Single-Use Item Reduction Toolkit Annotated Bibliography

Updates and Suggestions

This document was last updated September 5, 2019. Please email suggested edits, additions and updates to karen.storry@metrovancouver.org.

Annotated Bibliography:

All Items

1. Franklin Associates and Oregon State DEQ. (2018). *Technical Report Excerpt: Reusable Food Service ware.* Retrieved from: https://www.oregon.gov/deq/FilterDocs/reusable-fsw.pdf

   As a follow-up to a broader study on material attributes and environmental performance, this study reviews the environmental performance of reusable vs. single-use food service ware. The qualitative analysis found reusable tableware has lower impact than disposable tableware. Reusable cups generally outperform disposable cups. To maximize the benefits of reusable systems items, they need to be durable enough to be used enough times to outperform their single-use counterparts, and the cleaning processes need to be optimized. Performance of cleaning systems can result in high variability depending on frequency, manual or machine washing, energy source for heating, water use, and detergent use.

2. TRi Environmental Consulting. (2019). *2018 Single-Use Item Waste Composition Study Metro Vancouver.* Commissioned by Metro Vancouver. Burnaby, BC: Metro Vancouver. Retrieved from: http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/2018Single-UseItemsWasteCompositionStudy.pdf

   Single-use items, which include cups, take-out containers, utensils, straws and bags, composed 2.4% of the Metro Vancouver region's waste in 2018. In total, 1.1 billion single-use items were disposed in Metro Vancouver that year. The report estimates that 331 million utensils are disposed annually, two-thirds of which are wood. Almost half of the 262 million cups disposed were plastic-lined hot cups more commonly known as coffee cups. The most commonly disposed takeout containers were rigid plastic (71 million) and plastic-lined paper (62 million). Paper bags were approximately 5% by unit of the total 256 million retail bags disposed. Over 50% of retail bags were re-used as garbage bags (155 million) while some were thrown away empty (87 million).

3. Vendries J, Hawkins TR, Mosley J, Hottle T, Allaway D, Canepa P, Rivin J, Mistry M. (2018). *The Significance of Environmental Attributes as Indicators of the Life Cycle Environmental Impacts of Packaging and Food Service Ware*. State of Oregon Department of Environmental Quality. Portland, Oregon. Retrieved from: https://www.oregon.gov/deq/FilterDocs/MaterialAttributes.pdf.

   The report reviews LCA studies of packaging and food service ware published between 2000-2017, with the aim to determine if material attributes of *recycled-content, recyclable, biobased,* and *compostable* translate to better environmental performance. They specifically looked at: global

warming potential, eutrophication potential, particulate matter formation potential, smog formation potential, human toxicity, ecosystem toxicity, acidification potential, ozone depletion potential, land use, water consumption, fossil energy depletion and mineral depletion. Impacts associated with marine litter and generation of municipal solid waste were not included as those topics are outside of the scope of existing LCA methods and studies.

Overall the study found that:

- Clean production is an important consideration for policies aimed at improving environmental performance of food service ware;
- "Recyclability" is a poor predictor of environmental performance;
- Packaging with higher recycled content tends to be environmentally preferable to options using the same material with less recycled content;
- "Biobased" materials may have significant environmental trade-offs due to agricultural practices being largely powered by fossil fuels; and
- "Compostablility" is a poor predictor of environmental performance. Food service ware (primarily PLA-based and fibre-based) often have poorer environmental performance than their recyclable counterparts.

Reuse was included in a follow-up report. (See 1)

Plastics Management and Oceans Plastic

4. Canadian Council of Ministers of Environment. (2019). *Canada-Wide Action Plan On Zero Plastic Waste: Phase 1.* PN 1289. Retrieved from: https://www.ccme.ca/en/current_priorities/waste/waste/strategy-on-zero-plastic-waste.html

   The report describes Canada's vision for plastics in a circular economy which prioritizes prevention of plastic waste; collection of all plastics; and recovering the value of the plastics based on the waste hierarchy. The plans call for:

   - Plastics that are designed for durability, reuse, and recycling;
   - Replacement of single-use items with reusable, recyclable or compostable alternatives – especially if they aren't needed for health, safety, or security reasons;
   - Expanded recycling, harmonized programs, and modernized collection for all sectors in both urban and rural Canada;
   - Increased domestic demand for recycled plastic through procurement and regulatory measures;
   - Expanded capacity of plastics reuse and recycling infrastructure;
   - Education programs that empower households, businesses and institutions to prevent and manage plastic waste;
   - Measures that prevent plastics from entering oceans and freshwater resources;
   - A better understanding the environmental and health impacts of plastics pollution;
   - Clean Canadian shorelines; and
   - Global action.

   Canada is looking at a collaborative approach, which could include regulations and standards; market incentives and investments; and voluntary actions by consumers and businesses.

5. Deloitte & Cheminfo Services Inc. (2019) *Economic Study of the Canadian Plastics Industry, Markets and Waste.* Commissioned by Environment Climate Change Canada. Gatineau QC. Retrieved from: http://publications.gc.ca/collections/collection_2019/eccc/En4-366-1-2019-eng.pdf

   The report estimates that only 9% of all plastics put on the market were recycled in Canada in 2016. An estimated 90% was sent to responsible disposal with the remaining 1% (29,000 tonnes) sent to unmanaged dumps or leaked into the environment. The majority of the plastic waste comes from packaging (43%). For packaging, which most single-use plastics would fall under, the report estimates 1,542kt were discarded and 347kt were recycled resulting in a 23% diversion rate. The report also estimates that 15% of collected packaging was recycled which translates to recovery of 21% of the value.

   Recycled resins (primarily PET, HDPE and PP) account for $350 million in sales in Canada while virgin resins (primarily PE) accounted for $10 billion in sales. It identifies direct competition from primary resins and low disposal rates as a key challenge to increasing plastics recycling.

   The report recognizes that compostable plastics are a small portion of the market and that significant changes are needed before composting plastics could contribute to the reduction of plastic waste. “There is no labelling requirement, standardized chemistry or standardized degradation time for biodegradable plastics, and even certified compostable plastics are not accepted by many composting facilities in Canada due to the differences between the certification requirements and their operating conditions.”

6. Ellen Macarthur Foundation, World Economic Forum, & the McKinsey & Company. (2016). *The New Plastics Economy: Rethinking the Future of Plastics*. Retrieved from: https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy/2016-report.

   Most plastic packaging is only used once. Globally, 32% of plastic leaks into the environment; 40% is landfilled, 15% goes to incineration or waste-to-energy. Of the remaining 14% captured for recycling: 4% is lost during processing, 8% goes to cascaded recycling (lower value recycling) and 2% goes to closed-loop recycling (same value recycling). Plastics waste volumes remain a concern in many countries, where the volume of plastics has doubled in the last 50 years, and is expected to double again in the next 20 years. The report calls for better product design and production; increased reuse; and radically improved recycling economics and quality.

7. Ellen Macarthur Foundation, World Economic Forum, and the McKinsey & Company. (2017). *The New Plastics Economy: Catalyzing Action*. Retrieved from: https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy/2017-report

   The report maps out three key strategies to transform the existing global plastic packing market: reuse, recycling with radically improved economics and quality, and a fundamental redesign and innovation for the remaining plastics. The report specifically calls out polystyrene (PS); expanded polystyrene (EPS); multi-material packaging such as polycoat food service ware; small format items which could include straws and utensils; highly nutrient-contaminated packaging such as fast-food packaging as existing plastic packaging that will never be reused or recycled without a fundamental redesign or innovation. The report supports new delivery models based on reusable packaging and reusable alternatives to single-use bags. To enhance recycling of plastics the report suggests looking

at pigment choices: light-coloured and transparent plastics are more commonly recycled. It also recommends avoiding additives that result in packaging that is incompatible with commonly used recycling sorting technology or result in discoloration of recycled material.

8. House of Commons Canada. (2019). *The Last Straw: Turning the Tide on Plastic Pollution in Canada.* Prepared for the Standing Committee on the Environment and Sustainable Development. Ottawa, ON. Retrieved from: http://publications.gc.ca/collections/collection_2019/parl/xc50-1/XC50-1-1-421-21-eng.pdf

   The report summarizes the testimony of 41 witnesses and 9 written briefs on the issue of plastics pollution in marine and freshwater environments. While most plastic waste is technically recyclable, only 9% of plastics were recycled in Canada in 2016. Many witnesses identified economics of plastics production and recycling – in comparison to disposal rates and cost of plastic production - to be a key reason for low plastic recycling rates. Expert witnesses expressed concerns for human health due to the potential for micro-plastics to enter food systems through seafood and drinking water. These micro-plastics may contain persistent chemicals such as flame-retardants added to plastics during production or other harmful hydrophobic substances that attach to the plastic as it circulates in the environment. The committee also heard several potential solutions including: systems and materials innovations; consumer education; federal procurement practices; bans on certain plastic additives; bans on some plastics; bans on some plastic items; recycled content standards; recycling performance standards; extended producer responsibility legislation; and investments aimed at increasing Canada's recycling capacity. The committee listed several recommendations based on referenced research and witness testimony summarized in the report. The full list of recommendations and the dissenting report from the official opposition are available through the link above.

9. United Nations Environment Programme (2017). *Exploring the potential for adopting alternative materials to reduce marine plastic litter*. Retrieved from: https://www.unenvironment.org/resources/report/exploring-potential-adopting-alternative-materials-reduce-marine-plastic-litter

   The report provides a comprehensive overview of different material used to make single-use items and other commonly littered plastics. Using SWOT (strengths, weaknesses, opportunities threats) analysis it discusses the benefits and opportunities as well as the potential unintended consequences of alternatives. The report also looks at the human health implications of producing various plastics and alternatives, as well as the environmental and financial impacts. From that work, the authors landed on a set of conclusions and recommendations including that:
   - Use of alternatives needs to be part of a broader strategy towards sustainable production and use a systems thinking approach.
   - Increasing the use of common biopolymers such as PLA, PHA and TPS will not reduce the amount of waste ending up in our oceans or landfills.
   - Bio-plastics are best suited to closed loops systems and are not suitable for distribution by 'fast food' in uncontrolled public spaces.
   - Plastic bag bans incentivizes use of reusable bags made from natural materials.
   - Most published LCA do not consider end-of-life. As a result, the comparisons of materials can be misleading. Techniques for comparison of alternatives need to look at whole life cycle analysis.

- The impacts of artificial fertilizers and biocides should be considered when looking at the environmental impacts of bio-based products.
- Packaging needs better labelling that helps avoid confusion and minimize misuse.

Compostable Single-Use Items

10. Adamcova, Dana and Vaverkova, Magdalena. (2014) *Degradation of Biodegradable/Degradable Plastics in Municipal Solid-Waste Landfill.* Retrieved from: https://www.researchgate.net/publication/268512390_Degradation_of_BiodegradableDegradable_Plastics_in_Municipal_Solid-Waste_Landfill

    This study looks at the performance of biodegradable, compostable and regular plastic in a landfill. Plastic bags that were confirmed to be biodegradable or compostable by industry standard lab tests did not degrade in real landfill conditions after 12 months. Cellulose filter paper broke down in 8 months.

11. BC Ministry of Environment and Climate Change Strategy Environmental Standard Branch. (2002). Organic Matter Recycling Regulation. Retrieved from: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/18_2002

    OMMR Schedule 12 lists the organic matter suitable for composting. It does not include compostable plastics which is a commonly suggested alternative to conventional single-use plastic items. The Ministry of Environment and Climate Change Strategy is currently reviewing this (see 12).

12. BC Ministry of Environment and Climate Change Strategy Environmental Standard Branch. (2019). *Organic Matter Recycling Regulation Summary of public input in response to the 2018 Intentions paper Final Report*. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/reports-and-papers/2018_omrr_ip_summary_of_comments.pdf

    Compostable plastics are not included as acceptable feedstock in BC's Organic Matter Recycling Regulation (see 11). The Province invited feedback on their September 2018 intentions paper to update the regulation in fall of 2018. This report summarizes the feedback received on all areas of proposed updates including compostable plastics. With respect to inclusion of compostable plastics in the updated regulation, the Province responded that they are currently looking at:
    - how to practically excluded non-compostable plastic;
    - which composting systems and temperatures are capable of completely composting the feedstock; and
    - if the incorporation of compostable plastics contributes value to the final product.

13. Biodegradable Products Institute. https://www.bpiworld.org/Fluorinated-Chemicals. Accessed August 8, 2019.

    Biodegradable Product Institute (BPI) is a commonly used standard for certified compostable products. By the end of 2019 all products labelled with their certification must be not exceed the EN13432 limit of 100ppm total fluorine and must not intentionally add fluorinated chemicals. More details are available on their website.

14. Schaider, L. A., Balan, S. A., Blum, A., Andrews, D. Q., Strynar, M. J., Dickinson, M. E., … Peaslee, G. F. (2017). *Fluorinated Compounds in U.S. Fast Food Packaging. Environmental science & technology letters*, 4(3), 105–111. doi:10.1021/acs.estlett.6b00435. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6104644/

    Per- and poly- flouraolkyl substances (PFASs) are commonly used in fibre-based single-use items as a grease barrier. The study tested various single-use items distributed by U.S. fast food items and found that
    - 56% of dessert and bread wrappers
    - 38% of sandwich and burger wrappers
    - 20% of paperboard; and
    - 0% of paper cups

    tested positive for PFAFs. The report states that PFAFs should be considered incompatible with compostable food packaging because of their persistence in environment. However common, compostable standards such as ASTM, D6400 and D6868 do not consider PFASs and therefore they are currently allowed in compostable food ware. (Since the study was published the certified compostable standards have responded to this concern see 13).

Bags

15. Austin Resource Recovery. (2015). *Environmental Effects of the Single Use Bag Ordinance in Austin, Texas.* Retrieved from: http://www.austintexas.gov/edims/pio/document.cfm?id=301937

    This staff report summarizes the impacts of the Bag Ordinance (bylaw) that banned plastic bags in the City of Austin, Texas in March, 2013. The study found a 75% decrease in littered plastic bags compared to a sister city with no ordinance. Austin Parks Foundation reported a 90% reduction in plastic bag litter in the first six months after the ordinance had been passed. The cover report includes a response from staff regarding the June, 2018, Texas Supreme Court Ruling that such ordinances are not enforceable.

16. Ireland Department of Communications, Climate Action & Environment. https://www.dccae.gov.ie/en-ie/environment/topics/waste/litter/plastic-bags/Pages/default.aspx Website accessed July 31, 2019.

    Estimates that bag consumption in Ireland decreased from 328 in 2002 to 14 bags per capita in 2014 due to a $0.22 levy on plastic bags. The levy is remitted to the Environmental Fund.

17. Litter Monitoring Body, The & TOBIN Consulting Engineers (2018). *The National Litter Pollution Monitoring System – Litter Monitoring Body System Results 2018.* Commissioned by the Ireland Department of Communications, Climate Action & Environment: Dublin, Ireland. Retrieved from: https://www.dccae.gov.ie/documents/NLPMS%20Report%202018.pdf

    Results of Ireland's national litter monitoring program. In 2018, most litter came from cigarette butts (54.4%) and packaging items (18.2%). Prior to a bag levy, which was in introduced in March

2002, it was estimated that plastic bags constituted 5% of litter. Figure 6-5 of the report shows that since 2002 plastic bags were found to be less than 0.5% of litter.

18. Taylor, Rebecca. (2019). *Bag leakage: The effect of disposable carryout bag regulation on unregulated bags.* Journal of Environmental Economics and Management, 93, 254-271. https://doi.org/10.1016/j.jeem.2019.01.001

    Approximately 242 local governments adopted plastic bag reduction regulations between 2007 and 2016. The most common policies in California were found to be plastic bag bans with a fee for paper and other reusable bags - leaving trash bags unregulated. The paper uses:
    - check-out scanner data on sales of trash bags, and
    - observational data for changes to carryout bags

    to estimate if the consumption of non-regulated plastic bags outweighs that of regulated bags after regulations are in effect. Based on the best available data, the paper estimates that the elimination of 40 million pounds of plastic carry out bags in California was offset by the purchase of 12 million pounds of trash bags. The paper notes that paper bags increased from 0.05 bags per transaction to 0.51 bags per transaction while plastic bags decreased from 3.77 bags per transaction to 0.00 bags per transaction. For every 8 plastic bags produced 1 paper bag was purchased as an alternative. Based on the average weight of bags used in the study, the journal article concludes that disposable carryout bag regulations resulted in 0.03 fewer pounds of plastic per transaction and an increase in 0.06 pounds per paper per transaction. Quantifying the net environmental impact is difficult because LCAs, the most common method of quantification, do not accurately measure the impacts of marine litter from the reduction of plastic and are sensitive to the specific inputs of the study as discussed below. Subsequently, the author concludes that overall the disposable carryout bag regulations reduce plastic consumed and may reduce plastics entering waterways as trash bags are less commonly littered. More research is needed to determine the net environmental impact.

    Note the disposal per capita in 2017 was reported to be 2,263 lbs (1027kg) per capita in California compared to 477 kg per capita in British Columbia. Subsequently Metro Vancouverites may not need to purchase as many non-regulated trash bags to replace regulated plastic checkout bags. Also notable the LCA study assumed regular paper bags would go to landfill as the primary management method. Paper bags are readily recycled in B.C. Based on the most recent waste composition study from Metro Vancouver, most paper bags do not end up in disposal.

Cups

19. Hubbub. (2018). *Impact Report Disposable Cup Charge*. Retrieved from: https://www.hubbub.org.uk/blog/starbucks-rolls-out-5p-paper-cup-charge-to-all-stores-across-britain

    Starbucks conducted a 3-month trial of a 5p charge on single-use plastic-lined cups in 35 London, UK stores with all the proceeds going to Hubbub – an environmental charity. Customers continued to receive a 25p discount for bringing their own mug. The trial aimed to determine the effectiveness of a 5p charge with respect to people brining their own mug, test reactions from customers, and understand the factors which contribute to customers switching to reusable mugs. The trial included

in store communications, marketing of reusable cups, and paper cup recycling for stores that didn't already provide it. During the trial, hot drinks sold in reusable mugs increased from 2.2% to 5.8%.

20. Poortinga, W. (2017). *Results of a field experiment to reduce coffee cup waste. Summary Report to Bewley's Tea & Coffee UK Ltd.* Cardiff: Welsh School of Architecture & School of Psychology, Cardiff University. Retrieved from: http://orca.cf.ac.uk/99366/1/Coffee%20cup%20summary%20report%20-%20Poortinga%20%28FINAL%29.pdf

    Twelve university cafes participated in a field experiment at Cardiff University in South Wales from September to December 2016. The study tested the impact of different interventions including: environmental messaging, sales of reusable cups, providing free reusable cups, charging a fee and providing a discount. The field results suggest that fees are more effective than discounts. This finding is consistent with *prospect theory,* which offers that people are more sensitive to a charge on disposable cups (a loss) than a discount for disposable cups (a gain). The study found that discounts didn't make any difference to reusable cup sales, but a charge increased cup sales by 3.4%. Environmental messaging, providing free reusable cups and selling reusable cups were found to also increase reusable cup use. Sites that had environmental messaging, gave away free cups, had cups for purchase and charged a fee were able to increase the use of reusable coffee cups from 2.3% to 12.5%.

Containers

21. BC Ministry of Health. (2019). *Public Health Act Food Premises Regulation*. Retrieved from: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/11_210_99

    The Food Safety Act regulates the ability of food premises to accept reusable takeout containers from customers. As per Section 17: "Without limiting subsection (1), every operator of food premises must ensure that the equipment, utensils and food contact surfaces used on the premises are washed and sanitized in a manner that removes contamination."

22. Fraser Health & Vancouver Coast Health. (2019) *Food Safety Update*. Retrieved from: http://www.vch.ca/Documents/Food-Safety-Update.pdf

    The newsletter provides a clear interpretation of the Food Premises regulations which requires operators to make sure all food contact surfaces: including utensils and customer containers are sanitized. This means that operators much wash and sanitize customer's containers before filling them with food. The newsletter supports the use of container exchange (reuse) programs to promote the reduction of waste. Mug-share and container-share programs are allowed under the current health regulations because the containers are sanitized before being handed to the customers.

23. New York City Health (2017). *Article 81 of the NYC Heath Code: Food Preparation and Food Establishments May 2017.*Retrieved from: https://www1.nyc.gov/assets/doh/downloads/pdf/rii/article81-book.pdf.

The City of New York recently updated their Health Code so that New York City restaurants can accept containers if they sanitize them before filling them or get approval of a written standard operating procedure that demonstrates there is no risk of contamination of food and/or food contact surfaces.