A Review of Circular Economy Research and Recommendations From SEEDS

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February 3rd, 2025

SEEDS **Sustainability Program**

Acknowledgement

UBC's Vancouver-Point Grey campus is located on the traditional, ancestral and occupied territories of the həńq̓əmińəm̓-speaking xwməθ--kwəy̓əm (Musqueam) people. This land has always been a place of learning for the Musqueam, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

Photo: sʔi:ɫqəy qeqən (double-headed serpent post)
        UBC Brand and Marketing

Practitioners' Summary

1 Project Background

Moving away from traditional linear economies has become an essential part of global efforts to mitigate climate change. UBC has formally prioritized circular economies (CE) in its Zero Waste Action Plan (ZWAP) 2030, released in 2023, which established the following target: by 2030, UBC will apply a circular economy lens to enable a 50% reduction in operational waste disposal, progressing toward a zero-waste community. In light of this new target, it's important to monitor UBC's progress on circular economy initiatives.

2 Project Objective

The objective of the current project was to conduct a narrative review of reports on circularity found in the SEEDS Sustainability Library
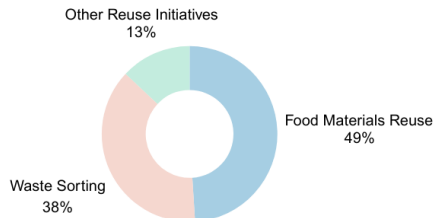
SEEDS SUSTAINABILITY LIBRARY

3 Key Questions

- To what extent is circularity being implemented at UBC?
- What gaps remain in transitioning to circularity?
- What actions should be prioritized in transitioning to circularity?
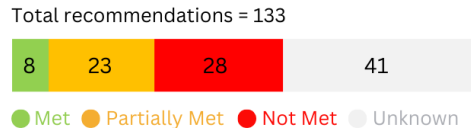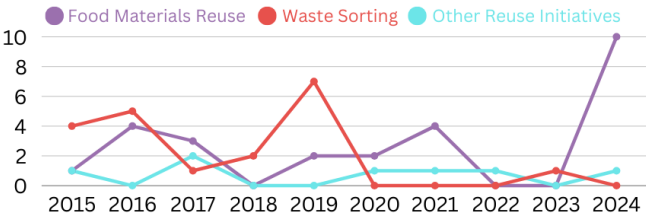
Number of Reports

322 unique reports → **121** relevant reports → **54** reports on **priority** CE topics

- Duplicates removed

- Post-2014 ZWAP
- Relevant to CE

1) Food materials reuse
2) Waste sorting
3) Other reuse initiatives (e.g., lab equipment)

4 Results

Popularity of priority CE topics since 2014

Other Reuse Initiatives 13%
Food Materials Reuse 49%
Waste Sorting 38%

Progress on CE recommendations since 2014

Total recommendations = 133

8	23	28	41

● Met   ● Partially Met   ● Not Met   ● Unknown

Research trends in CE since 2014

● Food Materials Reuse   ● Waste Sorting   ● Other Reuse Initiatives

Recs. made at least 2x more likely to be at least partially met

● Met   ● Partially Met   ● Not Met   ● Unknown
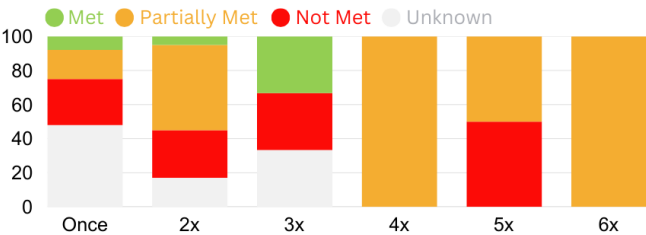
5 Key Recommendations

1 Improve the search capabilites of the SEEDS Sustainability Library

2 Improve tracking of UBC Mugshare Mugs or implement a new system for mug reuse with superior tracking and retention

3 Improve access to and convenience of composting and multi-stream recycling in student housing

4 Expand the reach and impact of the furniture reuse program

5 Improve Sort It Out stations to increase sorting accuracy

Executive Summary

In the past 10-15 years, the idea of circular economies has gained traction among policy makers, the media, researchers, and the general public. Maintaining resources and materials in circulation has the potential to reduce emissions, reduce waste and regenerate nature. In fact, circular economy strategies aimed at reducing production are critical to achieving net-zero emissions by 2050. UBC has formally prioritized circular economy in its Zero Waste Action Plan 2030, which established the following target: by 2030, UBC will apply a circular economy lens to enable a 50% reduction in operational waste disposal.

Tracking UBC's progress and highlighting key gaps is critical to achieving this target. To this end, the current project assessed the status of circularity at UBC by reviewing reports in the SEEDS Sustainability Library, available on the UBC sustainability website. We specifically reviewed reports released after the 2014 ZWAP, from January 2015 to June 2024, that pertained to the following priority topic areas: 1) materials' reuse within food systems, 2) initiatives for improving waste sorting accuracy, and 3) materials' reuse within other areas including furniture and lab equipment.

Descriptive findings illustrated the relative popularity of food materials reuse, which accounted for 49% of reports on priority topic areas (waste sorting, 38%; other reuse initiatives, 13%). Examination of research trends showed that food materials reuse gained popularity after the release of the ZWAP 2030 in 2023.

Narrative findings showed that campus-goers generally prefer lower deposits for container/mug-sharing, along with loyalty rewards, and there is a need for greater advertising and awareness-raising with regard to food materials reuse initiatives. For waste sorting, findings indicated that contamination rates have generally been high, with problematic items including plastic cutlery, compostable food containers and composite items like paper pastry bags with plastic lining. Reports also noted the beneficial impact of door-to-door canvassing in promoting better waste sorting. Regarding other reuse initiatives, findings demonstrated the feasibility and environmental benefit of a formal wear rental program, the high favourability yet low awareness of lab reuse programs, and the need for a standardized system of furniture reuse that includes storage space, a website, delivery and pick-up services, marketing campaigns, support for people to consult with an expert, and rules and standards governing quality.

Of all recommendations made, 31% have been met or partially met. 28% remain to be acted on and 41% are difficult to assess—their status remains unknown. Notably, recommendation status appears to relate to the number of times a recommendation has been made, with recommendations made multiple times more likely to have been at least partially met.

Based on student recommendations and findings made in the current report, we suggest a number of key recommendations for action: 1) improve the search capabilities of the SEEDS Sustainability Library, 2) improve tracking of UBC Mugshare Mugs or implement a new system for mug reuse with superior tracking and retention, 3) improve access to and convenience of composting and multi-stream recycling in student housing, 4) expand the reach and impact of the furniture reuse program, and 5) improve Sort It Out stations to increase sorting accuracy.

This study is supplemented by 3 separate "backgrounder" documents, one for each priority circular economy topic area (i.e., food materials reuse, waste sorting, other reuse initiatives). These documents provide a review of key findings and recommendations made in student reports and are meant to be used as a resource to inform policies or programs for circularity on campus.

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List of Abbreviations

ZWAP = Zero Waste Action Plan

CAP = Climate Action Plan

UBC = University of British Columbia

SEEDS = Social Ecological Economic Development Studies

FWS = Food Ware Strategy

Introduction

Moving away from traditional linear economies has become an essential part of global efforts to mitigate climate change. In linear economies, resources are extracted from the earth, manufactured into products and ultimately disposed of at the end of their life cycle, with substantial emissions produced at each stage (University of British Columbia, 2023). Circular economies, in which products and materials are circulated to extend their lifespans, have gained traction as an alternative because of their capacity to reduce emissions, reduce waste, and restore nature (Ellen Macarthur Foundation, 2021; Geissdoerfer et al., 2017). UBC has prioritized circularity in its climate action and zero waste plans, setting targets for waste reduction to be achieved through circular economy strategies (University of British Columbia, 2023). Despite formal targets, many gaps remain in transitioning UBC to circularity—underscoring the importance of continued research on circularity.

Circular Economy

Consumer economies today are mostly linear, or "take-make-waste"; materials are extracted from the Earth, manufactured into products, and then disposed of at the end of their use (Ellen Macarthur Foundation, 2021; Sariatly, 2017). This paradigm is destructive on multiple levels, contributing directly to climate change through emissions generated at each stage of a product's life cycle, depleting resources by fuelling production of brand-new materials, and polluting and poisoning ecosystems with plastics and chemical byproducts of production (Geissdoerfer et al., 2017; Johanson, 2021; Ellen Macarthur Foundation, 2021).

In contrast to linear economies, circular economies extend the life cycle of consumer products through continuous reuse, repair and refurbishment. Ideally, product design eliminates the need for disposal, either through technological processes (e.g., allowing for the remanufacture of a product, or the recycling of components) or natural processes (e.g., decomposition). The use of biodegradable materials not only eliminates disposal but helps to regenerate natural resources. In this way, circular economies reduce extraction, production, and disposal, and are therefore vital to reducing emissions and fostering a healthy natural environment. In fact, in 2019 the Ellen Macarthur foundation estimated that around a quarter of global emissions reductions required to hit net zero by 2050 can be achieved through circular economy strategies (Ellen Macarthur Foundation, 2021).

History of UBC Zero Waste Plans

At UBC, circular economy initiatives have been formally prioritized in the Zero Waste Action Plan (ZWAP) 2030, released in 2023. The ZWAP 2030 grew out of two prior action plans, the 2014 ZWAP and the Climate Action Plan (CAP) 2030.

The 2014 ZWAP was released after Metro Vancouver set regional waste reduction targets in 2010 and subsequently banned organics within garbage (University of British Columbia, 2014). A 2010-2011 UBC waste audit found that UBC was far from complying with these new standards, leading to the development of the 2014 ZWAP (University of British Columbia, 2014). This plan identified objectives and targets related to both waste diversion and reduction, including:

1. Implement multi-stream recycling across campus to target food scrap collection.
2. Increase diversion rates to meet Metro Vancouver's regional targets of 70% by 2016 and 80% by 2020.
3. Decrease operational waste disposal steadily towards zero waste.

Circular economy was not included as part of the plan, and strategies for reducing waste, beyond increasing waste diversion, were not explicitly identified.

Results of the 2014 ZWAP have been mixed. Despite falling short of waste diversion targets, UBC has achieved a number of successes including a reduction in per capita operational waste, creation of the Sort It Out program and the subsequent roll out of hundreds of multi-stream recycling stations, and implementation of a Food Ware Strategy (University of British Columbia, 2023). Overall, 83% of recommendations made in the 2014 ZWAP have been fully or partially implemented (University of British Columbia, 2023).

The CAP 2030 called for an update to the 2014 ZWAP (University of British Columbia, 2021). The CAP 2030 noted that, when considering emissions across the entire product life cycle, UBC waste-related emissions are mostly the result of production processes, not disposal; in fact, production accounts for an estimated 99% of total waste-related emissions at UBC. This means that reducing waste-related emissions at UBC requires a reduction in the use of brand-new (i.e., "virgin") goods and materials (University of British Columbia, 2021). Circularity, then, is a key strategy for reducing emissions.

As recommended by the CAP 2030, the ZWAP 2030 provided an update to the 2014 ZWAP, placing greater focus on waste reduction through circularity. For example, the plan calls for **increasing reuse initiatives** across different contexts (e.g., the food system, student housing, and laboratories), creating a **sustainable purchasing** strategy, and **increasing research on circular economy** strategies. To this end, the ZWAP 2030 established the following target: *by 2030, UBC will apply a circular economy lens to enable a 50% reduction in operational waste disposal, progressing toward a zero-waste community.*

Status of Circularity at UBC

In light of this new target, it's important to monitor UBC's progress on circular economy initiatives. The current project was guided by the following questions:

1. To what extent is circularity being implemented on the UBC campus?
2. What gaps remain in transitioning to circularity?
3. What recommendations from prior SEEDS research should be prioritized to support circularity?

These are difficult questions to tackle because of the decentralized nature of circularity initiatives on campus, paired with the number of departments or student groups involved. There is no central database in which all circular economy projects and initiatives are currently being tracked. However, one potentially useful resource is the SEEDS Sustainability Library, which is available on the UBC sustainability website[1].

The SEEDS Sustainability Library

The SEEDS Sustainability Library, maintained by the Social Ecological Economic Development Studies (SEEDS) program at UBC, is a database of student research spanning back to 2002. SEEDS is part of the Campus as a Living Lab initiative, managed by Campus and Community Planning, in which the UBC campus is used as a setting for research on new initiatives, policies, and knowledge dissemination and exchange activities. The library contains thousands of reports written by undergraduate and graduate students as part of degree requirements or as part of co-curricular projects, typically in partnership or under the direction of faculty collaborating with SEEDS. SEEDS reports explore a topic or challenge relevant to sustainability on the UBC campus and identify recommendations for action and future research.

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[1] https://sustain.ubc.ca/programs/seeds-sustainability-program/seeds-sustainability-library

Objective and Overview of Current Project

The objective of this project was to conduct a narrative review of UBC student research on circular economy initiatives on campus, in order to identify key findings and recommendations for action. We specifically examined reports released after the 2014 ZWAP, from January 2015 to June 2024, that pertained to the following topics: 1) materials reuse within food systems, 2) initiatives for improving waste sorting accuracy, and 3) materials reuse within other areas including formal wear, furniture and lab equipment. We extracted key findings and recommendations and conducted both a narrative review and descriptive analyses of research trends and the status of recommendations. Narrative findings provided insight on promising strategies, levels of awareness, barriers and possible future actions, whereas descriptive findings highlighted research trends, identified recommendations that have been made repeatedly, and revealed the percentage of recommendations currently met, partially met or not yet met.

Research Methodology and Methods

SEEDS Sustainability Library

In the SEEDS Sustainability Library, each report contains the following information fields: title, author(s), staff, course, themes, faculty, and year (see Figure 1).

Figure 1. Example of a report and its associated fields in the SEEDS Sustainability Library.

Reports returned by a search term are those that contain the exact word or phrase entered (non-case sensitive), in at least one of the above fields. There are no advanced search capabilities (e.g., use of AND, OR is not possible).

Search Strategy

In order to identify relevant papers, we developed an initial set of search terms. These were designed to capture specific sub-topics of interest within the larger category of "circular economy research". Sub-topics included:

- **Food materials**, i.e., research on circularity initiatives for materials like cups, containers, and cutlery
- **Waste sorting**, i.e., research on improving waste sorting accuracy across campus
- **Reuse initiatives**, i.e. research on circularity initiatives for non-food materials like furniture
- **Reduction initiatives**, i.e., research on reducing purchasing of new materials

- **Consumer attitudes**, i.e., beliefs and behaviours of faculty, students and staff towards circular economy initiatives, material use and procurement
- **Barriers to circularity**, i.e., political, economic, cultural, or structural barriers to achieving circularity

The terms used to search for papers within each topic area are listed in the table below.

Topic	Search Terms	
Generic terms	Zero waste	
	Business model	
	Circular economy	
Food materials	Food materials	Food system
	Reusable food containers	Food system sustainability
	Food service ware	Packaging
	Food waste	Sustainable food
Waste Sorting	Waste management	Compost contamination
	Managing waste	Contamination
	Waste reduction	Green bin
	Degradable	Contaminant
	Waste management system	Compost
	Litter	Recycle
	Waste sorting	Recycling
Reuse Initiatives	Reuse	Share
	Reusable	Cup
	Sharing	Container
	Mug share	Mugshare
	Mug-share	Remanufacture
	Mug	Furniture
Reduction Initiatives	Reduce	
	Reducing	
	Reduction	
Consumer Attitudes	Behaviours	Consumer
	Behaviour	Attitude
	Behaviour change	Beliefs
	Change behaviour	Environmental education
	Behavioural	Willingness
	Intentions	Climate action
Barriers to Circularity	Barriers	
	Political	
	Feasibility	

Exclusion Criteria

The search terms above yielded 474 reports spanning over 20 years of research. A list of reports was created and revised in Excel that included information related to publication year, search terms and topic. After removal of duplicates, 344 reports remained. We then applied the following exclusion criteria.

1. **Reports were published during or after the 2014-2015 academic year following the release of the 2014 UBC Zero Waste Action Plan** (released on October 3rd, 2014). Reports published pre-

2014 are more likely to be out of date and are likely less useful in the context of the current Zero Waste Action Plan and our focus on circularity.

2. **Reports were relevant to circular economy / zero waste topics.** Ultimately, the decision to exclude a report involved a degree of subjectivity but a system was applied to ensure consistency. First, relevance was determined from titles; if titles made clear reference to other topics (e.g., bird-window collisions, post-occupancy evaluations, gardening practices, active study stations, physical exercise, etc.), those reports were excluded. Second, remaining reports were excluded if executive summaries indicated non-relevance.

Revision of Circular Economy Sub-topics for Review

The process of identifying key sub-topics for the review was iterative. After development and application of the initial search terms, we refined sub-topics of interest to align with ongoing priorities. Sub-topics were narrowed down to the following priority areas:

- **Food materials reuse,** i.e., research on reuse of materials in the food system, primarily mug- and container-sharing

- **Waste sorting**, i.e., research on improving waste sorting accuracy

- **Reuse initiatives** related to materials other than food materials, e.g., furniture, lab equipment and formal wear

These sub-topics focused on specific aspects of the broader initial categories; findings related to consumer attitudes and barriers to circularity were integrated into the revised sub-topics because reports often included a discussion of student perspectives and barriers.

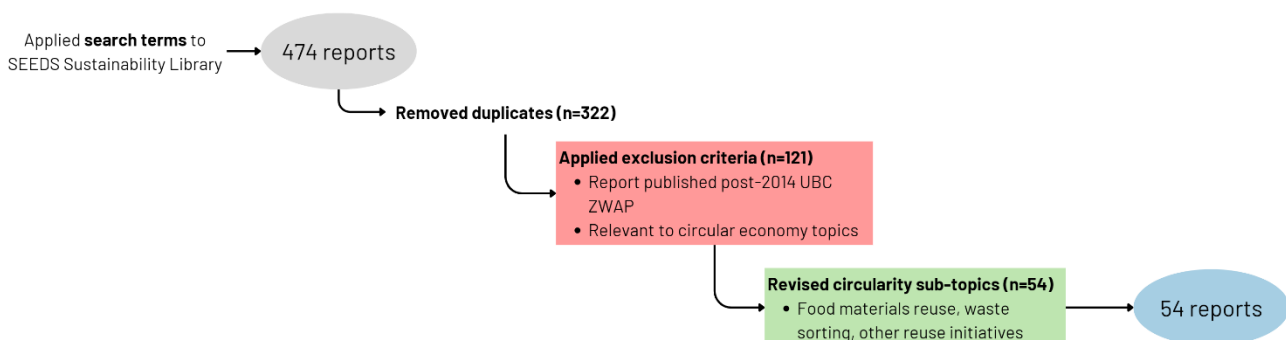After applying exclusion criteria and revising the circularity sub-topics, 54 reports remained.

Figure 2. Depiction of the search process.

Descriptive Analysis

Student reports in the SEEDS Sustainability Library typically include two main elements: **findings** (from surveys/experiments/literature review) and **recommendations** (recommendations for both action and future research). In our descriptive analyses, we characterized both the state of research findings and the status of recommendations. To characterize the state of the research, we looked at the overall popularity of research topics between 2015 and June 2024. We also looked at research trends over time, and contextualized trends by noting key events (e.g., launch of new initiatives, release of influential reports, revisions of guidelines) that preceded moments of intense research interest, as well as key

events that followed those moments to get a sense of research motivators and impacts. To characterize recommendations and recommendation status, we first categorized recommendations into themes and then identified recommendation status by consulting official policy changes, guidelines, documents and Ubyssey articles. We then calculated percentages of recommendations met for each circularity sub-topic area. We also identified recommendations that were made multiple times across different reports; this allowed us to 1) assess the relationship between repetition of recommendations and recommendation status, and 2) highlight urgent recommendations that are currently unmet.

Narrative Review and Recommendations

We conducted a narrative review of the reports included, pulling out key findings and categorizing them by theme (e.g., barriers, financial incentives, student perspectives, etc.). We identified all recommendations made, categorized them by theme and determined their current status (i.e., met, partially met, not met, unknown). We also identified priority recommendations based on the number of times recommendations were made, the issues raised in the UBC ZWAP 2030, and research findings.

This project also led to the creation of a series of backgrounder documents on food materials reuse, waste sorting, and reuse initiatives focused on lab equipment, furniture, and formal wear, which are included in the "narrative review" section of the results section of this report.

Results

Descriptive Findings: Research Focus, Trends, Key Motivators, and Impacts

State of the Research

Since the release of UBC's 2014 ZWAP, the most popular areas of student research on circularity have been **food systems** (54 reports), **behaviours/attitudes** towards circularity (54 reports), **waste management systems** (37 reports), and **reuse** (32 repors)(Figure 3).
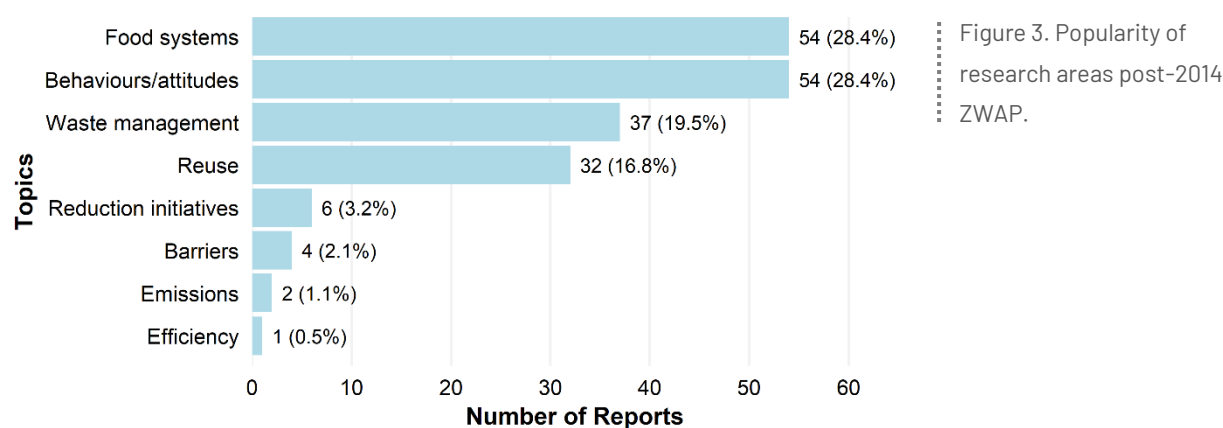

Figure 3. Popularity of research areas post-2014 ZWAP.

Trends over time show four major spikes in research interest. In 2015-2016, there was a moderate increase in research on food systems, materials reuse, and behaviours/attitudes. In 2018-2019, there was a large increase in research on food systems, materials reuse, behaviours/attitudes, and waste management systems. In 2020-2021, there was a moderate increase in research on food systems, materials reuse, and behaviours/attitudes. In 2024, there was a large increase in research on materials reuse (Figure 4).
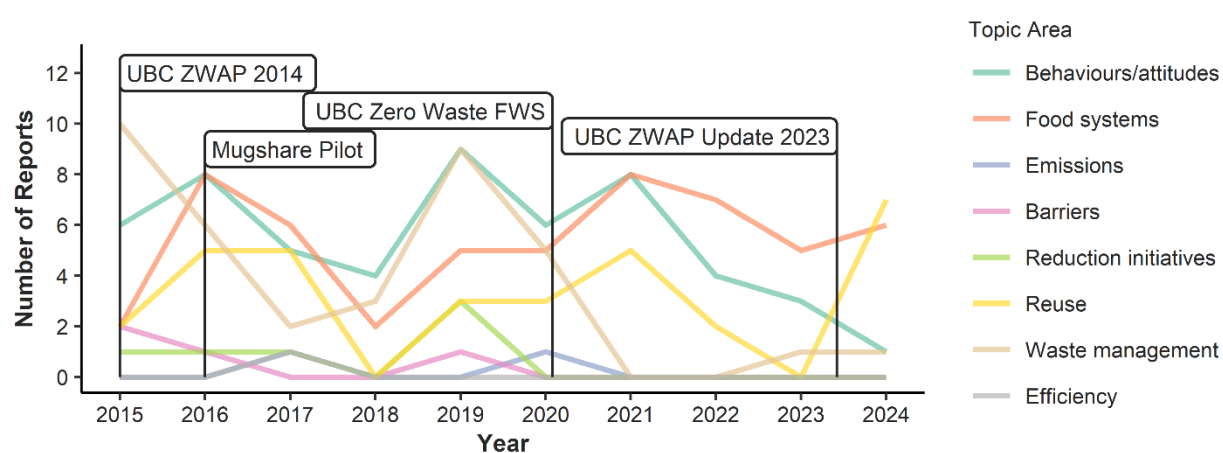

Figure 4. Research trends post-2014 ZWAP.

These spikes in research interest coincided with several key events in the UBC sustainability space. For example, the release of the UBC 2014 ZWAP in October of 2014, and the launch of the Mugshare Pilot in 2016 coincided with the 2015-2016 spike. While the events highlighted in Figure 4 are not necessarily responsible for changes in research interest, they do reflect the wider context that may have driven those trends.

Among the subset of reports that were included in our priority topic areas (i.e., food materials reuse, waste sorting, other reuse initiatives), the most popular research area from 2015-2024 was food materials reuse (Figure 5).

Figure 5. Popularity of priority CE topics post-2014 ZWAP.
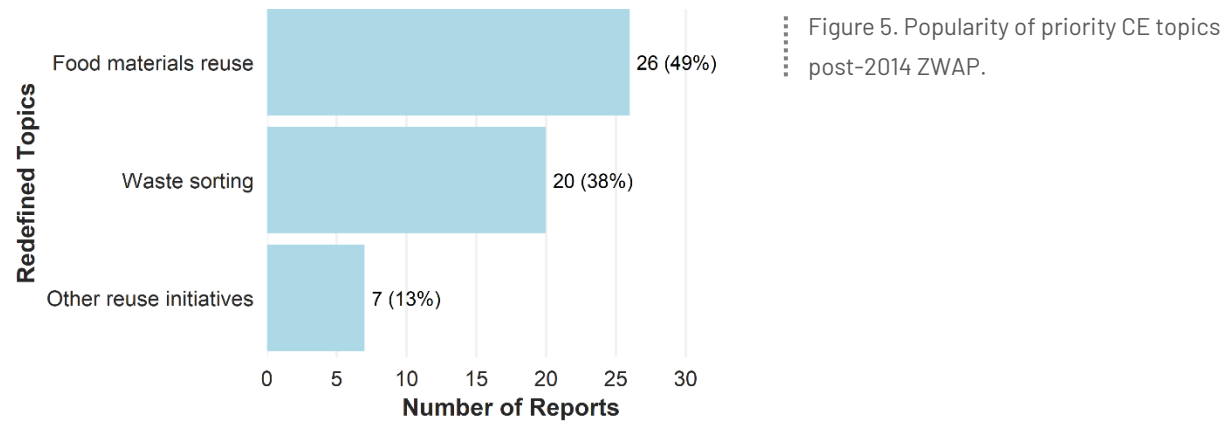
Trends over time reflect the same 4 spikes discussed above: a small increase in food materials reuse and waste sorting in 2015-2016, a large increase in waste sorting (with a smaller increase in food materials reuse) in 2018-2019, a small increase in food materials reuse in 2020-2021, and a large increase in food materials reuse in 2023-2024 (Figure 6).

For research trends over the period 2002-2024, see appendix A.

Figure 6. Research trends for priority CE topics post-2014 ZWAP.
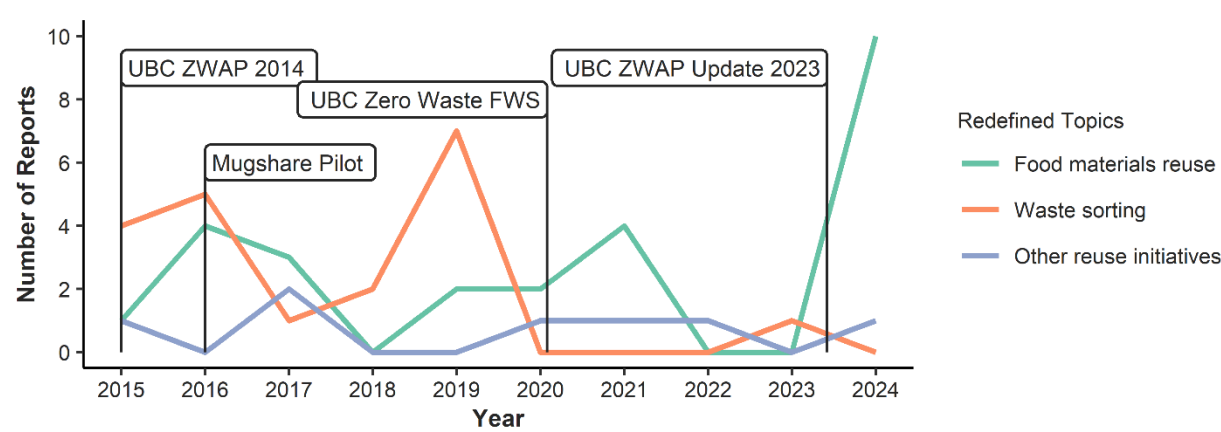
Status of Recommendations

Reports included in the review each made specific recommendations related to their findings. In total, reports on food materials reuse made 41 recommendations, reports on waste sorting made 61 recommendations, and reports on other resue initiatives made 31 recommendations. Food materials reuse had the largest proportion of met or partially met recommendations (43%), followed by waste sorting (26%), and other reuse initiatives (25%). Other reuse initiatives had the largest proportion of recommendations that were unknown (i.e., difficult or impossible to assess; 55%) (see Figure 7). Across all three topics, 30% of recommendations have been met or partially met.

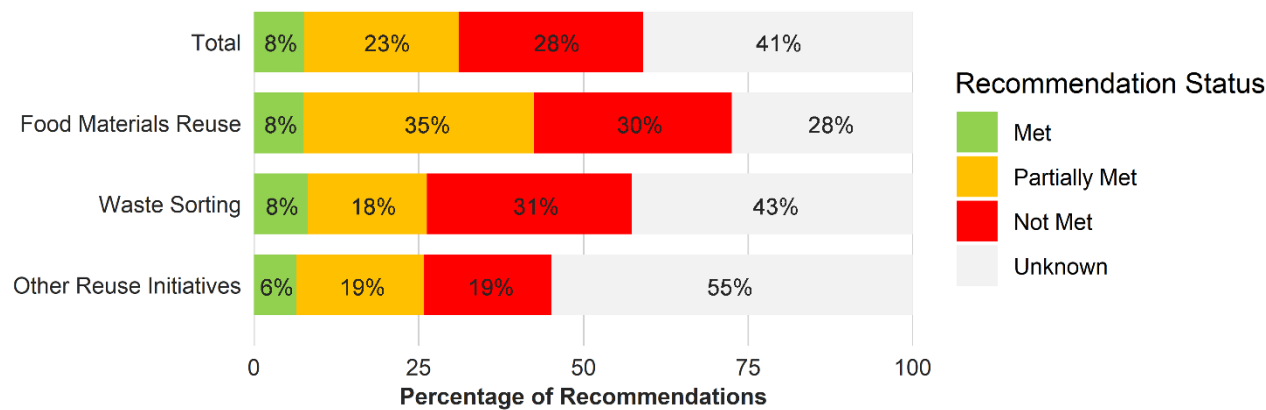For a more detailed breakdown of recommendations within each topic area, see Appendix B.

Figure 7. Status of recommendations by topic area.

Repeat Recommendations

Although the majority of recommendations were made once, 20% of all recommendations were made at least twice (Figure 8). These repeated recommendations are potentially higher impact and more likely to have been addressed or at least partially addressed.
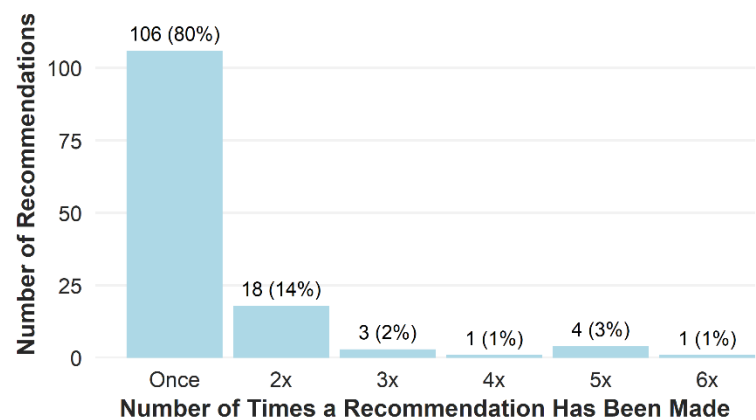

Figure 8. Distribution of the number of times recommendations were made.

The topic area with the largest number and percentage of repeated recommendations (i.e., recommendations made at least twice) was food materials reuse, with 12 repeated recommendations

comprising 29% of its recommendations (see Figure 9). Research on other reuse initiatives made 7 repeated recommendations (22%), and research on waste sorting made 8 repeated recommendations (14%). See appendix C for a detailed breakdown of these results.

Figure 9. Number of times recommendations were made by topic area.
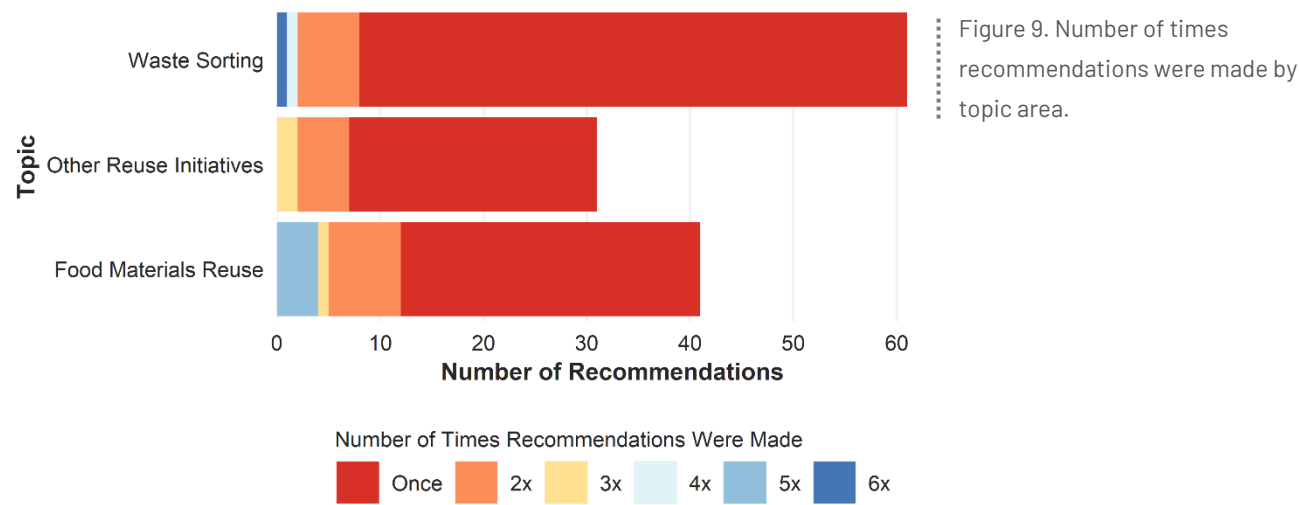
A key issue is whether recommendations made multiple times were more likely to be met or at least partially met. We investigated this by cross-tabulating recommendations by their status (i.e., met, partially met, not met, unknown) and their repetitions (see Figure 10 and Appendix D). Results demonstrated that recommendations made at least twice were more likely to be at least partially met (Figure 10; $\chi^2(1) = 9.71$, $p = .002$). This is promising evidence that UBC circularity initiatives reflect, whether directly or indirectly, student research making repeated recommendations.
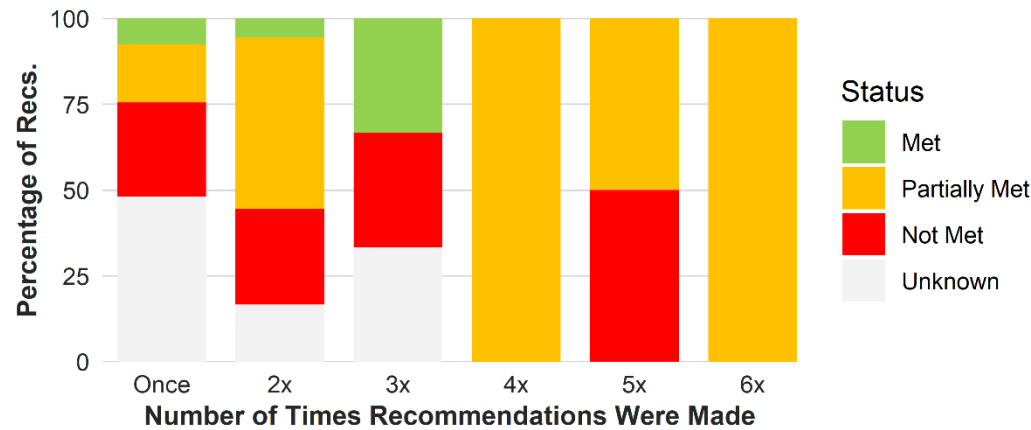

Figure 10. Status of recommendations by topic area.

Narrative Review: Main Findings by Topic Area

The following section presents main findings from the narrative review of student research. Findings are presented for each topic area: food materials reuse, waste sorting, reuse initiatives for other materials.

Food Materials Reuse

Summary of Key Findings:

Awareness and engagement

From 2017 to 2020, reusable mug/container use was low due to a lack of awareness of initiatives and eco-taxes on disposables (no up-to-date estimates available in the SEEDS library)

Ideal container/mug types for reuse programs

The ideal container would have adjustable compartments and be large enough to accommodate an entrée plus a side

The ideal mug would be stainless steel, visually appealing, well-insulated, spill-proof, portable, lightweight, easy to clean, and convenient to access and return

Areas of improvement

There is a need for greater awareness, more advertising, and improved tracking systems for container/mug reuse programs

Campus-goer perspectives

Most campus-goers are motivated to behave sustainably and may participate in reuse due to social pressure, financial incentives, frequent reminders, and perks like faster checkout lines

Most campus-goers want to see mug sharing expanded to Tim Hortons, Starbucks, the Nest, and UBC residences, with drop-off locations favored in social spaces (like the Nest and LIFE building), libraries (IKB, Koerner, Woodward), and residential cafeterias

Financial incentives

Most campus-goers prefer lower deposits (<$5), larger eco-taxes on disposables ($0.50+ per purchase), and loyalty rewards for participating in reuse programs

Key Findings:

Consumer habits and awareness

Three reports (Smith, 2015; Hatmi et. al, 2016; Heo et al., 2020) have explored consumer habits around coffee consumption, use of reusable mugs, and engagement with container reuse programs like the UBC Mugshare program[2] and the Eco-2-Go program[3]. In terms of coffee consumption, a majority of campus-goers regularly buy coffee/tea on campus. In 2014-2015, 79% of respondents bought coffee/tea on campus 1+ times a week (n = 252) (Smith, 2015), while in 2016-2017, 55% of respondents bought coffee 2+ times a week (n=80) (Hatmi et al., 2016). In 2019-2020, 79% of respondents bought 2+ cups of coffee a week (n=150) (Heo et al., 2020). In terms of reusable mug use, a majority of campus-goers rarely or never use reusable mugs. In 2014-2015, 73% of respondents used a reusable mug less than ¼ of the time, never, or simply didn't own a reusable mug (Smith, 2015). In 2016-2017, 60% of respondents did not bring their own mugs to campus (Hatmi et al., 2016). In 2019-2020, respondents used disposable cups more than reusable cups and ordered "to go" more frequently than "for here" (Heo et al., 2020).

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[2] Mugshare is an initiative started in 2016 by a team of students at UBC sustainability organization Common Energy that offers reusable cups with a $5 deposit onsite at partner cafes. Partner cafes on campus: Blue Chip Café, The Boulevard Coffee Roasting Co., Doughgirls, Great Dane Coffee, Harvest, Hero Coffee + Market, Ike's Café, JJ Bean Coffee Roasters, Mercante, Perugia Italian Caffé.

[3] Eco-to-go was a container sharing program in which participants paid a $5 deposit to receive a card token, the card was then exchanged for clean containers. Eco-to-go was offered at AMS food/beverage and UBC food services locations. It is not clear if Eco-to-go currently exists.

In terms of awareness and engagement with reusable container programs, a majority of campus-goers are unaware and/or unsubscribed to programs like UBC Mugshare and Eco-2-Go. In 2014-2015, 70% of students were unaware of the Eco-2-Go program (Smith, 2015). In 2016-2017, 80-96% were unaware of the Mugshare program in the AMS nest (Hatmi et al., 2016). Two other reports from 2015-2016 have noted low awareness of the Mugshare program (Ruskey et al., 2016; Kaczkowski et al., 2016). In 2020, 83% of respondents had never used Mugshare (Heo et al., 2020). However, first-year students living in campus residences are highly aware of the Green-2-Go[4] reusable container program (92%; n = 66), thanks to Jumpstart/orientation programming and word of mouth (Brown et al., 2021).

Ideal container/mug types

A number of reports have investigated the ideal kind of reusable containers for both beverages and food. These reports have focused on economic, environmental, and social considerations (i.e., "triple bottom-line assessment").

In terms of reusable food containers, the ideal container would feature adjustable compartments, and be large enough to accommodate an entrée plus a side. In 2020-2021, 67% of participants preferred a medium sized container, described as fitting 'one entree', while 30% of participants preferred a large container, described as fitting 'one entree and a side dish' (Baskett et al., 2021). Another 2020-2021 report found that participants preferred single space or compartmentalized food containers with adjustable compartments over stacked containers (Lillywhite et al., 2021).

In terms of reusable mugs, the ideal mug would be made of stainless steal, would be visually appealing, spill proof and easy to clean. Three reports from 2015-2016 identified stainless steel as a good material because of its capacity for insulation and its durability, making it cheaper and more environmentally sustainable over time (Karna et al., 2016; Ruskey et al., 2016; Kaczkowski et al., 2016). Other potential mugs include borosilicate glass mugs due to their aesthetic appeal (customizable sleeves) and durability, and ceramic mugs due to their low ecological footprint (negligible emissions after disposal), ease of cleaning, and aesthetic appeal (anti-chip paint coating) (Evans et al., 2016; Garcia-Alonso et al., 2016).

Campus-goer perspectives: general reasons for participating

A number of reports have looked at campus-goer perspectives on reusable container programs and have ranked factors related to participation and non-participation.

Over the years, campus-goers have expressed their main reasons for not using reusable mugs. In 2014-2015, these were: "I don't like carrying it around", "I forgot to bring it", "I only get coffee/tea occasionally", "it is what the shops offer and I have not considered the alternative", "they are cleaner than reusable mugs", and "I don't own a reusable mug" (Smith, 2015); in 2019-2020: "inconvenience" (specifically volume and weight of cup, difficulty of cleaning and difficulty remembering to bring them), "not buying enough hot beverages", "not interested in environmental issues", "forgetfulness", and "not knowing which cafes accept them" (Heo et al., 2020); in 2023-2024: "inconvenience of carrying " (83%), "forgetting to bring reusable" (82%), "disposable cup is habit" (55%) (Duwel et al., 2024), and "forgetfulness", "needing to wash them", "baristas not asking about them", "lacking space to bring them" (See et al., 2024), and "forgetting" (78%), "not wanting to carry around a reusable cup" (69%), "reusable cup not clean" (27%), "difficult to find facilities to clean reusable cups" (24%) (Berthiaume et al., 2024). These findings highlight the importance of mugs being convenient, portable, non-cumbersome, and easily cleanable.

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[4] Green-2-Go is a reusable container program in first-year residences (e.g., Orchard Commons), where students pay a $2 deposit and receive a container which they can return to receive their deposit back. Students receive a $0.20 discount when using Green-2-Go.

The main reasons for using a reusable mug were, in 2014-2015: "I want to be sustainable", "the insulation keeps my coffee/tea warm", "spill proof", "I like the look of my mug", and "I get a discount on coffee/tea" (Smith, 2015); in 2023-2024: "environmental concern" (76%), "saving money" (74%) (Duwel et al., 2024) and "reducing environmental impacts" (59%), "avoiding paying $0.25 single-use cup fees" (58%), "because I like my own cup" (36%), "because it keeps temperature warm" (29%) (Berthiaume et al., 2024). These findings highlight the importance of behaving sustainably, mug practicality/functionality (e.g., well-insulated, non-spill), mug aesthetics, and financial incentives. Also, respondents identified what it would take for them to switch to reusable mugs, in 2014-2015: "I get a bigger discount when bringing my own mug" (60%), "A regular reminder or prompt" (41%), and "an extra charge for using a paper cup" (26%) (Smith, 2015); in 2019-2020: "environmental reasons", "economic incentives", and "safety and cleanliness" (Heo et al., 2020); in 2023-2024: "incentives such as discounts or rewards" (71%), "easy cleaning and maintenance of reusables" (56%), "lower cost options for reusables" (45%) (Duwel et al., 2024), again highlighting the importance of financial incentives and reminders for increasing participation.

In 2016-2017, the following factors, in order, affected reusable cup usage: lightweight mugs, easy to clean mugs, convenient purchase location, attractive aesthetics, and affordable price (Hatmi et al., 2016). Further, respondents were influenced to participate in reuse programs by friends, discounts, faster check-outs, and social pressure, highlighting the importance of sustainability social culture, financial incentives, additional perks like faster check-outs, and convenience (Hatmi et al., 2016).

In 2020-2021, hygiene and transparency (public knowledge of container cleaning actions) were the highest-rated factors contributing to participation in container sharing (Baskett et al., 2021). Heightened concern around hygiene was likely a result of COVID-19. Other factors that may be more relevant in today's context (June 2024) include convenience, portability/design, and discounts/benefits (Baskett et al., 2021).

Campus-goer perspectives: financial incentives

Some reports have explored perspectives on financial incentives in the form of eco-taxes on disposable cup use or rewards/discounts for participating in reusable container programs. In 2016-2017, most respondents (60-76%) were unaware of the eco-tax on disposable cups ($0.10 at the time) and 67% expressed that the tax was not enough to motivate a switch to reusables. Instead, 31% of respondents agreed that $0.50 per purchase would be enough to motivate a switch (Hatmi et al., 2016).

Regarding mug price or deposits, a 2015 report found that 70% of respondents preferred a price of $5.00 or less for a reusable mug if it were made available at UBC cafés (Smith, 2015). In 2016-2017, 25% of respondents suggested that the deposit to join the Mugshare program should be less than $3. Another 22% of participants said the deposit should be $5 (Hatmi et al., 2016). In 2020-2021, respondents expressed a preference for rewards instead of a discount or points system for the reusable container program (e.g., $2 off every 5th, and $5 off every 10th purchase) (Chiu et al., 2021). In 2023-2024, most respondents (57%) preferred a points-based reward system akin to stamp cards, where points are accumulated and redeemed at a later point (Duwel et al., 2024). In 2024, two reports found that advertising and implementing probabilistic reward systems for customers who brought reusable mugs (e.g., spin-the-wheel to win an AMS gift card, or lottery-style with a 1-in-10 chance of winning a free coffee) led to significant increases in reusable mug use at participating cafes (Desvaux et al., 2024; Argentopolous et al., 2024).

In 2018, an increase in the eco-tax to $0.25 coincided with a 29% average reduction in disposable cup usage in 4 outlets from 2017 to 2018 (Ike's, Mercante, Totem Residence Dining Hall, Stir It Up), suggesting that an eco-tax of $0.25 per purchase can reduce disposable cup use without significantly impacting sales (Sidhu et al., 2018).

Campus-goer perspectives: locations for pick-up/drop-off

Location-wise, a 2015-2016 report found that people wanted to see UBC Mugshare expanded to Tim Hortons / Starbucks, the nest, and UBC residences (Karna et al., 2016). In 2020-2021, people preferred container drop-off locations in social spaces (e.g., the nest, LIFE building), libraries (e.g., IKB, Koerner, Woodward), and residential cafeterias (Baskett et al., 2021).

Campus-goer perspectives: "for-here" vs "to-go" culture

A 2019-2020 report explored facilitators and barriers for ordering coffee "for here" instead of "to go". The main reasons for ordering coffee "for here" were: "studying" (23%), "meeting someone at the cafe" (20%), "I want to stay and enjoy the drink" (14%), "environmental reasons" (10%), "enjoying the cafe atmosphere" (10%), "wanted access to power outlets" (7%), and "forgot my to go cup" (6%) (Heo et al., 2020), highlighting the importance of cafes providing a good atmosphere, study spaces and access to power outlets. Barrier to getting drinks "for here" included: "not having enough time" (33%), "lack of seating" (23%), "no reason to stay" (15%), "lack of power outlets" (9%), "too noisy" (8%), and "no for here mug option" (6%) (Heo et al., 2020), highlighting the importance of providing enough seating and having for here mug options for customers.

Effects of "framing" on behaviour

A few reports have looked at motivating reusable cup behaviour through marketing and "framing" strategies. In 2024, posters that were image-based and presented financial, convenience, social desirability or environmental arguments for using reusable cups significantly increased motivations to use reusable cups above text-based posters or "control" posters (Goble et al., 2024). Another strategy is "loss framing" or emphasizing the personal financial cost of using disposable cups (i.e., eco-taxes on disposables); this was found to increase intentions to use reusable cups more than "gain framing", which emphasizes personal savings accrued from using reusable cups (Battu et al., 2024). Loss framing was found to be especially impactful when the cumulative "$0.25 losses" were framed as a yearly loss (e.g., a "$100 yearly cost" rather than a "$0.25 per cup cost") (Battu et al., 2024).

Problems with UBC Mugshare and other programs

A couple reports have identified lack of awareness and a need for more advertising for the UBC Mugshare program specifically (Hatmi et al., 2016; Kaczkowski et al., 2016; Smith, 2015). Another problem is the tracking system, which is tedious and unreliable, leading to high rates of loss or theft of mugs (Karna et al., 2016; Lam et al., 2017; Evans et al., 2016; Ruskey et al., 2016; Kaczkowski et al., 2016). Currently, the Mugshare program requires a $5 deposit to acquire a membership card and a mug from any participating location, after which the mug can be returned and the deposit refunded (i.e., a "deposit-drink-return system"). Each vendor tracks mug use on paper and this information is entered into a global spreadsheet daily (Karna et al., 2016). Another reusable container program in Vancouver (Reusables.com) has achieved a 99% return rate by charging deposits after use if a container is not returned on time. This is similar to the model currently employed by the UBC UmbraCity umbrella exchange, which charges a fee of $2 each day after 48 hours of free access, up to 20$ total (Evans et al., 2016).

The Green-2-Go program is fairly well-known among first years but has logistical problems including not enough containers, no places to wash containers, inadequate return procedures, and containers running out at busy times and right after breaks (Brown et al., 2021). Additionally, a large proportion of users (42% of first years surveyed) have taken containers out of the system by either recycling, throwing away, or repurposing them (Brown et al., 2021).

One report looked at common concerns associated with a hypothetical container-sharing program. Concerns included hygiene concerns (e.g., cleanliness of reusable cups, including ease of maintenance, exposure to germs, and adequacy of washing facilities), concerns about implementation and practicality including cup design concerns (e.g., usability, aesthetics and functionality), drop-off accessibility, environmental impact (e.g., concerns about the ecological impact of cup production), incentive to return (e.g., concerns about theft or removal of cups from the reuse system). A number of respondents emphasized personal responsibility for reusable cup use and suggested increasing the tax on single-use containers (Berthiaume et al., 2024).

Event waste

A 2018-2019 report explored plastic cup waste at Engineering Student Centre events (Stoicheff et al., 2019). They found that roughly 1675 plastic cups were used per event, with about 90% (1507) ending up in the landfill. Proposed solutions include, from cheapest to most expensive: 1) the Engineering Undergraduate Society (EUS) switches its stock of cups to biodegradable cups, so that event organizers may purchase these cups from the EUS when putting on events, 2) the EUS switches its stock of cups to biodegradable cups and includes a damage deposit in the event contract to incentivize event organizers to bring their own biodegradable cups, and 3) the EUS fully stocks their bar with re-usable cups as well as a commercial bar washer for events, so event organizers don't have to bring cups.

Waste Sorting

Summary of Key Findings:

Compost contamination

Contamination in UBC compost bins is high; contaminated bins cannot be composted and instead are sent to the landfill

Most compost contaminants fall into 6 categories, in order of prevalence: paper coffee cups, plastic cutlery, food waste with packaging, plastic containers and cups, plastic bags, and plastic cup lids

Locations with high contamination of compost include the Nest, "Central" (i.e., retailers around the bus loop on University Boulevard), University Village, Vanier Dining Hall, Totem Dining Hall, Orchard Commons Dining Hall

Barriers to accurate waste sorting

Specific items often lead to confusion. Problematic items include plastic cutlery, compostable food containers, and composite items (e.g., paper pastry bags with plastic lining)

A key problem is that food service ware varies across food outlets and cannot be disposed of in consistent fashion, leading to incorrect sorting

Strategies for improving waste sorting

Strategies for improving sorting accuracy at Sort It Out stations include clearer signage, higher (i.e., more visible) placement of signage, 3D display boxes, use of bin lids, mirrors and messages/reminders ("Do you sort your waste?"), and more bins

In student/family residences, door-to-door canvassing can be an effective means of increasing participation and reducing contamination in compost and other recycling streams

Key Findings:

Status of waste sorting at UBC: waste audits

A few reports have conducted waste audits to describe the state of waste sorting at UBC (Crolla et al., 2018; Goodeve et al., 2016; Cheng, 2016).

All reports identified an abundance of contaminants in UBC sorting bins. In 2013, an audit of the Wesbrook building by TRI Environmental Consulting Inc. found that paper, recyclable containers, and the compost stream were 46%, 39% and 21% contaminated, respectively (Cheng, 2016). Major contaminants in the paper stream included recyclable plastic film and soiled paper. Major recycling contaminants included food waste with non-compostable packaging, compostable food waste, and recyclable plastic films. Major compost stream contaminants included deposit glass beverage containers, food waste with non-compostable packaging, recyclable plastic films, and non-compostable paper cups (Cheng, 2016). Further, waste audits of the Student Union Building by student-led Common Energy found that, in 2014, only 50% of waste was sorted correctly, with food scraps representing the largest category of incorrectly sorted waste (Cheng, 2016). In 2015, the audit was repeated and only 39% of waste was correctly sorted. Commonly missorted items included coffee cups, chopsticks, portion-packed sauces, expanded polystyrene, plastic cutlery (with and without a recycling sign), food scraps, soup bowls, sushi containers and soft plastics (Cheng, 2016).

In 2016, 8 outdoor compost bins had an average daily contamination rate of 10% (Goodeve et al., 2016), above the recommended threshold of 5%. These contaminants were largely dominated by three major groups: plastic cutlery, recyclable coffee cups, and recyclable food containers (Goodeve et al., 2016). Another 2016 report found that the average percentage of correctly sorted items across 10+ Sort It Out stations was 63% (Cheng, 2016). The most commonly missorted items included coffee cups, coffee cup

lids, coffee cup sleeves, paper sleeves, compostable take-out containers, chequered food wrapping paper, compostable Nature bowls, recyclable Nature bowl lids and soiled napkins; 98% of these items originated on campus (Cheng, 2016). In 2018, 57% of compost contaminants were "non-conforming" contaminants[5], and 81% of contaminants fell into 6 major categories (Crolla et al., 2018): paper coffee cups (21%), plastic cutlery (17%), food waste with packaging (15%), plastic containers and cups (15%), plastic bags (9%), and plastic cup lids (4%) (Crolla et al., 2018). Of these, plastic cutlery, food waste with packaging, and plastic containers and cups were non-conforming items.

These reports highlight a number of recurring item categories: recyclable coffee cup components (lids, sleeves, cups), plastic cutlery, recyclable/compostable food container components, soft plastics, food scraps, and packaging with food scraps.

Campus-goer perspectives on waste sorting: attitudes and barriers

In terms of attitudes around waste sorting, UBC bin users appear to compost for moral/environmental reasons, including sustainable lifestyle (96%), reduced amount of waste to landfill (78%), and positive environmental impact (69%) (Goodeve et al., 2016). However, bin users seem to have a limited understanding of what waste sorting entails (Goodeve et al., 2016; Charles et al., 2019).

When asked about the functionality of UBC's Sort It Out campaign survey respondents had mixed feedback, saying that the stations were easy to use (43%) and had clear signage (39%), yet 22% found the stations confusing (Goodeve et al., 2016). When asked about improvements, students indicated that Sort It Out Stations could benefit from better signage, higher placement of signage, and 3D displays to clarify sorting for the user (Goodeve et al., 2016). Also, when asked the question, "What, if anything, would encourage you to compost at UBC?", 35% of respondents recommended more bins on campus (Goodeve et al., 2016).

Two reports have noted confusion over sorting of specific items. In 2016, 28% of respondents did not know how to sort compostable food containers, with 21% choosing to recycle them instead of composting (Goodeve et al., 2016). In 2018, the most commonly missorted item was plastic cutlery, likely due to confusing signage (i.e., recyclables signage states that plastics belong in the recycling bin, leading users to sort plastic cutlery accordingly—but this is not true of all plastics). Composite items were also problematic, especially items consisting of paper and plastic (e.g., paper pastry bags with plastic lining), due to plastic components such as lining being easy to miss (Crolla et al., 2018). A central issue identified in both reports was that food packaging items vary across food outlets and cannot be sorted in a standardized/consistent manner (Goodeve et al., 2016; Crolla et al., 2018).

A 2019 report examined waste sorting in the Meekinson Arts Student Space (MASS) specifically (Charles et al., 2019). When asked if there were any potential barriers to disposing of waste efficiently, the majority of respondents (29%) stated that there were not enough bins, the bins were too small (26%), and there was no clear signage (19%). There were also concerns regarding the location of bins in MASS. Preferred approaches to improving waste sorting included improving the cleanliness of the space, providing an e-waste disposal program, providing better sorting bins (e.g., larger) and clearer signage (Charles et al., 2019).

High-contamination locations on campus

Three reports identified problematic areas with particularly high contamination on campus. In 2016, the most polluted bin was located near the Triple O's on Main Mall and Agriculture Boulevard, with an average daily contamination rate of 16% (Goodeve et al., 2016). Five locations were found to be over the in-vessel

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[5] The authors define non-conforming contaminants as contaminants that are not recyclable in another stream, i.e., garbage, whereas conforming contaminants are recyclable but mis-sorted (Crolla et al., 2018).

composter threshold (i.e., 5% contamination): The Trolley Bus Loop, Triple O's on Main Mall, The UBC Fountain on Main Mall near the Biology Building, Forestry and Sauder School of Business. The bin with the least contamination was located near the Earth Sciences Building with an average daily contamination rate of 6% (Goodeve et al.,2016). Another 2016 report identified the Nest, Vanier Residence Dining Hall and The Sauder Exchange Café as problematic sites with percentage of correctly sorted items under 50% (Cheng, 2016). In 2018, the top 5 buildings with highest compost contamination were the Nest, Central, University Village, Vanier Dining Hall, Totem Dining Hall, and Orchard Commons Dining Hall (Crolla et al., 2018). The authors attributed contamination primarily to confusion arising from variability in food packaging for

Figure 11. Map of contamination hotspots taken from Crolla et al. (2018).

similar food items from different outlets. They suggested that food outlets within 100-meter buffers of contamination hotspots may be important contributors to contamination (see figure below; Crolla et al., 2018).

Individual business and food service ware

A 2016 report investigated food materials and packaging at food vendors across campus (Cheng, 2016). "Unmarked" disposable materials like unmarked plastic cutlery, unmarked straws, unmarked plastic soup bowl lids, unmarked plastic sleeves, plastic bags and unmarked plastic stir sticks were identified at several locations—importantly, unmarked items are likely to cause confusion at sorting stations. Locations that carried unmarked materials included UBC food services like Mercante, Sauder café, and Totem Residence Dining Hall, AMS vendors like the Delly, Palate, Qoola, and independent outlets like Tim Hortons and Great Dane (Cheng, 2016).

Additionally, some independently run locations don't have bins that align with UBC's Sort It Out program (e.g., Starbucks on east mall and agronomy, Tim Horton's in forest sciences, QOOLA in the nest, and Uppercase/Lowercase/Flip Side/Delly in the nest) (Cheng, 2016).

3D display boxes as visual aids to improve sorting accuracy

A number of studies have investigated the effect of 3D display boxes on waste sorting behaviour (Talbot et al., 2019; Foster, 2016; Cho et al., 2019; Morgan et al., 2016). 3D display boxes are placed directly above waste bins and contain physical examples of items that belong in each bin.

Results are mixed; some reports have shown that 3D display boxes can improve waste sorting at Sort It Out stations on campus. In 2015-2016, reports found that 3D display boxes improved the percentage of correctly sorted pizza plates and napkins from 61% to 74% for pizza plates and 59% to 77% for napkins (n

= 593 sorted items; Foster, 2016), and reduced contamination in the recycling stream (n = 100 participants; Fu et al., 2016). A 2018-2019 report identified improvements in peoples' average accuracy of sorting and average number of items correctly sorted, especially for garbage and paper streams (n = 986 participants; Talbot et al., 2019). Other reports have found no evidence that 3D display boxes affect sorting behaviour (sample size not given; Cho et al., 2019; n = 1115 participants; Morgan et al., 2016). Possible reasons for null findings included 1) the time of day evaluated coincided with peak busyness (Cho et al., 2019), 2) the short time period evaluated (e.g., 1 week; Cho et al., 2019), 3) the method of measuring contamination levels (e.g., counting missorted items based on a phone picture; Cho et al., 2019, Morgan et al., 2016), the possibility of one or a few people skewing results by mis-sorting a large number of items (Morgan et al., 2016).

Other studies have explored how users engage with Sort It Out stations, signage and visual aids. 2016 reports noted the following prevalent behaviours: 1) no attempt to sort the waste, placing waste directly in the garbage (Foster, 2016), 2) peering into the bins for guidance (Foster, 2016; Cheng, 2016), 3) not noticing 3D display boxes at all (Foster, 2016), 4) incorrect sorting triggered by full bins (Cheng, 2016), and 5) appearing to be in a hurry, on a phone or otherwise distracted (Cheng, 2016). Another 2016 report found that only 44% of surveyed students actually used the 3D display boxes when sorting their waste (Fu et al., 2016). However, when surveyed, students felt that improvements in signage, higher placement of signs, and 3D display boxes would improve composting at UBC (Goodeve et al., 2016).

Other behavioural interventions to improve sorting accuracy

A number of reports have investigated other methods to improve waste sorting behaviour (Cheung et al., 2015; De Cesare et al., 2015; Zelenika, 2018).

A study from 2014-2015 found that mirrors and messages (e.g., "do you sort your waste?") placed above Sort It Out stations both resulted in improved accuracy of waste sorting (Cheung et al., 2015).

A 2015 report found that the presence or absence of a lid on waste bins can impact how effectively users sort their waste (De Cesare et al., 2015). Specifically, lids on all bins at sorting stations force users to consider where their waste should go, leading to improved waste sorting (72% of study participants sorted effectively in the "lid" condition); effective sorting decreases dramatically when the garbage bin has no lid, especially for people with weak pro-environmental attitudes (51% of participants sorted effectively in the "no garbage lid" condition; De Cesare et al., 2015).

A 2018 report investigated the effect of different interventions on participation and contamination in recycling streams in Multi-Unit Residential Buildings on campus (Zelenika, 2018). Interventions included: 1) basic signage (i.e., basic information for item sorting), 2) signage designed by metro Vancouver to emphasize that food is not garbage, 3) psychology-informed signage that used pictures to display correct item-sorting, and 4) a door-to-door canvassing intervention where residents were reminded to sort waste, could ask questions and were handed a pamphlet that included key information like no plastic bags in any bins, and a QR code for an educational waste sorting game. Door-to-door canvassing was most effective at decreasing contamination in compost and recycling streams specifically, and also at increasing participation in the compost stream (Zelenika, 2018). Signage was generally ineffective, aside from the psychology-informed signage, which significantly decreased contamination in the recycling stream.

One important finding was that "food isn't garbage" posters led to increases in participation and contamination in the compost stream, because people were motivated to act but not fully informed on appropriate waste sorting (Zelenika, 2018). This shows that motivational strategies on their own, without education, can lead to higher rates of contamination.

Reuse Initiatives (for materials other than food materials)

Summary of Key Findings:

Lab equipment reuse

There is strong interest in a lab equipment reuse program; in 2021, the majority of lab admins had donated equipment at some point

The "Reuse-it!" program is not well-known or well-liked. Barriers include uncertain quality and payment, and difficulties coordinating exchange

User preferences for a lab equipment reuse platform include: storage space, advertising, a venue to connect buyers and sellers, reliable payment platform

Formal wear reuse

A formal wear reuse program would meet student demand and have positive environmental impacts, and is economically feasible

Furniture reuse

In 2020, furniture reuse at UBC was an inconsistent process with many opportunities for items to be missed and end up in the landfill. The Facilities Planning Unofficial Pilot offered a standard system for furniture reuse but was not widespread due to limited staff and lack of information and awareness

Barriers make furniture reuse on campus difficult— these include logistical difficulties, limited resources, lack of information

In 2022, participants suggested the following improvements for furniture reuse on campus: a central warehouse, a website, delivery and pick-up services, marketing campaigns, support for people to consult with expert, and rules and standards governing quality

Key Findings:

Laboratory equipment reuse

    i.   Engagement with lab equipment reuse and the "Reuse-it!" program[6]

Sundaram et al. (2021) surveyed lab managers and administrators (n=20) and found that the majority (80%) of participants had, at some point, donated equipment to another UBC group, 20% had sold to another UBC group before, 10% had exchanged equipment with another UBC group, 25% had donated equipment to a non-UBC research group, and 10% sold equipment to a non-UBC research group. On the other hand, 55% of respondents had placed unused equipment in storage or left it unused in the lab, and 40% of respondents had either recycled or disposed of equipment (Sundaram et al., 2021). It's unclear how consistently equipment donations occur since these categories were not exclusive and many indicated having done multiple of these options before.

For both buyers and sellers of lab equipment, UBC's "Reuse-it!" program was used in a minority of transfers (24% for buyers and 20% for sellers) (Sundaram et al., 2021). Most buyers of reused equipment heard about the equipment through word of mouth (71%), or emails sent to them regarding the sale of equipment (65%). Most sellers of reused equipment identified buyers through word of mouth (50%), or through an email sent to potential recipients (30%). Further, only 21% of participants (n=20) reported using the "Reuse-it!" program and thinking it worked well (Sundaram et al., 2021). Some thought the "Reuse-it!" program interface was difficult to use (5%), and most had never heard of the "Reuse-it!" program (42%) (Sundaram et al., 2021).

    ii.   Lab equipment reuse: interests and preferences

There seems to be a strong interest (95% of respondents, n=20) and a potential market for a laboratory equipment reuse program like "Reuse-it!" (Sundaram et a., 2021), given that 65% of respondents' labs at

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[6] "Reuse-it!" is an online platform initiated at UBC in 2010. This online platform allows UBC Staff and Faculty to register with their UBC email, post items and facilitate exchanges.

UBC had unused lab equipment in their storage (Sundaram, et al., 2021). Such a program would ideally include the following aspects identified by participants: an advertising platform operating internally within UBC (100% support), a venue to connect buyers and sellers in and around UBC (84% support), a payment platform through web service (63% support), advertising for external buyers (58% support), and storage spaces (warehouses, etc.)(Sundaram et al., 2021). Further, most respondents (63%) were willing to pay a transaction fee for using an online payment service, 11% would not pay this amount, and 21% would prefer coordinating independently, meaning a transaction fee for online payment could lead to a ~30% reduction in users (Sundaram et al., 2021).

Participants (n=20) also outlined their preferences for transportation methods. Most preferred self-pickup in and around UBC (33%) or stated that it depended on the type of equipment (33%). Some felt the recipient should coordinate the pickup (21%)(Sundaram et al., 2021).

iii.   The "Reuse-it!" program for lab equipment: barriers

A number of barriers have been identified that potentially lower the impact of "Reuse-it!". Based on survey results, the main barriers for sellers of lab equipment include uncertainty regarding payment transactions (45%), the possibility of not having relevant details about the equipment (35%), and difficulty in coordinating an exchange of equipment (30%). For buyers, main barriers included uncertain quality (75%), items not meeting exact needs (70%), unknown history of usage (50%), uncertainty regarding payment transactions (25%), and difficulties in coordinating an exchange of equipment (25%)(n=20)(Sundaram et al., 2021).

Furniture reuse

A number of reports (Gondaliya et al., 2024; Kirk, 2020; Wong et al., 2022; Wysocki, 2016; Chang et al., 2017) have examined furniture reuse on campus.

i.   Environmental impacts of furniture

A 2024 report (Gondaliya et al., 2024) assessed the environmental benefits of reusing furniture and ranked a specific subset of items/brands with respect to their environmental impact. In broad terms, furniture reuse reduces emissions, and "life cycle analyses" can help identify items with the largest emissions reduction potential. The items assessed were the "commercial grade", "low-grade" and "reused" tables by Wayfair and IKEA. The lowest to highest emitting tables over a 10-year span were the IKEA reused (provided by the UBC Furniture Reuse Program[7]), Wayfair reused (provided by UBC Furniture Reuse Program), the IKEA "commercial-grade", the IKEA "low-grade", the Wayfair "commercial-grade", and the Wayfair "low-grade". For Wayfair tables, acquiring a reused version avoids 85-97% of emissions associated with a brand-new "low-grade" version. For IKEA tables, the reused version avoids 60-95% of emissions associated with a brand-new "low-grade" version. Notably, the report found that IKEA is a better brand choice than Wayfair for environmentally conscious consumers (i.e., IKEA low-grade tables had 62% lower emissions than Wayfair low-grade tables, and IKEA commercial-grade tables had 15% lower emissions than Wayfair commercial-grade tables over their lifecycle). Ultimately, reused tables acquired from the UBC Furniture Reuse Program have the best monetary value—for example, the reused IKEA commercial-grade table is priced 99 CAD less than its closest equivalent IKEA commercial-grade table.

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[7] The UBC Furniture Reuse Program is an initiative started by UBC Facilities that accepts donations of surplus furniture from UBC departments/faculties and resells furniture to the UBC community and general public.

Key contributors to emissions throughout the lifecycle include paper production and steel casting (for the IKEA "low-grade" tables), and fiberboard production and packaging (for the Wayfair "low-grade" tables) (Gondaliya et al., 2024).

ii.   Furniture reuse at UBC in practice

UBC's Policy UP3 (previously known as Policy 108) outlines an official process for furniture reuse (see appendix B). However, the policy is outdated (e.g., makes reference to SERF[8] which is closed) and many people are unaware of it (Wysocki, 2016; Kirk, 2020). In practice (as of 2020), furniture reuse on campus is accomplished in 3 ways (Kirk, 2020): 1) the "Reuse-it!" program, 2) the initiative of individuals, and 3) the Facilities Planning Unofficial Reuse Pilot[9].

Some data exists on the success of "Reuse-it!" and the Facilities Planning Pilot. Between March and September of 2011, the "Reuse-it!" program led to the reuse of 1100 items, equivalent to savings of approximately $24,700 (the cost of purchasing these items brand new) (Wysocki, 2016). Since then, the "Reuse-it!" program has seen limited use due to lack of promotion (Wysocki, 2016; Kirk, 2020; Wong et al., 2022; Sundaram et al., 2021). The Facilities Planning Pilot involves one planner, and the work required amounts to 15-20 hours a week (Kirk, 2020). Between 2018 and 2020, the pilot program led to the reuse of roughly 600 items (an estimated 10% of reusable furniture at UBC), equivalent to savings of $300,000 (the cost of purchasing these items brand new) (Kirk, 2020).

A 2020 report (Kirk, 2020) investigated how furniture reuse actually occurs at UBC and outlined 2 different processes: large projects (including demolitions, renovations or moves) and small-scale surpluses (Kirk, 2020).

Large projects are the most common process. In large projects, Facilities Planning may or may not be made aware of "surplus" items to be dealt with. Unidentified items are left and eventually disposed of by contractors. Surplus items are either passed on to the Facilities Planning Pilot to be inventoried and stored for reuse, or left up to the department, at which point a number of outcomes are possible: the item may end up in storage somewhere if item is valuable enough and space allows, posted on "Reuse-it!", offered within the department via email, offered to other departments via email, taken by individuals within the department, sold externally, or disposed of through building ops services (most common outcome). The result is an inconsistent process with many opportunities for items to be missed and end up in the landfill (Kirk, 2020).

Small scale surpluses involve the removal of one item from a space. This is carried out in three main ways: 1) an individual contacts department administrators, who decide if an item must stay or coordinate removal (resulting in storage, relocation to another office, posting on "Reuse-it!" or Craigslist, or landfill), 2) an individual simply moves the item to a loading bay or the hallway, and 3) an individual rehomes the item themselves through email, "Reuse-it!" or another office space. Again, the process is varied and inconsistent (Kirk, 2020).

When the Facilities Planning Pilot is involved in item removal, the process is standardized and efficient. Unwanted items are assessed by the Facilities Planning Coordinator, and either not inventoried (left to the responsibility of the department) or inventoried and subsequently stored or directly transferred to a department that made a specific request for items. However, the use of Facilities Planning Unofficial

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[8] The Surplus Equipment Recycling Facility (SERF) allowed for storage and reallocation of surplus furniture through sales or rentals. Priority was given to UBC departments, faculties and programs. Sales to other educational institutions or private citizens were also considered. SERF was closed down in 2006 and has not reopened since.

[9] The Facilities Planning Unofficial Reuse Pilot was a project initiated in 2018 to find new homes for second-hand UBC furniture. It has since expanded in size with more information available at: https://facilities.ubc.ca/projects/ubc-furniture-reuse-program/).

Pilot is not currently widespread due to limited staff and lack of information and awareness (Kirk, 2020; Wong et al., 2022).

iii.   Furniture reuse: ideas from past UBC initiatives and case studies

A 2016 report (Wysocki, 2016) discussed successful initiatives that have occurred at UBC in the past. These include the General Services and Administrative Building (GSAB) garage sale, and the SERF (Wysocki, 2016). The GSAB garage sale took place in a building slated for demolition in 2014, the General Services and Administrative Building. Furniture was given away for free or max $50, which saved UBC $173,100 in new purchases (Wysocki, 2016). This example demonstrates the demand that exists for second-hand furniture. However, the time and organization required presents a significant challenge on top of UBC employee duties; a structured, standardized process for reuse is likely to be more efficient (Wysocki, 2016). The SERF was a facility that provided storage space and managed rehoming of furniture. Priority was given to internal sales or rental of equipment, otherwise sales were made to other educational institutions or the general public (Wysocki, 2016). The SERF was closed down in 2006 although it is still mentioned in Policy UP3. No replacement exists other than the "Reuse-it!" program.

More examples can be taken from other educational institutions. The University of Victoria implemented a "Program of Warehousing and Re-allocation of Reusable Furniture", which generates approximately $40,000 a year. More details can be found in the 2016 report (Wysocki, 2016). Briefly, the process involves the following steps: 1) UVic Faculty & Staff identify surplus items, 2) UVic Faculty & Staff fill out a Surplus Disposal Request Form, 3) the "Manager for Interior Modification Services" receives the form and decides whether items are re-usable on campus—if yes, the item is stored in the on-campus warehouse and sold on-campus for 20% of the new value, if no, the "Surplus Asset Coordinator" can take the items for separate storage to resell or donate them off-campus (Wysocki, 2016). This UVic program constitutes a best practice example with key features UBC should incorporate into its own initiatives, mainly: storage space on campus for surplus furniture, general surplus assets including IT and scientific equipment, and multiple people on the team, including one person in charge of furniture and another in charge of general surplus items (Wysocki, 2016).

The University of Washington created a Surplus Store, which is open to the public and sells furniture and other items. Store hours for university departments, non-profits and government agencies differ from store hours for the general public. The store resembles the former UBC SERF space (Wysocky, 2016).

iv.   The "Reuse-it!" program for furniture: engagement and awareness

The "Reuse-it!" program appears to be underutilized for rehoming furniture relative to the demand for furniture (Wysocki, 2016; Kirk, 2020; Wong et al., 2022). A 2020 report found that "Reuse-it!" is not reliably utilized for disposing of furniture (Kirk, 2020). First, throughout 2018, an average of only 27 items per month were posted on the website (only a fraction of which were furniture) while an average of 400 tonnes of furniture are disposed of from UBC every year (Kirk, 2020). Second, it appears many registered "Reuse-it!" users are inactive (Kirk, 2020). In 2022, 25% of UBC faculty and staff (n=20) were not aware of the UBC "Reuse-it!" program (Wong et al., 2022). The remaining 75% of respondents either knew of the program or had participated in the program. Additionally, among those who sought furniture for their offices or labs, "Reuse-it!" was used in 25% of cases (Wong et al., 2022). Other options included IKEA (20% of cases), other suppliers such as Brooks Corning (16%), Staples, and suppliers of reused furniture such as Buy Nothing project, Facebook Marketplace and thrift stores. Among those who acquired furniture, 26% reported acquiring new, instead of used, furniture (Wong et al., 2022). A 2016 report (Wysocki, 2016) suggested usership of the "Reuse-it!" platform dropped after launch in 2011 due to a lack of promotion.

v.   Barriers to furniture reuse

Many barriers to furniture reuse on campus have been identified. A key barrier noted across multiple reports is lack of storage for unwanted items (Wong et al., 2022; Kirk, 2020). For recipients of used furniture (based on a survey of n=20, and in-depth interviews of n=3), other challenges revolved around the following themes:

- Limited resources (e.g., limited resources to facilitate furniture transfers, in terms of planning, consultation, pick-up and delivery; this contributes to a lack of convenience)(Wong et al., 2022)

- Logistical difficulties (e.g., difficulties working with the UBC labour crew to move furniture around campus)(Wong et al., 2022)

- Lack of information (e.g., lack of clarity on how to pay UBC labour crews, limited information on what kind of furniture is available for transfers across campus and how to access those furniture pieces, and lack of awareness of reuse programs)(Wong et al., 2022)

- Lack of suitability and customizability of used furniture (Wong et al., 2022)

A 2020 report (Kirk, 2020) identified an extensive list of barriers that make furniture reuse difficult (see appendix A). These barriers include lack of paid work to facilitate furniture reuse, cultural norms (e.g., that new spaces and staff require brand-new furniture), and year-end spending to secure equivalent future funding (Kirk, 2020).

vi. Furniture reuse: interest and preferences

There seems to be support for furniture reuse on campus, with most participants in a 2022 survey (n=20) identifying reuse (46%) and recycling (44%) as preferred methods for dealing with surplus furniture. Only 10% preferred landfill disposal (Wong et al., 2022). Further, all participants (n=20) stated that they would donate or sell surplus furniture to a reuse program, but only 70% would buy their furniture from a reuse program. Participants who wouldn't purchase reused furniture stated reused furniture should be free (Wong et al., 2022).

Respondents also made suggestions to improve furniture reuse on campus. Suggestions included 1) a central warehouse to allow departments and students to donate used furniture, shop and browse for furniture, 2) a website to promote the reuse program and well as providing details on available furniture (e.g., dimensions, colour and design), 3) delivery and pick-up services, 4) marketing campaigns to raise awareness (e.g., UBC could host a social event promoting furniture to be rehomed, reminders in news items such as the UBC Today newsletter, sending out regular/monthly updates of what is available for people), 5) support for people to consult with experts and ensure good fit, and 6) rules and standards governing quality and similarity of furniture for ease of transfer (Wong et al., 2022).

The same report (n=20) also assessed furniture preferences and identified the following key factors in purchasing decisions: affordability (68%) and comfort (63%)(Wong et al., 2022). Other factors including recyclability (20% were likely to consider recyclability when purchasing), design (20% were likely to consider design/aesthetics when purchasing), durability (45% were likely to consider durability when purchasing), and transportation or delivery concerns, stock availability, company reputation, and functionality (Wong et al., 2022).

Motivators or facilitators for furniture reuse identified from interviews (n=3) included 1) rules and regulations to guide the purchasing of furniture and ensure high quality, ergonomics, versatility, and durability, 2) centralized systems to provide easy access and support for obtaining reused furniture, and 3) human resources to support monitoring of sales, moving, and consultation (Wong et al., 2022).

Formal wear reuse

A 2014 report (Fan et al., 2014) investigated the benefits of implementing a formal wear rental program in the UBC bookstore. The authors noted social and environmental benefits, and suggested a rental program would be economically viable in the medium- to long-term. Social benefits include employment opportunities (e.g., program staff to manage the storefront/inventory and oversee rental transactions; IT professionals to create a tracking database; cleaning/maintenance staff), increased business/foot traffic in the bookstore, free advertising and increased business for suppliers of formal wear, and increased business for local dry cleaners. Environmental benefits include decreases in production-related emissions and pollution, and far outweigh the costs arising from increases in energy and water use due to laundry between rentals. The program could achieve economic viability with an effective pricing regime, which the report lays out in detail (Fan et al., 2014). The program should start by providing 6 categories of items: suits for men and for women, dress shirts, tuxedo, tuxedo shirts, and formal dresses. With prices of $46.28 per day (tuxedos and dresses) and $27 per day (other items), the initial investment required to purchase 15 sets of formal wear could be returned within a month.

Additionally, a survey (n = 54) (Fan et al., 2014) indicated a potentially large demand for a formal wear rental service on campus. Students reported using formal wear at least once a month (41%) or once a year (35%). Most students reported not owning formal wear (52%), and most (71%) stated they would be interested in looking into a rental service if it were provided on campus (Fan et al., 2014). Somewhat paradoxically, 56% of respondents would prefer to buy their own formal wear. However, a plurality of students (37%) reported having spent more than $170 when purchasing or renting formal wear in the past, and only 12% consider this an acceptable price. On the other hand, 18% of students reported spending under $75 when purchasing or renting formal wear in the past, and most (52%) considered this an acceptable price. This shows students are likely to choose renting formal wear over buying (despite a stated preference for buying and owning) due to high prices.

Finally, students highlighted price as the biggest priority (49% ranked price as highest importance) when making a decision on formal wear, followed by cleanliness (cleaning between rentals), look/design and size. Brand was ranked as low priority by most respondents (63%; n=54) (Fan et al., 2014).

Recommendations

Recommendations from SEEDS Sustainability Reports

Overview

Recommendations touched on a variety of themes within each topic. For example, recommendations for food materials reuse initiatives included calls to increase awareness and marketing, improve tracking of mugs for Mugshare, and modify financial incentives for reuse. Recommendations for waste sorting included calls to regulate businesses, increase the use of visual-behavioural techniques to aid waste sorting, and increase educational initiatives to improve knowledge of waste sorting. Recommendations for other reuse initiatives included general recommendations to increase furniture reuse, and recommendations for formal wear rental, and specific calls to improve the "Reuse-it!" program website.

The recommendations are shown in the tables below. The recommendations included here are the "priority" recommendations that have been made at least twice. See Appendix E for a full table of all recommendations.

Recommendations for Action

Table 1. Recommendations for action.

🟢 Recommendation well met   🟡 Partially met   🔴 Not met   ⚪ Unknown

Topic	Sub-topic	Recommendation	Status	# of times made
Food Materials Reuse	Ideal container/mug type for sharing initiatives	Use large leak-proof containers that can fit entrees or entrees + a side, with adjustable compartments, for a container-sharing program on campus	🟡	2
		Use stainless-steel mugs for the UBC Mugshare program	🔴	3
		Use borosilicate glass or ceramic for the UBC Mugshare program	🔴	2
	Effective financial incentives for container/mug reuse	Implement loyalty/reward-based incentives for reusable mug/container programs on campus	🟡	5
		Implement probabilistic rewards for reusable mug use on campus cafes	🔴	2
	Improving tracking of mugs	Improve Mugshare's mug-tracking system by digitizing and automating data collection processes	🔴	5
		Recruit local UBC talent, specifically either computer science majors in 3rd or 4th year or engineering students as part of a capstone project to develop the software/hardware needed to create a digital tracking system	🔴	2
	Improving awareness/marketing	Encourage cafes to supply in-store cups, instead of offering coffee in disposable cups for in-store consumption	🟡	2
		Encourage cafes to offer attractive reusable mugs for purchase at the point-of-sale	🟡	2
		Use marketing strategies to increase awareness of Mugshare on campus	🟡	5
		Use signage and posters in high-traffic areas to inform and remind people of the impact that single-use items have on the environment	🔴	5
		Target motivational/positive marketing strategies specifically to coffee-focused outlets on campus	⚪	2
Waste Sorting	Visual behavioural techniques to improve waste sorting accuracy	Fill 3D displays boxes above all Sort It Out bins on campus to clarify where items belong	🟡	4

		Minimize number of posters at Sort It Out stations to reduce "information overload"; remove unnecessary signage like "talking bins" labels	🟠	2
	Creating supportive infrastructure for good waste sorting behaviour	Ensure waste bin design (e.g., color) is consistent across campus and lines up with regional standards that people are used to	🟠	2
		Residential buildings should install compost bins on each floor, instead of using one bin per building	🔴	2
	Educational initiatives to improve knowledge of good waste sorting	Create educational content for students to improve waste sorting	🟠	6
	Requirements for businesses and food services	Standardize packaging at UBC food outlets—all outlets should follow UBC Food Service Ware guidelines. Relatedly, food services should reduce the amount of food ware types, increase the amount of compostable items, and share product-specific information to identify similar food ware items across businesses	🟠	2
		Ensure waste management staff receive training and maintain separation of garbage, compost and recycling when emptying bins	⚪	2
Other Reuse Initiatives	Specific improvements to the UBC "Reuse-it!" program	Improve accessibility and awareness of the UBC "Reuse-it!" program	🟠	2
	General recommendations to increase furniture reuse	Identify more storage space (e.g., a warehouse) for surplus items to prevent disposal	🟢	3
		Update the Surplus Equipment Policy (UP3) and the Purchasing Policy (FM2) and ensure substantial awareness of both on campus	🟠	2
		Create a standardized process for furniture reuse on campus	🟠	2
		Create a Furniture Coordination/Officer role within the Facilities Planning (FP) team and allocate an associated budget	⚪	3
		Create a new Surplus Asset form or system to improve the tracking of surplus items (no system is currently in place on campus that allows formal tracking across all departments)	⚪	2

Recommendations for Future Research

Table 2. Recommendations for future research.

Topic	Sub-topic	Recommendation	Status	# of times made
Waste Sorting	Further research	Explore the use of "descriptive norms" (and other nudging strategies) in signage directed at improving waste sorting (e.g., "others are all doing the same thing!")	🔴	2
Other Reuse Initiatives	Further research	Modify existing procurement guidelines to ensure purchasing of high quality, ergonomic and aesthetic furniture	🟢	2

Recommendations from the Current Review

This review will make its own recommendations below.

Recommendations for Action

The SEEDS Sustainability Library

Future reviews of research in the SEEDS Sustainability Library would benefit from improvements to the limited search capabilities of the database. In the library search tool, users can perform basic or advanced searches. **Basic searches** involve 1) keywords or phrases, or 2) "categories" (e.g., buildings, climate, community, etc.). Categories are defined when a report is first uploaded. **Advanced searches** can target

any of the fields contained in a report entry: title, author(s), staff, course, themes, faculty, and year. This allows users to undertake highly specific searches.

When using the keyword or keyphrase feature, the search returns entries that contain the *exact* term used in any field. There is no way to search abstracts, executive summaries, or full texts, no use of advanced search tools like wildcards or truncation to capture similar or related terms, no use of AND or OR, no way to specify date ranges other than to pick a specific year, and no way to export relevant records. These limitations make it difficult to conduct a review—for example, records must be entered manually into a spreadsheet and inadequate search terms may lead to missed reports.

Recommendation #1: Improve the search capabilites of the SEEDS Sustainability Library

Specific suggestions: 1) Enable use of AND or OR, 2) allow exporting the results as an excel spreadsheet or other file type, 3) create filters for date ranges, 4) allow search terms to be applied to abstracts or executive summaries, 5) incorporate search tools for truncation (e.g., a way to find a term and its variations such as other word endings and plural forms; this can be done in Web of Science using an asterisk after the term).

Problem addressed: Limited search capabilities of the SEEDS Sustainability Library

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Student Recommendations to Prioritize

Given limited resources and a large number of recommendations made, it's important to identify priority recommendations to focus on. The list of recommendations below is based on 1) findings from the narrative review, 2) recommendation status, 3) the number of times that recommendations have been made by student reports, and 4) the priority areas identified in the UBC ZWAP 2030. These recommendations are not in order of priority level.

Recommendation #2: Improve tracking of UBC Mugshare Mugs or implement a new system for mug reuse with superior tracking and retention

Problem addressed: A number of recommendations for Mugshare are currently unmet. 7 reports have recommended taking steps to improve tracking and retention of mugs, and 5 have recommended using mugs of steel or borosilicate glass. Mugshare also struggles with lack of awareness. Implementing a new mug or container reuse system through an external vendor can potentially address multiple issues simultaneously: improved marketing and awareness, durable materials, improved tracking systems and higher rate-of-retention, and increased capacity to serve the whole campus.

Recommendation #3: Improve access to and convenience of composting and multi-stream recycling in student housing; install compost bins on each floor, multiple bins in each suite, provide paper compost bags to residents and include the cost in residence fees

Problem addressed: The recommendation to install compost bins on each floor has been made by two reports and is currently unmet. The UBC ZWAP 2030 notes that student housing accounts for 50% of waste disposed at UBC, making this a critical area to target for both waste diversion and waste reduction. The "University Neighbourhoods Association (UNA) Multi Unit Residential Building (MURB) Waste Behavioural Research" by Zelenika (2018) outlines a number of recommendations for residential buildings (see appendix E).

Recommendation #4: Expand the reach and impact of the furniture reuse program; expand opportunities for furniture and household item reuse within student residences. Examples: move-in/move-out item exchange days, scale-up the furniture reuse program, awareness-raising through flyers, orientation when people move in.

Problem addressed: A number of reports have made recommendations to improve reuse programs on campus. 2 reports have recommended improving the "Reuse-it!" program, 3 reports have recommended creating a "furniture coordinator" role within the Facility Planning team. Other recommendations have been made around modifying official policy around furniture reuse, improving tracking of surplus items, and formalizing the process of obtaining second-hand furniture.

Recommendation #5: Improve Sort It Out stations to increase sorting accuracy; declutter signage to avoid confusion, fill 3D display boxes above all Sort It Out stations, potentially staff busy stations to aid people in sorting appropriately

Problem addressed: A number of reports have made recommendations to improve Sort It Out stations that are partially met or unmet. 4 reports have recommended filling 3D display boxes, and 2 reports have recommended decluttering signage to avoid confusion; both are easy recommendations to address.

Conclusion

The aim of this project was to inform ongoing efforts to transition UBC to circularity. To this end, we reviewed student research on circularity initiatives conducted between 2014 and 2024. The narrative review of student reports shed light on a number of themes including levels of engagement and awareness with different circularity initiatives, effective strategies for improving circularity, and barriers or challenges to circularity initiatives.

Descriptive findings showed that research trends have fluctuated over time in response to the release of action plans and updates. Only 31% total recommendations concerning food materials reuse, waste sorting initiatives, and other materials reuse initiatives have been met or partially met. However, a large percentage (41%) are difficult to assess, and their status remains unknown. Further analysis showed that recommendations made multiple times are more likely to be met or at least partially met than those made fewer times, indicating that UBC initiatives are responsive to "Campus as A Living Lab" research.

A number of key, repeated recommendations have been distilled from student reports: these include improving the search capabilities of the SEEDS Sustainability Library, improving Mugshare mug tracking or implementing a new system for container/mug reuse with a higher retention rate, improving access to composting within student residences, expanding the reach and impact of furniture reuse initiatives, and improving Sort It Out stations to improve sorting accuracy.

Ultimately, this study provides a foundation of recommendations for action aimed at achieving the ZWAP 2030 goals for circularity and operational waste reduction, while serving as a model for future reviews of sustainability research.

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Appendices

Appendix A. Plots of circularity research trends since 2002.

1. Trends in circularity research since 2002; reports are double- or triple-counted if they touch on multiple topics
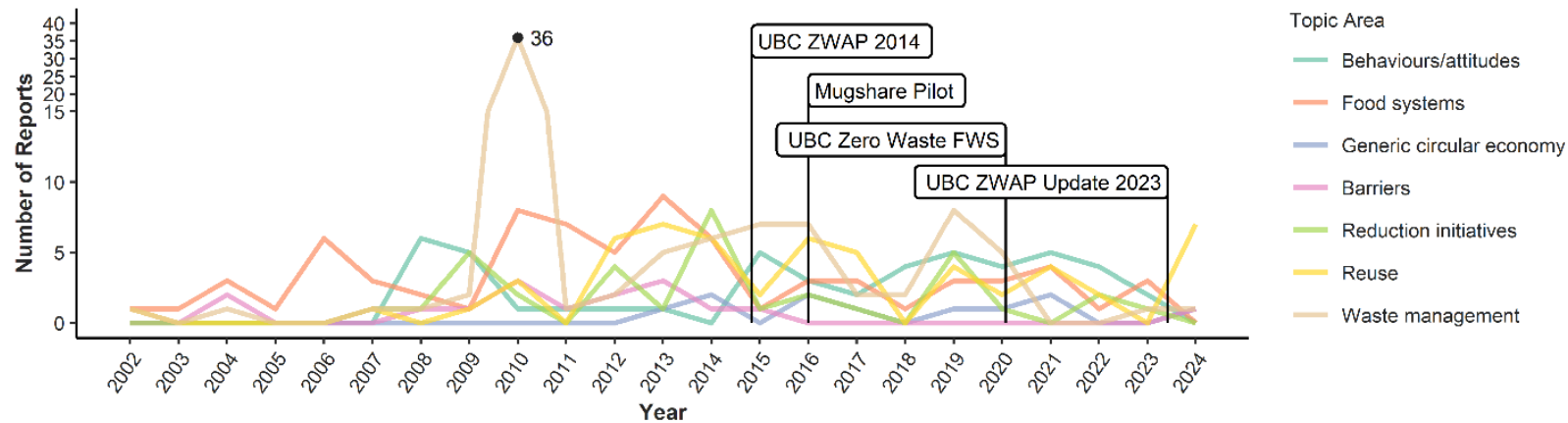
2. A bar plot of the total number of reports in each topic area over the time span 2002-2024.
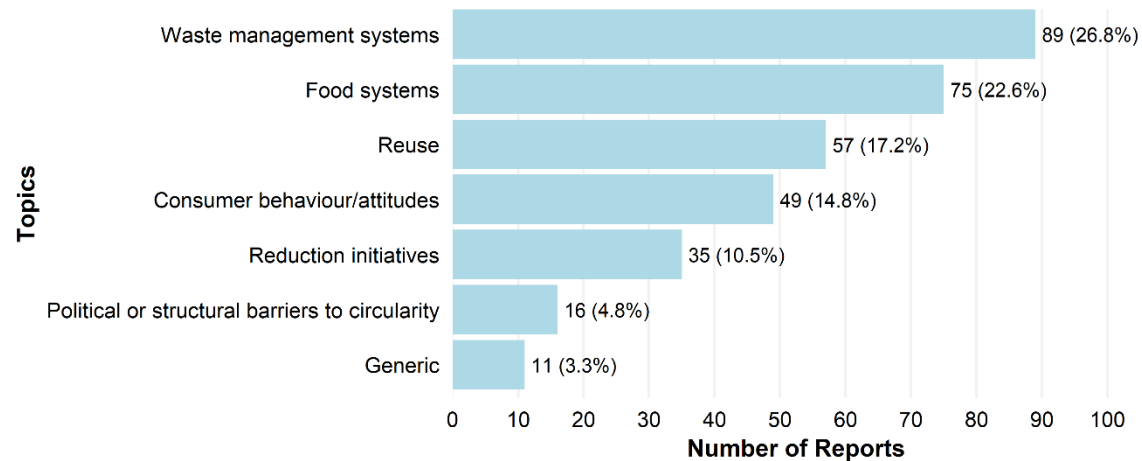
Appendix B. Status of recommendations by the themes within each topic area.
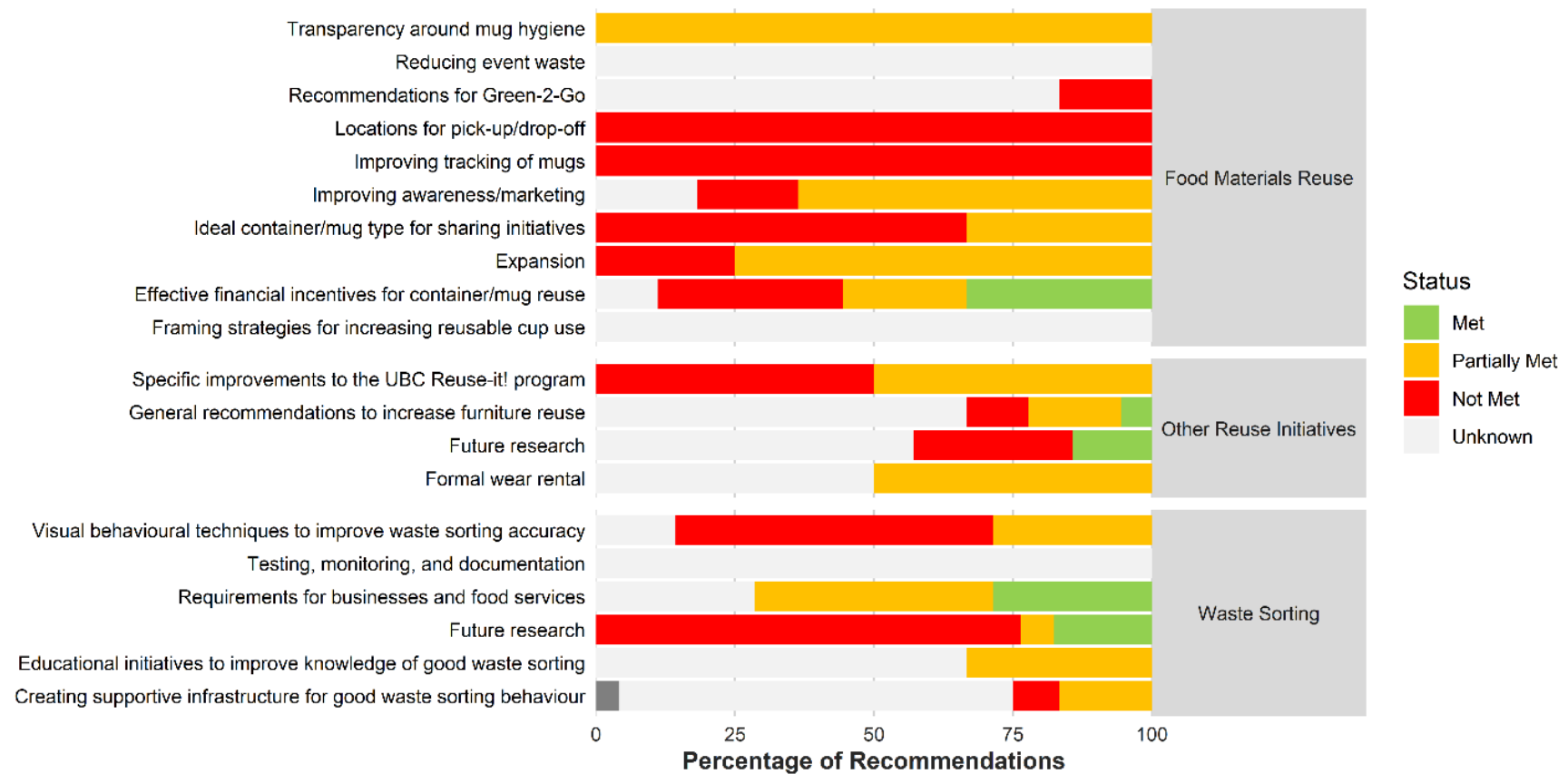
Appendix C. Tables reporting exact percentages for recommendations made multiple times stratified by topic area.

1. Percentages represent row percentages

Topic	Number of Times a Recommendation Was Made						
	Once	**2x**	**3x**	**4x**	**5x**	**6x**	**All**
Food Materials Reuse	29 (71%)	7 (17%)	1 (2%)	0	4 (10%)	0	41
Waste Sorting	53 (87%)	6 (10%)	0	1 (2%)	0	1 (2%)	61
Other Reuse Initiatives	24 (77%)	5 (16%)	2 (7%)	0	0	0	31
Total	106 (80%)	18 (14%)	3 (2%)	1 (1%)	4 (3%)	1 (1%)	133

Note. Cell values: # (row percent)

2. Percentages represent column percentages

Topic	Number of Times a Recommendation Was Made						
	Once	**2x**	**3x**	**4x**	**5x**	**6x**	**All**
Food Materials Reuse	29 (27%)	7 (39%)	1 (33%)	0	4 (100%)	0	41 (31%)
Waste Sorting	53 (50%)	6 (33%)	0	1 (100%)	0	1 (100%)	61 (46%)
Other Reuse Initiatives	24 (23%)	5 (28%)	2 (67%)	0	0	0	31 (23%)
Total	106	18	3	1	4	1	133

Note. Cell values: # (column percent)

Appendix D. Association between status of recommendations and the number of times they were made.

1. Plot of recommendation status by the number of times recommendations were made, stratified by circularity topic area.
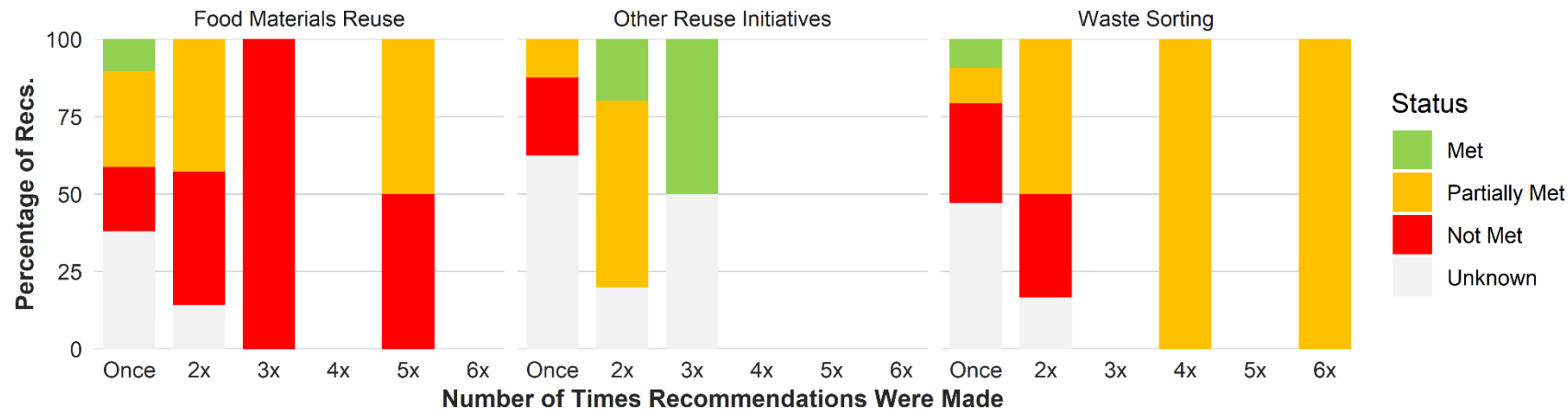
2. Results from statistical analyses of the relationship between recommendations being made multiple times and their status. The tests examined whether recommendations made at least twice were more likely to be at least partially met. The variables were 1) "recommendation made at least twice" (yes or no) and 2) "recommendation at least partially met" (yes or no). Analyses were stratified by circularity topic and showed that this relationship is significantly positive for recommendations on other reuse initiatives only. This means recommendations on other reuse initiatives in the SEEDS Sustainability Library were more likely to be at least partially met if they were made at least twice.

Topic	Chi-square test		Fisher's Exact Test	
	Result	Bonferroni-corrected p	Result	Bonferroni-corrected p
Food Materials Reuse	$\chi^2(1) = 2.71 \times 10^{-31}$, $p = 1.0$	NA	p = 1.0	NA
Other Reuse Initiatives	$\chi^2(1) = 6.99$, p = .008	.025	p = .006	.017
Waste Sorting	$\chi^2(1) = 4.29$, $p = .038$	.115	p = .024	.072

Note. Chi-squared tests used Yates' Continuity Correction for expected cell counts < 5.

Appendix E. Full length table of all recommendations made by student reports.

🟢 Recommendation well met   🟡 Partially met   🔴 Not met   ⚪ Unknown

Topic	Sub-topic	Recommendation	Status	Rep.
Food materials (reusable materials) **% of recommendations met:** 🟢 8% met 🟡 35% partially met 🔴 30% not met ⚪ 28% unknown	Ideal container/mug type for sharing initiatives	Use large leak-proof containers that can fit entrees or entrees + a side, with adjustable compartments, for a container-sharing program on campus	🟡	2
		Use stainless-steel mugs for the UBC Mugshare program	🔴	3
		Use borosilicate glass or ceramic for the UBC Mugshare program	🔴	2
	Effective financial incentives for container/mug reuse	Raise the eco-tax on disposable cups from $0.10 to at least $0.15 per purchase	🟢	1
		If the mug-tracking system for Mugshare program continues to be a manual pen-and-paper system, increase the deposit cost up to $10 due to the high cost of stainless-steel mugs, or alternatively, seek cheaper mugs	🟢	1
		Raise Mugshare deposit to $5 to prevent customer loss of mugs	🟢	1
		Investigate financial cost-benefit of discounts for incentivizing reusable mug use	🟡	1
		Implement loyalty/reward-based incentives for reusable mug/container programs on campus	🟡	5
		Consider providing reusable mugs for free	🔴	1
		Implement probabilistic rewards for reusable mug use on campus cafes	🔴	2
		Consider implementing a points system in tandem with probabilistic rewards, so that customers may compete to accumulate points and win rewards	🔴	1
		Increase discount associated with using reusable mugs to $0.25 per purchase	⚪	1
	Improving tracking of mugs	Improve Mugshare's mug-tracking system by digitizing and automating data collection processes	🔴	5
		Recruit local UBC talent, specifically either computer science majors in 3rd or 4th year or engineering students as part of a capstone project to develop the software/hardware needed to create a digital tracking system	🔴	2
	Improving awareness/marketing	Encourage cafes to supply in-store cups, instead of offering coffee in disposable cups for in-store consumption	🟡	2
		Encourage cafes to offer attractive reusable mugs for purchase at the point-of-sale	🟡	2
		Use marketing strategies to increase awareness of Mugshare on campus	🟡	5
		Train staff to remind or prompt customers to use reusables or consider Mugshare, e.g., "do you need a single-use or reusable cup today?"	🟡	1
		Encourage vendors to redesign price tags to display the menu item's price and the disposable cup's price (i.e., eco-tax) separately, along with the price of CO2 in production	🟡	1
		Place small signs in visible areas (e.g., the till of a coffee shop or on the mixing station where milk and sugar are kept) or print information on coffee cups reminding people of discounts associated with reusables	🟡	1
		Inform students of incentives	🟡	1
		Use signage and posters in high-traffic areas to inform and remind people of the impact that single-use items have on the environment	🔴	5
		Encourage cafes to implement a "script change", where Mugshare mugs or reusable mugs are the default option when customers order coffee	🔴	1

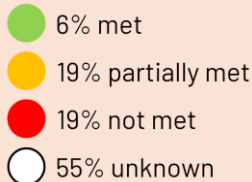|				
		Use imagery in posters rather than text. Focus messaging around financial (Battu et al., 2024) and convenience advantages of reusable mugs	⚪	1
		Target motivational/positive marketing strategies specifically to coffee-focused outlets on campus	⚪	2
	Transparency around mug hygiene	Implement a thorough and efficient cleaning process for containers used in sharing programs and ensure that students are informed/aware of the container cleaning policy	🟠	1
	"Framing" strategies for increasing reusable cup use	Use "loss framing" in posters advocating for reusable cup use; place posters in high visibility areas, especially where people make decisions about beverages (e.g., tills, entrance, etc.) and consider advertising the cumulative effects of the $0.25 fee (e.g., $100 per year on average)	⚪	1
		Frame the $0.25 fee in terms of money saved using a reusable cup (e.g., getting baristas to as: "Would you like to save 25 cents by using a reusable cup?")	⚪	1
	Locations for pick-up/drop-off	Introduce drop-off bins in high foot-traffic areas across campus; bins should be designed to allow for drop-off only (i.e., no easy retrieval of mugs from bins) and prevent bashing of mugs upon return	🔴	1
	Expansion	Coordinate with UBC food outlets to expand the Mugshare program across campus	🟠	1
		Explore partnerships with service providers for alternatives to single-use cups	🟠	1
		UBC should conduct a pilot study for a reusable mug program featuring the following: increased pick-up and drop-off locations, transparent cleaning process, avoiding terms such as "shared" that carry connotations of contamination, financial incentives to return mugs such as deposits	🟠	1
		Partner with Reusables.com as the default option for campus-wide reusable cups. This would help mitigate common barriers including forgetting to bring a mug, challenges with cleaning mugs, and lacking space to bring mugs	🔴	1
	Recommendations for Green-2-Go	Up-scale Green-2-Go to all UBC food services outlets, initiate collaboration between the Zero Waste Action Plan committee, creators of the Zero Waste Food Service Ware Strategy, and the UBC AMS	🔴	1
		Inform dining hall staff and container distributors of container return process, frequently share this information with students to encourage returns	⚪	1
		Remind students 8 weeks prior to the end of term to return containers, issue frequent reminders	⚪	1
		Increase number of return locations for Green-2-Go containers	⚪	1
		Introduce loyalty stamp cards for Green-2-Go, with free items every 10 meals	⚪	1
		Increase communication around "accountability model", i.e., increase awareness about 8-dollar refunds for container return to avoid containers being repurposed or thrown away	⚪	1
	Reducing event waste	The Engineering Undergraduate Society (EUS) should switch their stock supply of cups to biodegradable cups and include a $200 damage deposit incentive in rental event contracts to encourage event organizers to bring biodegradable or reusable cups	⚪	1
		The EUS should seriously investigate the possibility of purchasing reusable cups and washers to align with UBC's zero waste food ware strategy	⚪	1
Waste sorting **% of recommendations met:**	Visual behavioural techniques to improve waste sorting accuracy	Fill 3D displays boxes above all Sort It Out bins on campus to clarify where items belong	🟠	4
		Minimize number of posters at Sort It Out stations to reduce "information overload"; remove unnecessary signage like "talking bins" labels	🟠	2
		Introduce signs and mirrors above bins to improve sorting accuracy. Messages might be simple reminders to sort, e.g., "Do you sort your waste?"	🔴	1

		🟢	8% met
		🟠	18% partially met
		🔴	31% not met
		⚪	43% unknown

	Contents of 3D display boxes should be updated and changed frequently, once a week or every other week	🔴	1
	Use visual cues to attract attention to 3D display boxes so people actually use them to inform their sorting (e.g., motion-detected light, or colourful, attention-grabbing cues)	🔴	1
	UBC should include lids on all sorting stations across campus, especially "priority buildings" with low sorting accuracy	🔴	1
	Design of 3D display boxes should be reconsidered because the current boxes are fragile and inflexible	⚪	1
Creating supportive infrastructure for good waste sorting behaviour	Residential buildings should supply each unit with the 4 different types of bins that are present in the common waste sorting room, because residents are unlikely to sort through their single bin before disposing of its contents	🟠	1
	Standardize all waste materials provided by food establishments in the Nest, in order to minimize confusion around which materials go in which bins	🟠	1
	Ensure waste bin design (e.g., color) is consistent across campus and lines up with regional standards that people are used to	🟠	2
	Clear and explicit differentiation of compostable and recyclable items in terms of bins and item-labels	🟠	1
	Residential buildings should install compost bins on each floor, instead of using one bin per building	🔴	2
	Introduce a food-court style, manned waste sorting station in the Nest. This will create more jobs and is a more effective way to increase sorting accuracy	🔴	1
	Residential buildings should provide paper compost bags to residents and have the cost be included in the residence fees	⚪	1
	Residential bins in common waste sorting rooms should be labelled with their weight when empty to make it easier to quantify contents in future studies	⚪	1
	Place a "plastic bags only" bin next to compost to reduce contamination of plastic bags in the compost bins	⚪	1
	Improve convenience, ease of process: all bins placed together in the same room, similar bins placed together (e.g., cardboard next to paper, compost next to garbage to throw away any plastic bags)	⚪	1
	Ensure bin lids are consistently open and flipped all the way over, and push bins against the wall to avoid covering any signage. Ideally, all lids should be open to avoid overstocking of open bins	⚪	1
	Provide residents with free or discounted recycling and composting materials to entice participation: small recycling and compost bins, bin-liners, etc.	⚪	1
	Incorporate zero waste norms and practices within the building events (e.g., make every event zero waste, organize clothing/household item donation drives, discuss recycling participation in strata meetings)	⚪	1
	All rooms should have relevant signage displayed above bins (signage obtained from waste hauler websites, UNA or UBC sustainability office); do periodic checks for missing or damaged signage	⚪	1
	Provide verbal and written information about waste sorting to existing and new tenants, including why it is important (e.g., bylaw policy, resource efficiency and being a part of Vancouver culture), and info on correct item sorting	⚪	1
	Communicate with waste haulers to identify bin issues (e.g., broken, insufficient, dirty or sticky) and which bins should be replaced	⚪	1
	Conduct contamination checks to identify commonly missorted materials; communicate this with tenants through internal channels, letters, meetings, elevator flyers, message boards). Focus on a few key items instead of all items at once	⚪	1
	UBC should continue working closely with MURB through Zero Waste Committees to share best practices, support and resources	⚪	1

		Provide alternative recycling streams for household items that don't fit traditional bins, e.g., batteries, kitchenware, e-waste, soft plastics)	○	1
		Advertise reuse programs in the community or partner with organizations to pick up items/donations	○	1
		Educate leaders on campus, such as Residence Advisors (RAs), on the impacts of landfills and contamination and encourage them to disseminate this information to their residents	○	1
		Recommended improvements for MASS bins: 1) introduce Type A Bins to accommodate the volume of waste produced in MASS, reduce the chance of overflowing trash, increase the pick-up frequency, and enhance the aesthetic of the building while also increasing the bins' visibility, 2) include visual aids like 3D display boxes	○	1
		Replace single garbage cans with the Sort It Out equivalent bin; further, food services with single bins should eventually provide additional bins in alignment with UBC Sort It Out. Specific outlets include Starbucks (east mall and agronomy), Tim Horton's (Forest sciences), QOOLA (nest), Uppercase, Lowercase, Flip Side and the Delly in the nest	○	1
		Waste sorting staff should be trained to empty bins more frequently during peak hours due to overflowing	○	1
	Educational initiatives to improve knowledge of good waste sorting	Create educational content for students to improve waste sorting	🟠	6
		Provide educational information regarding plastic bags disposal to students living in residence	○	1
		Create an awareness campaign for waste sorting in the MASS; first steps would include mass distribution of posters and infographics. Leverage existing UBC resources to do so, e.g., recruit talented design and arts students to create informative and relevant waste management posters	○	1
	Requirements for businesses and food services	Make a set of "food service policies" to mandate that vendors use compostable/recyclable food service ware that is compatible with campus and regional processing system	🟢	1
		UBC should make compostable packaging mandatory	🟢	1
		Standardize packaging at UBC food outlets—all outlets should follow UBC Food Service Ware guidelines. Relatedly, food services should reduce the amount of food ware types, increase the amount of compostable items, and share product-specific information to identify similar food ware items across businesses	🟠	2
		UBC should phase out certain materials including 1) biodegradable and compostable plastics, 2) coffee cup sleeves, 3) straws, and 4) plastic bags (replaced with paper bags)	🟠	1
		Current and prospective food services should implement reusable food ware	🟠	1
		Ensure waste management staff receive training and maintain separation of garbage, compost and recycling when emptying bins	○	2
		UBC Food Services, the AMS and independently run food services should share product-specific information and consolidate which items are purchased by vendors across the main campus	○	1
	Testing, monitoring, and documentation	Campus and Community Planning should develop a standard operating procedure to test, document, and ensure compatibility of current and prospective compostable products with the in-vessel composter on South Campus.	○	1
		UBC and Campus and Community Planning should monitor and evaluate waste management by 1) keeping track of commonly incorrectly sorted items, 2) assessing quality of compost generated by the in-vessel composter, and 3) identifying which items are worsening the compost quality	○	1
		Create an online data management system to document the data management process. The following documents should be stored: current policies, non-compost-ability reports, waste composition	○	1

		audit reports and progress reports, inventory lists from all food service locations		
	Further research	Future research should determine whether 3D display boxes are better than signage that explains which item belongs where, and whether most users rely on the display boxes or signage to inform their sorting	🟢	1
		Determine which waste streams are especially difficult for people to sort correctly	🟢	1
		More research needed to understand how to prevent specific contamination issues like plastic bags and Styrofoam in compost or recyclables bin	🟢	1
		Identify the food retailers distributing confusing items, including plastic cutlery and composite packaging items—starting with major locations of concern and nearby vendors: the Nest, Vanier dining hall, Central, University Village, Orchard Commons Dining Hall	🟡	1
		Explore effectiveness of different types of signage including "saliency messages", "collective efficacy", and "optimized displays"	🔴	1
		Explore the effect of "contamination-specific" tags (providing positive or negative feedback on the previous weeks' contamination levels) in combination with the "illusion of being watched" (e.g., eyes on posters) on waste sorting accuracy and contamination in residential buildings	🔴	1
		Future research on visual interventions for improving waste sorting should use the "sort it" poster and have limited and consistent signage	🔴	1
		Determine if stickers for better waste sorting are more effective in a particular location (e.g., directly on bins or on the wall)	🔴	1
		Explore the use of "descriptive norms" (and other nudging strategies) in signage directed at improving waste sorting (e.g., "others are all doing the same thing!")	🔴	2
		Conduct more research on the effect of informing people that they are on camera as they sort waste, with posters of varying tone, from positive (e.g., "Smile you're on camera!") to aggressive (e.g., "Waste Sorting Accuracy is Monitored and Evaluated in this Area"); ensure posters are large and highly visible	🔴	1
		Explore stationing people at Sort It Out stations to help with waste sorting	🔴	1
		Explore the effect of all possible bin orders on waste sorting accuracy	🔴	1
		Further explore the potential for plants and other "natural" stimuli to positively impact waste sorting behaviour	🔴	1
		Explore methods for increasing visibility of 3D display boxes (e.g., white backdrop)	🔴	1
		More research needed to study effective interventions in Multi-Unit Residential Buildings. Future studies should ensure the following: one (or several) buildings in the control condition, comparison of effects on each individual building in the study, ensure interventions have the same period, and allow 2-3 weeks post intervention to go into the next intervention strategy, more rigorous contamination inspection of bins	🔴	1
		More research needed to determine if bin users are more confused by items and inconsistency in packaging or the designs of the bins themselves	🔴	1
		Research needed to assess waste management in the Meekison Arts Students Space	🔴	1
Reuse initiatives other than food materials **% of recommendations met:**	Specific improvements to the UBC "Reuse-it!" program	Improve accessibility and awareness of the UBC "Reuse-it!" program	🟡	2
		Improve methods for ensuring equipment reliability on the "Reuse it" platform	🟡	1
		Improve the transaction process through the UBC "Reuse it" platform. Specifically, the payment process must be clear to all parties, must be completed through an online secure server, and	🔴	1

6% met ●green			
19% partially met ●orange			
19% not met ●red			
55% unknown ○			

	the $1000 dollar limit for purchases must be eliminated to all purchases can be completed through a single we service		
	Improve logistics and coordination for re-housing items. UBC should consider a donation-storage based system modelled after UMichigan's reuse program	● red	1
General recommendations to increase furniture reuse	Identify more storage space (e.g., a warehouse) for surplus items to prevent disposal	● green	3
	Update the Surplus Equipment Policy (UP3) and the Purchasing Policy (FM2) and ensure substantial awareness of both on campus	● orange	2
	Create a standardized process for furniture reuse on campus	● orange	2
	Establish a "pool of partners" for asset resale and donation, both on campus and external	● orange	1
	Use Warp It as UBC's new online reuse platform	● red	1
	Merge and/or harmonize "Reuse-it!" with the informal furniture transfer network within Facilities Planning	● red	1
	Create a Furniture Coordination/Officer role within the Facilities Planning (FP) team and allocate an associated budget	○	3
	Create a new Surplus Asset form or system to improve the tracking of surplus items (no system is currently in place on campus that allows formal tracking across all departments)	○	2
	Create a dedicated project budget to support staffing and project costs for furniture reuse, including either a specific budget for a dedicated furniture reuse "removal service", or, alternatively, subsidizing a free or discounted removal service for users of the furniture reuse network	○	1
	UBC should provide financial incentives or subsidies to departments who are participating in exchanges by giving furniture away for free	○	1
	UBC should increase marketing and communications efforts around furniture reuse. For example, social "marketing" events throughout the year could help promote furniture reuse and the UBC reuse program itself	○	1
	Create educational "how-to" materials on furniture exchange and circulate widely. Departments should be especially aware of how to remove furniture and transfer funds between departments	○	1
	Melt Collective should purchase a hot press machine to allow for melting and joining without requiring metal bolts or nuts	○	1
	Melt Collective should purchase a laser cutter to allow uniqueness and precision	○	1
	Melt Collective should initiate collaboration with students (volunteers) who have a background in UBC Theatre Production Design and UBC Visual Arts, to support in furniture design	○	1
	Melt Collective should create a closed-loop model, where every piece of furniture made by Melt Collective will be 100% recycled and remodelled to become another piece of furniture	○	1
	Melt Collective should allow customers that lease furniture the opportunity to also return the product at the end of their contract, or to purchase at a discount	○	1
	Melt Collective should Allow customers who have purchased from Melt Collective in the past the ability to return furniture to get it remodelled, for a fee	○	1
Formal wear rental	Implement a formal wear rental service for UBC students in the UBC bookstore. The service could start by providing six categories of formal wear: suits for men and for women, dress shirts, tuxedos, tuxedo shirts, and formal dresses. It will be necessary to acquire an inventory of formal wear and establish a process for cleaning and repairing rental items	● orange	1
	Partner with eco-friendly dry cleaners for the cleaning of rental wear	○	1
Future research	Modify existing procurement guidelines to ensure purchasing of high quality, ergonomic and aesthetic furniture	● green	2

Develop marketing strategies to increase public exposure and awareness of the UBC Furniture Reuse Program, both at UBC and other educational institutions	⬤ 1
Conduct further research on environmental impacts of furniture brands and furniture items; include brands/items other than IKEA and Wayfair tables, explore alternate scenarios (e.g., beyond a 10-year lifespan, frequent replacement due to high degree of use, etc.), more thorough cradle-to-grave analysis including the transportation of raw materials to the manufacturing sites, production facilities and warehouses	⬤ 1
Grow and expand the UBC Furniture Reuse Program	◯ 1
Explore methods for improving interdepartmental transfers of furniture	◯ 1
Investigate how UBC could engage with furniture buy-back programs	◯ 1
Assess the specific financial costs and benefits of investing in a "furniture transfer network". This analysis should consider 1) how cost savings that are likely to be felt by individual departments and 2) environmental benefits accounting for the difficulty in capturing environmental benefits in standard cost-benefit analyses or profit-loss statements	◯ 1