
https://www.theguardian.com/business/2018/jun/25/morrisons-paper-bags-plastic-supermarket-fruit-vegetables
- (9) [Boots UK - Boots move to 100% compostable pharmacy bags \(boots-uk.com\)](http://www.boots-uk.com/newsroom/features/boots-move-to-100-compostable-pharmacy-bags/)
www.boots-uk.com/newsroom/features/boots-move-to-100-compostable-pharmacy-bags/
- (10) [Morrisons' paper bag switch is bad for global warming, say critics | Morrisons | The Guardian](#)



- <https://www.theguardian.com/business/2018/jun/25/morrisons-paper-bag-switch-is-bad-for-global-warming-say-environment-agency>
- (11) [Life cycle assessment of supermarket carrierbags: a review of the bags available in 2006 - GOV.UK \(www.gov.uk\)](#)
<https://www.gov.uk/government/publications/life-cycle-assessment-of-supermarket-carrierbags-a-review-of-the-bags-available-in-2006>
 - (12) [Plastic or paper: Which bag is greener? - BBC News](#)
<https://www.bbc.co.uk/news/business-47027792>
 - (13) [Recycling: Where is the plastic waste mountain? - BBC News](#)
<https://www.bbc.co.uk/news/science-environment-46566795>
 - (14) [Plastic Bags Emit Methane, Too \(treehugger.com\)](#)
<https://www.treehugger.com/plastic-bags-emit-methane-contribute-climate-change-4866262>
 - (15) [How Many Times Can Plastic Be Recycled? \(treehugger.com\)](#)
<https://www.treehugger.com/how-many-times-can-plastic-be-recycled-5184396>
 - (16) [Recycled materials | Forest Stewardship Council UK \(fsc.org\)](#)
 - (17) The Significance of Environmental Attributes as Indicators of the Life Cycle Environmental Impacts of Packaging and Food Service Ware, *Environ. Sci. Technol.* 2020, 54, 9, 5356–5364, Publication Date: April 3, 2020, <https://doi.org/10.1021/acs.est.9b07910>
 - (18) [CO2 and Greenhouse Gases - Recycled Papers \(recycled-papers.co.uk\)](#)
<https://recycled-papers.co.uk/green-matters/why-use-recycled-papers/co2-and-greenhouse-gases/>
 - (19) [Is it better to use recycled paper or FSC-certified paper? | Recycling | The Guardian](#)
<https://www.theguardian.com/environment/2013/mar/31/recycled-or-fsc-certified-paper>
 - (20) [Co-op to replace plastic bags with compostable carriers - BBC News](#)
<https://www.bbc.co.uk/news/uk-45612315>
 - (21) [EUBP_BP_En_13432.pdf \(european-bioplastics.org\)](#)
https://www.docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf
 - (22) [Compostable Plastics | Wales Recycles](#)
<https://www.walesrecycles.org.uk/recycle-an-item>
 - (23) [The UK does not compost enough - 97% don't \(businesswaste.co.uk\)](#)
<https://www.businesswaste.co.uk/news/97-of-uk-households-dont-compost-britain-forgets-the-art-of-composting/>
 - (24) [Home - Bevan Commission](#)
<https://bevancommission.org/>
 - (25) [Environmental Policy - Midco \(midco-pp.co.uk\)](#)
<https://www.midco-pp.co.uk/environmental-policy/>
 - (26) [Embodied Carbon Footprint Database - Circular Ecology](#)
<https://circularecology.com/embodied-carbon-footprint-database.html>
 - (27) [Greenhouse gas reporting: conversion factors 2022 - GOV.UK \(www.gov.uk\)](#)
<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022>