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The Environmental Impacts of Virtual Conference Promotional Products

Materials Management
DEQ State of Oregon

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Executive Summary

The Materials Management Program at the Oregon Department of Environmental Quality envisions that in 2050, Oregonians produce and use materials responsibly - conserving resources, protecting the environment and enhancing wellbeing. To achieve this vision, the Materials Management Program examines the life cycle environmental impacts of all types of materials and products.

Background

Conferences often provide promotional items, such as souvenirs, wearables, practical items and food, as a means of recognizing sponsoring organizations and enhancing attendee experience. With the onset of the COVID-19 pandemic in 2020, many conferences shifted from in-person to virtual formats and often sent attendees gift boxes containing promotional materials.

To understand the environment impacts of promotional products, the Oregon Department of Environmental Quality (DEQ) evaluated the impacts of an actual gift box and its components that was sent to attendees of a virtual conference focused on procurement, held in 2021. DEQ evaluated all of the gift box items, referred to as an "Activity Pack" in this report, using life cycle assessment (LCA) methodology, and compared the carbon footprint of the Activity Pack to the calculated carbon footprint of the conference.

The Activity Pack was sent to approximately 500 attendees and contained 16 items, including:

- Electronic, phone, and computer accessories
- A portable UV sterilizer
- Snack food
- Novelty items and signs
- Note pads and other writing accessories
- Pastel markers
- Reusable face mask

Results

LCA impact indicators of the Activity Pack were assessed and scaled to the cumulative impact of 500 Packs. These impacts were transformed into environmental impact equivalencies to illustrate the impacts:

Environmental Impact Category	Equivalence of 500 Promotional Boxes
Global Warming Potential	Driving 7,163 miles
Acidification	Driving 8,486 miles
Ecotoxicity	Driving roundtrip to Pluto (7.5 billion miles)
Eutrophication	Driving 78,550 miles
Particulate matter	Driving 170,625 miles
Human toxicity, cancer	Driving 499 miles
Human toxicity, non-cancer	Driving 495 miles
Fossil Fuel Resources	Home electricity usage for 39 days Total household energy usage for 20 days
Smog Formation	Driving 4,973 miles
Blue Water Consumption	1343 showers

Using LCA data, a "heat map" was created to show the relative contribution of every Activity Pack item to each environmental impact (e.g., smog formation). This color-coded map is a visualization of relative environmental impacts.

DEQ estimated that the virtual conference had a calculated carbon footprint (global warming potential) of 4263 kg CO2 eq. and 500 Activity Packs produced 2865 kg CO2 eq. for a combined carbon footprint of 7128 kg CO2 eq. Therefore, the Activity Packs contributed 40% to the total carbon footprint of the conference.

Key points

- Conference organizers may want to consider the environmental footprint of activities associated with the conference when planning the event. Although virtual conferences have smaller carbon footprints than in-person ones, there is still a need to reduce environmental impacts. Promotional materials provide a clear opportunity to do so.
- Life cycle assessment indicated, and the heat map illustrated, that the most significant contribution to environmental impacts occur during the production phase of the product life cycle. Therefore, the most effective means of affecting the impacts is by addressing the products themselves.
- Evaluating the environmental impacts of each item and selecting products for inclusion in a gift box based on the size of its environmental footprint is the most effective strategy for reducing the environmental footprint of the gift box. Alternatively, in the absence of environmental impact data, purchasing products that comply with environmental (and social) standards (e.g., using third party certified ecolabels) can reduce environmental (and social) footprints. However, the easiest approach for decreasing environmental impacts is to reduce the number of items in the Activity Box.
- Reducing unnecessary waste is another strategy for reducing the environmental footprint. Unsolicited products, such as the promotional items, are at higher risk of non/little use than products that are selected by the users, producing "unnecessary" waste. One simple way to reduce this waste might be to require conference attendees to opt-in to receive complimentary items during the conference registration process.

- The strategies for reducing the environmental footprint of the Activity Pack, and thus the virtual conference, should be considered holistically, not individually, to be most effective.
- Promotional products, albeit wasteful, are not major contributors/sources of global environmental impacts, but are illustrations of overconsumption that plague developed countries. Reducing the environmental impacts of promotional materials at conferences is readily obtainable by taking simple measures and may promote the decrease of overconsumption.
- The strategies described in this report show how critical evaluation could have reduced the environmental footprint of the Activity Packs, but can, and should be, applied proactively to purchasing decisions.
- Procurement, especially public procurement, has the leverage to affect markets and thus affect the environmental footprint of purchases, which is especially important because greenhouse gas emissions along the supply chains contribute significantly to global warming.

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Introduction

A national procurement conference was held virtually in 2021, and all attendees were sent an "Activity Pack," a gift box containing 16 items. Approximately 500 Activity Packs were sent out. As a registrant of the conference, the author (J. Rivin) received an Activity Pack and noted the plethora of products. As a member of the Oregon Department of Environmental Quality (DEQ) Materials Management Program, which examines life cycle environmental impacts of materials and products, the author became interested in the environmental impacts of the Pack. The Materials Management Program envisions that in 2050, Oregonians produce and use materials responsibly - conserving resources, protecting the environment and enhancing wellbeing.

DEQ used life cycle assessment to quantify the environmental impacts of the Activity Pack and its contents, compared the carbon footprint to that of the conference, and developed recommendations for reducing the environmental footprint of the Activity Pack. This case study has implications for procurement program strategies in general.

Background

Promotional Products

Souvenirs, wearables, practical items and food are commonly used as promotional mechanisms for organizations and businesses. These items are sometimes colloquially termed SWAG, or Stuff We All Get. Organizations invest much money in SWAG. The promotional products (SWAG) industry generated over $24 billion in sales in 2019.[1]

Conferences often provide promotional products as a means of recognizing the sponsoring organizations and to make attendees feel they are part of the experience. Tradeshows, either independent or conference-associated are also venues for promotional giveaways. However, the goodwill of these organizations has an environmental consequence.

Environmental Impacts

All products, including SWAG, are manufactured from raw (and sometimes recycled) materials, used and ultimately disposed of. This is termed the "life cycle" of the product. During all stages of the life cycle, due to the discharge of emissions to the air, water or land, structures and living organisms are exposed to pollutants. These pollutants can degrade the quality and performance of materials[2, 3] and adversely affect the health of organisms and the environment, directly or indirectly.[4]

Human activity results in environmental degradation and in extreme cases destruction. As the global population increases and consumption (i.e., human activity) grows, the stress on Earth's

resources increases. Natural resources, both biotic and abiotic, are being depleted, the Earth's climate is being changed and the well-being of communities is being affected, and this is just a partial list.

Consumption of Earth's resources (i.e., production, use and disposal of products and services) varies across global populations, with developed countries using a disproportionate amount of resources, on a per capita basis.[5] However, the impacts can be global (e.g., degradation of rainforests). Improved technological efforts, such as material recycling and increasing product durability, are only partial solutions to mitigating resource depletion and other environmental impacts.[6] Worldwide consumption continues to increase as population and affluence grows. Climate change, and the current climate crisis, which has been deemed a public health issue,[7] is caused by human consumption.[8]

Although the intent of promotional products is to provide useable products, the usefulness of these products is subjective. Products that are never used and just thrown away are the most environmentally destructive, being without benefit for their intended audience. Unsolicited products, such as the Activity Packs, have a high risk for being superfluous and thus generating large amounts of unused product waste.

To effectively address the human impact on the Earth's ability to sustain human populations, a critical assessment of human consumption is needed.[9] Products and services may also be seen through the lens of environmental impacts and the effect on human well-being[10], and not only seen through a business lens of profit and market share.[11] This is especially true for extravagances, like the Activity Pack, which are examples of unnecessary consumption.

DEQ used life cycle assessment (LCA) to evaluate the magnitude and contribution of each item to the overall environmental impact of the Activity Pack and compared the carbon footprint of the Pack to that of the conference. This analysis illustrates that the environmental impacts of promotional materials, such as the Activity Pack, should be considered.

Methodology

Life cycle assessment

A life cycle assessment (LCA) is a formal method for quantifying life cycle environmental impacts of products, materials, and services.[12] Here, an LCA was performed on all promotional items contained in the Activity Pack, including the packaging itself.[†] The results were used to provide an understanding of the consequences of sending out these gift boxes. These Packs were large cardboard boxes containing numerous, disparate items. Appendix A enumerates the contents, which included both consumables (i.e., food) and non-consumables. Thirteen environmental impacts were evaluated and are described in Appendix B. The life cycle stages of the products studied included production through disposal, but excluded any use-related impacts. The impacts were scaled to two units of measure - the impact of a single Activity Pack and the cumulative impact of 500 Activity Packs (the estimated distribution to conference attendees).

To perform an LCA, the weight and material composition of the finished product must be known. This includes not only the weight of the whole product, but also of the individual components that make up the finished product. Furthermore, in the Activity Pack, most of the items were packaged (e.g., in sealed plastic pouches, boxes, etc.). Consequently, the LCA included the product and any associated packaging.

Due to time constraints and availability of primary data, this analysis also relied on expert judgement and in some cases, assumptions regarding the material composition of a product. As such, the accuracy of the results is low, thus representing a conservative estimate of life cycle impacts. An accurate evaluation of a finished product would entail dismantling (often destructively) the item into its basic components (e.g., screws, wires, threads) to obtain component weights and determining the material type. Instead, when product disassembly was not feasible, research and expert judgement were used to make determinations. For example, for one electronic accessory made of metal and plastic, the metal was assumed to be a

[†] Data for the LCA model and associated Life Cycle Inventory (LCI) were developed using the GaBi ts Software system. GaBi is developed and maintained by Sphera. The GaBi (Content Version 2021.1) and Ecoinvent (v3.6) databases were used for life cycle inventory data of raw materials and processes. Life Cycle Impact Assessment (LCIA) results are based on the TRACI 2.1 impact assessment methodology as its characterization factors are representative of the U.S.; LCA performed by Peter Canepa, Oregon Department of Environmental Quality.

ferronickel alloy and the plastic, a high density polyethylene; the metal and polymer were assumed to each constitute fifty percent of the total weight.

Additionally, other factors in the product life cycle, such as part production or assembly, were unaccounted for due to lack of readily available data. For some products only the production of the raw materials was included. For example, for a plastic polypropylene pouch, the life cycle stages might only include polypropylene production but exclude the manufacturing processes for pouch formation. Furthermore, final assembly of the products was not included, nor were the impacts of packing the box with the items. All transportation stages prior to delivery to user (i.e., conference participant) were also excluded. These omissions result in conservative estimated environmental impacts, as these additional manufacturing and transportation activities, if included, would increase the overall impact results. Final delivery to user was included, and a conservative estimate of 500 delivery miles was assumed, as well as the use of truck transport.

As for final disposal options, all items were assumed to be destined for landfills. This is not an unreasonable assumption, as about 50% of municipal solid waste in the United States is landfilled.[13] Some material loss could occur during usage, although the original state of the product was assumed at disposal. The paper products (i.e., pads of paper, "do not disturb sign" and cardboard ad) could potentially be recycled, reducing environmental impacts, but to simplify the LCA, this was not considered.

Environmental impacts during the use phase of the products' life cycles would be inconsequential and were ignored. However, the use of several products would have repercussions in the disposal phase, albeit minor in some cases. Use of the pastel markers, pen (i.e., ink) and food consumption would have reduced the product weight at disposal and consequently decreased landfill impacts. However, these potential decreases in impacts were also not included in the LCA. Furthermore, batteries for the sterilizer are necessary for operation but were not included in the Activity Pack and were thus excluded from the assessment. Inclusion of batteries would have added production and disposal environmental impacts, and consequently increased the total environmental impacts of the sterilizer.

Conference carbon footprint

The conference was a four-day virtual conference in April 2021, attended by participants from across the United States via the ZOOM® platform. The carbon footprint of the conference was estimated based on Faber's study, *A Framework to Estimate Emissions from Virtual Conferences*, which used a model to calculate the carbon footprint of a specific virtual conference.[14] Model inputs were adjusted to reflect the conference particulars.

Results

The environmental impact results for the LCA are shown in Table 1. These results are called life cycle impact assessment indicators and they estimate the potential effects on the environment (air, water and soil). See Appendix B for explanation of impact categories and units.

LCA results are best understood on a comparative basis, instead of raw numbers. Two methods are used to explain the results. One technique equates impacts to commonly understood measures, termed "equivalencies." The second technique uses relative comparisons, where impacts of each Activity Pack item are compared using a "heat map."

Additionally, the global warming potential of the gift box was compared to that of the conference as a whole.

Table 1: LCA Results for Activity Box

See Appendix B for descriptions of each impact category

Environmental Impact Category	Units (equivalents, eq)	Impact*– 1 Box	Impact**– 500 Boxes
Global Warming Potential	kg CO2	5.7	2865
Primary Energy Demand	MJ	89.8	44907
Acidification	kg SO2	0.0177	8.8
Ecotoxicity	CTUe	21.0	10506
Eutrophication	kg N	0.0105	5.2
Particulate matter	kg PM2.5	0.00273	1.4
Human toxicity, cancer	CTUh	8.6E-08	4.3E-05
Human toxicity, non-cancer	CTUh	3.8E-06	0.0019
Ozone Depletion	kg CFC 11	6.8E-08	3.4E-05
Fossil Fuel Resources	MJ	8.9	4436
Smog Formation	kg O3	0.22	109
Blue Water Consumption	Kg	162.7	81361
Water Scarcity Index	m3	0.0587	29.3

* Rounded for presentation; ** Raw data (not rounded) used for calculations

Equivalencies

Table 2 is a summary of the impact equivalencies for 500 Activity Packs. For example, production, distribution and disposal of 500 Boxes, release 4.3E-05 CTUh of cancer-causing emissions (Table 1). Driving a car also releases cancer causing emissions (CTUh) from the tailpipe. These 500 Activity Boxes are equivalent to driving a car 499 miles.

Not all of the environmental impacts listed in Table 1 were transformed into equivalent measures. Appendix C explains the calculations.

Table 2: Environmental Impact Equivalencies

Environmental Impact Category	Equivalence of 500 Boxes
Global Warming Potential, a.k.a. Carbon Footprint	Driving 7,163 miles
Acidification	Driving 8,486 miles
Ecotoxicity	Driving roundtrip to Pluto (7.5 billion miles)
Eutrophication	Driving 78,550 miles
Particulate matter	Driving 170,625 miles
Human toxicity, cancer	Driving 499 miles
Human toxicity, non-cancer	Driving 495 miles
Fossil Fuel Resources	Home electricity usage for 39 days Total household energy usage for 20 days
Smog Formation	Driving 4,973 miles
Blue Water Consumption	1343 showers

Heat map

Figure 1 shows the impacts of each of the promotional products and also includes transportation to user and landfill disposal. This map was developed based on the LCA. In presenting the results, all of the food products were aggregated and were combined with the large, aluminized (Al) pouch in which most of the food was contained (Al Package + Food).

The intent of the heat map is to show relative contributions to impacts using color coding. In Figure 1, comparisons between items are made within each column of impacts and colors are used to represent the relative contribution to the impact: dark red means the greatest impact and dark blue the least. For example, under "Global Warming Potential," the pastel markers contributed the largest share of any single item within the Activity Pack to this impact and the cardboard ad, "do not disturb" sign and packaging strips contributed the least. The heat map indicates that of all the promotional items, pastel markers and food (Al Package + Food) produced the largest environmental footprints, shown by multiple red cells.

Additionally, the numbers in each cell in Figure 1 indicate the percent contribution to that impact. For example, the packing box contributed 3.7% to the overall energy demand.

Conference carbon footprint

The conference had a calculated carbon footprint (global warming potential) of 4263 kg CO2 eq. When combined with the Activity Pack impacts (2865 kg CO2 eq), the total carbon footprint of the conference is estimated to be 7128 kg CO2 eq. Consequently, the Activity Packs contributed 40% to the overall carbon footprint of the conference.

Figure 1: Heat Map

	Global Warming Potential [kg CO2 eq]	Energy Demand [MJ]	Acidification [kg SO2 eq]	Ecotoxicity [CTUe]	Eutrophication [kg N eq]	Particulate Matter [kg $PM_{2.5}$ eq]	Human toxicity, cancer [CTUh]	Human toxicity, non-cancer [CTUh]	Ozone Depletion [kg CFC 11 eq]	Fossil fuels [MJ]	Smog [kg O3 eq]	Blue water consumption [kg]	Water Scarcity Index [m^3]
Al Package + Food	7.0	14.3	12.4	49.3	44.6	40.2	18.5	29.7	41.9	6.3	12.0	39.3	39.2
Box	5.3	3.7	11.2	2.7	1.5	6.0	1.7	6.4	17.4	3.3	9.1	0.8	0.7
Cardboard Ad	0.2	0.1	0.4	0.1	0.1	0.2	0.1	0.2	0.7	0.1	0.3	0.0	0.0
Electronic Accessories	2.9	3.8	4.7	2.5	2.2	6.5	5.0	2.0	5.6	3.6	3.5	0.6	0.7
Do Not Disturb Sign	0.1	0.1	0.2	0.1	0.0	0.1	0.0	0.2	0.4	0.1	0.2	0.0	0.0
Reusable Face Mask	1.2	1.6	1.1	0.1	3.1	0.4	0.1	-0.6	0.0	1.4	1.8	9.5	9.0
Mouse Pad	4.7	6.8	1.6	0.1	0.2	0.5	0.1	0.4	0.0	9.5	3.3	0.5	0.7
Travel Case	17.3	17.9	9.3	0.3	1.4	2.4	0.5	0.8	0.0	21.7	18.0	1.6	2.2
Charger Accessory	2.2	2.4	5.1	19.5	9.5	8.6	27.3	5.7	6.6	1.9	3.2	0.5	0.6
Notebook	4.3	5.6	4.7	1.2	1.8	2.1	1.5	4.8	6.1	6.8	5.7	2.6	2.6
Pad of Paper	2.1	2.1	3.1	1.2	2.8	0.8	2.8	7.7	4.5	1.3	3.5	3.9	3.7
Pastel Markers	25.6	28.9	21.8	3.8	13.1	16.0	5.3	0.9	7.5	30.1	23.0	34.5	34.8
Pen	0.5	0.9	0.4	0.1	0.2	0.3	0.2	0.0	1.1	1.2	0.5	0.1	0.1
Packaging Strips	0.3	0.3	0.3	0.1	0.4	0.1	0.4	1.1	0.5	0.2	0.4	0.6	0.5
Rubber Ball	3.2	2.8	3.4	1.7	2.9	5.7	6.9	0.8	1.1	3.1	3.2	1.8	1.7
UV Sterilizer	5.5	6.8	6.8	16.5	8.8	8.5	23.5	6.0	6.6	7.2	6.2	3.4	3.3
Transport by Truck	1.0	0.9	1.6	0.0	0.2	0.3	0.0	0.0	0.0	1.2	2.9	0.1	0.1
Landfill Disposal	16.6	0.9	12.0	0.8	7.3	1.2	5.8	33.9	0.0	1.1	3.1	0.1	0.1

Legend: Darker red=greatest impact; darker blue=smallest impact
Note: numbers in each cell indicate percent contribution to the impact

Discussion

The consumption of goods and services has adverse environmental impacts and production, distribution and disposal of the Activity Pack resulted in significant additional impacts for the conference. Several different strategies for reducing the environmental footprint of the Activity Pack are described below. However, these are not intended to be implemented in isolation, but considered in concert to be most effective.

Conference carbon footprint

The carbon footprint of a virtual conference is primarily dependent upon computer usage, with the largest contributors being network data transmission emissions, duration of device (e.g., computer) usage and carbon emissions during device life cycle.[14] The Activity Packs contributed 40% to the total carbon footprint of the conference. As with the LCA calculations, the result is an estimate, not an accurate depiction. Nonetheless, promotional products can significantly increase the environmental footprint of a virtual conference. Furthermore, the result was limited to global warming impact and does not portray the full scope of environmental impacts.

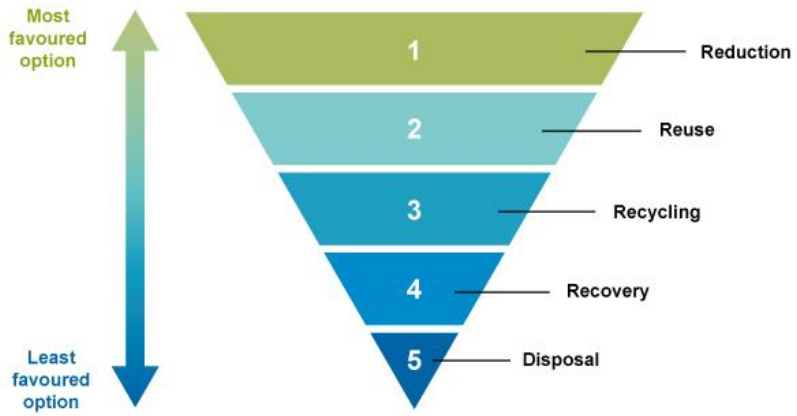
Conference organizers may want to consider the environmental footprint of activities associated with the conference. Although virtual conferences have smaller carbon footprints than in-person ones[14], there is still a need to reduce environmental impacts. Promotional materials provide a clear opportunity to do so.

Activity packs

There are a number of strategies for reducing the environmental impacts of the Activity Packs. The heat map indicates that in general, the distribution and final disposition stages contribute less to the environmental impacts than the production phase. This indicates that the most effective means of affecting the impacts is by addressing the products themselves.

The easiest means of decreasing environmental impacts is just by reducing the number of items in the Activity Box, which is a high priority (reduction) in a waste management hierarchy (Figure 2). This can be accomplished in a systematic way.

Figure 2: Waste Management Hierarchy[15]



Prioritize high value products

Value is a subjective interpretation. However, if value is explained as usefulness (another subjective term), products could be evaluated for the occasion. For example, attendees at a virtual conference in the time of COVID, may deem pens, pads of paper, face masks, electronic accessories/charger and a couple of snacks more useful than the other items, such as pastel markers.

Prioritize products with lower environmental impact

Evaluating the environmental impacts of each item is the most effective strategy for reducing the Activity Pack environmental footprint and the heat map is a useful tool. The products with the greatest impacts should be the highest priority for removal. For the Activity Pack, the pastel markers and packaged food contribute most significantly to the environmental impacts, indicated by the numerous red cells. In the case of food, elimination or reduction in amount are possible options. The sterilizer also had a relatively large environmental footprint. Furthermore, since the batteries were not even included in the LCA, which would have increased the impacts, the sterilizer could also be considered for removal from the SWAG.

When LCA-based heat maps are not available, product weight is sometimes a proxy for relative environmental footprint size since there is generally a correlation between weight and impact.[16] This is especially true, when comparing the same product in smaller and larger (heavier) sizes. However, with disparate products, the correlation is less consistent since environmental impacts are highly dependent upon the materials and processes used in the production phase. For example, in the Heat Map, higher impacts are produced from heavy items, pastel markers

(182.2g) and the food/packaging (169.9) – see Appendix A. However, the promotional box, itself of similar weight (173g), had a much lower impact, registering no red cells.

Reduce unnecessary waste

One strategy for reducing the environmental footprint of the Activity Pack is by reducing "unnecessary" waste generation. Unsolicited products, such as the SWAG, are at higher risk of non/little use than products that are selected by the users, producing "unnecessary" waste. This waste includes that at final disposition plus the wasted resources used in other life cycle stages of the products. Options for reducing "unnecessary" waste include requiring conference attendees to opt-in to receive complimentary items during the conference registration process or transitioning to another gift format, such as product discounts.

Overconsumption

Overconsumption is an underlying cause of many crises related to environmental issues of concern, including the climate crisis[17] [18] and the plethora of products in the Activity Packs is a reflection of overconsumption. None of the promotional items are necessities. Although largesse may not be a major component of human consumption, simply reducing the number of promotional products or even eliminating them, will decrease the environmental impacts of the gift box and address the issue of overconsumption.

Promotional product assumptions

Reducing or even eliminating conference promotional products to decrease environmental impacts may seem like a relatively easy task. However, conferences use promotional products as a means of recognizing the sponsoring organizations and to make attendees feel they are part of the experience. Therefore, from a business perspective, promotional items may seem crucial. What appears to be lacking, though, is an understanding of the effectiveness of this largesse in achieving these objectives.

Additional promotional product concerns

Three other issues germane to promotional products include:

- Promotional products are often mass-produced, low-quality items.[19] Although high quality promotional products can enhance a company's reputation more so than lower quality products,[20] high quality products are usually associated with different materials, processes and/or durability, which may not only be more expensive, but may also increase the environmental footprint of the product. Consequently, high quality characteristics may be counter-productive if not combined with recommendations for reducing "unnecessary" waste.

- Much SWAG is branded merchandise. When companies rebrand, are acquired or over-produce SWAG, these obsolete/excess products are often disposed of. Recycling and reuse are options to divert this waste from landfills.[21] However, as mentioned previously in this report, diversion from landfills does little to eliminate the largest proportion of environmental impacts that occur upstream, during production.

- Although this report focused on environmental impacts related to promotional products, social impacts cannot be overlooked. Many consumer products are manufactured in developing countries, but unfortunately, many of these same countries have been implicated in human rights violations.[22] [23] Considering social impacts, along with environmental impacts with promotional marketing, is more aligned with a sustainable procurement approach.[24]

Public procurement

Public procurement is the purchasing of good and services by public authorities, such as governments. Due to purchasing power, public procurement has the leverage to affect markets and thus affect the environmental footprint of purchases. The same strategies used for evaluating the environmental footprint of the Activity Pack can and should be integrated into purchasing decisions. The retrospective exercises, performed above, should be used proactively in public procurement.

When making purchasing decisions, the question of need is foundational, as a non-purchase completely eliminates environmental (and social) impacts from happening in the first place. Understanding environmental impacts is more challenging, particularly when life cycle assessments are the most accurate indicators. LCAs, and thus heat maps also, are not readily available for most products, and to perform an LCA can be costly and requires expertise. Consequently, life cycle assessment data are usually unavailable when making procurement decisions.

An alternative is to purchase products that comply with environmental (and social) standards, if available. These products can have a smaller environmental footprint than products not complying (conventional) and are often identified with ecolabels.[25] For a sustainable procurement program, the largest reduction in environmental footprints can be achieved by prioritizing products or product categories that have the highest environmental impacts.

The Intergovernmental Panel on Climate Change has stated that if GHG emissions continue to increase or do not diminish sufficiently, global warming will continue to increase with potentially catastrophic results for the human population and Earth's ecological system.[26] The supply chain, especially for consumer goods, contributes significantly to organizational GHG emissions.[27] [28] [29]

Since public procurement has the leverage to affect markets and thus environmental consequences of products and services, public procurement has an obligation to do its utmost to mitigate this planetary exigency. Furthermore, public procurement has the ability to influence overconsumption as well.

Conclusions

1. Promotional products have been a traditional, and often unsolicited by the recipient, component of conferences. Evaluation of environmental impacts illustrates that promotional products can contribute significantly to the total carbon footprint of a virtual conference. As virtual conferencing has become more common, environmental impact concerns around these events have dampened since it has been well-established that they are less environmentally harmful than in-person conferences. However, the environmental impacts of conference promotional products should not be ignored.

2. Strategies for decreasing the environmental impacts of conference promotional products include reducing the number of items offered and considering the environmental impacts of the products. Considering the strategies holistically will be more effective than implementing each of these strategies separately.

3. The strategies described in this report are intended to show how critical evaluation could have reduced the environmental footprint of the Activity Packs, but can also be applied proactively to purchasing decisions. Public procurement has the leverage to affect markets and thus affect the environmental footprint of purchases, which is especially important since supply chains contribute significantly to GHG emissions.

4. Although LCA was used to quantify the Activity Pack environmental footprint, LCAs can be complex and costly to perform, and therefore, practically, are not commonly available for procurement decision making. Alternatively, purchasing products that comply with environmental (and social) standards (e.g., using third party certified ecolabels) is a highly effective means of reducing environmental (and social) footprints via procurement.

5. Promotional products, albeit wasteful, are not major contributors/sources of global environmental impacts, but are illustrations of overconsumption that plague developed countries. Reducing the environmental impacts of promotional materials at conferences is readily obtainable by taking simple measures and may promote the decrease of overconsumption.

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Appendix A: Activity Box Contents

Contents of Activity Box (packaging box is listed as second item):

ITEM	WEIGHT (g)
Al Package + Food	169.9
Box	173.0
Cardboard Ad	6.5
Electronic Accessories	42.0
Do Not Disturb Sign	5.2
Reusable Face Mask	12.0
Mouse Pad	61.3
Travel Case	79.5
Charger Accessory	20.7
Notebook	147.8
Pad of Paper	121.1
Pastel Markers	182.2
Pen	10.5
Decorative Packaging Strips	15.9
Rubber Ball	24.6
UV Sterilizer	99.3

The total weight of the Activity Pack was 1,157g (2.5 lbs.).

Appendix B: Environmental impacts

Environmental impact definitions

Acidification (kg SO2 eq): A measure of emissions that cause acidifying (decreasing pH) effects to the environment. Potential effects include fish mortality, forest decline and the deterioration of building materials.

Blue water consumption (kg): A measure of the net usage (intake and release) of fresh water (surface and ground water) across the life of the product system.

Ecotoxicity (CTUe): Estimated increase in aquatic morbidity due to toxic chemical emissions.

Eutrophication (kg N eq): A measure of the discharge of macronutrients (nitrogen and phosphorus are of primary importance) that cause excessive nutrient enrichment in aquatic ecosystems leading to a proliferation in aquatic life, resulting in an undesirable shift in organism populations. For example, increased aquatic biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition.

Fossil fuel consumption (MJ): A measure of the energy consumed based on the fossil fuel resources coal, diesel, gasoline, heavy fuel oil, propane and natural gas.

Global warming potential (CO2eq): A measure of greenhouse gas emissions, such as CO_2 and methane, which cause increases in the natural greenhouse (warming) effect. The value used in this report is per IPCC AR5* GWP20, excluding biogenic carbon, as defined in TRACI 2.1.[30] The 20-year time frame for global warming potential (GWP20) instead of the 100-year time frame (GWP100) was used to emphasize the urgency to act now. The IPCC has stated that global governments are not adequately responding to the need to limit GHG emissions to forestall a global temperature rise of at least 1.5^{O} C.[31]

Human health – cancer (CTUh): Estimated increase in human morbidity due to cancer from chemical emissions.

Human health - non cancer (CTUh): Estimated increase in human morbidity from non-cancer diseases due to chemical emissions.

* Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5)

Ozone depletion (kg CFC 11 eq): A measure of air emissions that contribute to the depletion of the stratospheric ozone layer, which protects the Earth from high levels of UVB ultraviolet rays.

Particulate matter (kg PM2.5 eq): A measure of emissions of particles $\leq$ 2.5 μm, which are strongly associated with chronic and acute respiratory symptoms, as well as mortality rates.

Primary energy demand (MJ): A measure of the total amount of energy extracted from the earth from non-renewable resources (e.g., petroleum, natural gas, coal, etc.) and renewable resources (e.g., hydropower, wind energy, solar, etc.), plus the calorific value of the product.

Smog formation (kg O3 eq): A measure of ground level emissions that form ozone, which is a major contributor to ground level smog formation.

Water scarcity index (m3 eq): Represents the available water remaining after human and aquatic demand for water has been met; or indicator of water use relative the available water remaining.

Units legend

CO2 eq = carbon dioxide equivalents

CTUe = comparative toxic units for ecotoxicity

CTUh = comparative toxic units for humans

kg = kilogram

kg CFC 11 eq: = kg chlorofluorocarbon 11 equivalents

kg N eq = kg nitrogen equivalents

kg PM2.5 eq = kg particulate matter $\leq$ 2.5 microns equivalents

kg O3 eq = kg ozone equivalents

kg SO2 eq = kg sulfur dioxide equivalents

MJ = megajoules

m3 = cubic meters

Appendix C: Equivalencies

The US EPA has developed calculations and calculators for understanding impacts through equivalencies, although these are only available for GHG emissions and water consumption. Additional equivalencies are illustrated using LCA data and other data sources.

Global warming potential

Greenhouse gas (GHG) emissions contribute to climate change (global warming potential). Many gases are considered GHG: carbon dioxide, fluorinated gases, methane, nitrous oxide, and sulfur hexafluoride. When determining global warming potential, all emissions are aggregated using carbon dioxide (CO2) as the basis; the terminology is CO2 equivalents (CO2eq).

Over the life cycle of one SWAG box, as defined in this report, 5.73 kg CO2eq of GHG are emitted. The US EPA has estimated that a passenger vehicle emits from the tailpipe, 4600 kg CO2 annually, burning gasoline as fuel.[32] For 500 boxes (2865 kg CO2eq), this is equivalent to driving 7,163 miles.

Water consumption

About 163 kg of water (or ~43 gallons) are consumed over the life cycle of one SWAG box. For 500 boxes, this is equivalent to 21,493 gallons of water or 1343 showers.[33]

Fossil fuel resources

One SWAG box consumes almost 9 MJ of fossil fuel resources (energy), with 500 boxes using 4436 MJ. As the average annual electricity consumption of a US residence is 10,649 kWh[34] (38,336 MJ), these 500 boxes could cover one home's electricity usage for more than one month (39 days).

Similarly, total average energy consumption per household, which includes electricity, natural gas, heating oil and propane usage, is 77.1 M BTUs.[35] This means that 500 SWAG boxes could power one household for 20 days.

Particulate matter

Particulate matter less than or equal to 2.5um ($PM_{2.5}$) is linked to human illness and death.[36] Using Bureau of Transportation Statistics information, for light duty vehicles fueled by gasoline (in year 2020), the total $PM_{2.5}$ emissions from all sources was 0.008 g/mile.[37] With 500 SWAG boxes producing 1.365 kg PM2.5 (0.00273 kg/box), this is equivalent to driving 14.8 vehicles for 1 year or driving one vehicle 170,625 miles.

Acidification

A passenger vehicle using gasoline as fuel emits 0.001037 kg SO2 eq/mile. The 500 SWAG boxes, emitting 8.8 kg SO2 eq, are equivalent to driving the passenger car 8486 miles.

Ecotoxicity

A passenger vehicle emits 1.4E-06 CTUe/mile. The 500 boxes emit 10506 CTUe. This is equivalent to driving 7.5 billion miles or driving to Pluto and back (so take some snacks, it's a long trip).

Eutrophication

A passenger vehicle emits 6.62E-05 kg N eq/mile. 500 SWAG boxes emit 5.2 kg N eq, which is equivalent to driving 78550 miles.

Human health

A passenger vehicle emits 8.62E-08 cancer CTUh/mile. 500 boxes emit 4.3E-05 CTUh, which is equivalent to driving 499 miles.

As for non-cancer emissions, a passenger vehicle emits 3.84E-06 CTUh/mile. With 500 boxes emitting 0.0019 CTUh, this is equivalent to driving 495 miles.

Smog formation

One passenger car emits 0.021919 kg O3 eq/mile. 500 SWAG boxes emitting 109 kg O3 eq is equivalent to driving 4,973 miles.

References

1. Annual sales revenue of the distributor promotional products industry in the United States from 2007 to 2019. https://www.statista.com/statistics/732818/promotional-products-industry-sales-usa/

2. Cai, Y., Y. Xu, Y. Zhao and X. Ma. (2020). *Atmospheric corrosion prediction: a review*. Corrosion Reviews, 38(4): 299–321.

3. Kucera, V., J. Tidblad, K. Kreislova, D. Knotkova, M. Faller, D. Reiss, R. Snethlage, T. Yates, J. Henriksen, M. Schreiner, M. Melcher, M. Ferm, R. Alexandre Lefèvre and J. Kobus. (2007). *UN/ECE ICP Materials Dose-response Functions for the Multi-pollutant Situation*. Water Air Soil Pollut: Focus, 7:249–258

4. *Air Pollution and Your Health*. National Institute of Environmental Health Sciences. https://www.niehs.nih.gov/health/topics/agents/air-pollution/index.cfm

5. World Bank. https://data.worldbank.org/indicator/EN.ATM.CO2E.PC

6. Mulrow, J. and V. Santos. *Moving the Circular Economy Beyond Alchemy*. Discard Studies. 11/13/17. https://discardstudies.com/2017/11/13/moving-the-circular-economy-beyond-alchemy/

7. Cancryn, A. *HHS Unveils Office to Treat climate Change as a Health Issue*. Politico. 8/30/21. https://www.politico.com/news/2021/08/30/hhs-unveils-office-climate-change-507603

8. *AR6 Climate Change 2021: The Physical Science Basis*. IPCC. https://www.ipcc.ch/report/ar6/wg1/#SPM

9. UNEP. *Assessing the Environmental Impacts of Consumption and Production*. 2010. https://www.resourcepanel.org/reports/assessing-environmental-impacts-consumption-and-production

10. Davis, T. *What is Well-Being? Definition, Types and Well-Being Skills*. Psychology Today. 1/2/2019. https://www.psychologytoday.com/us/blog/click-here-happiness/201901/what-is-well-being-definition-types-and-well-being-skills

11. Norris, S. *We Could Get Rid of Cheap Swag Altogether*. Promo Marketing Magazine. 1/23/2019. https://magazine.promomarketing.com/longform/cheap-swag-promo-industry-fighting-perception-wont-quit/

12. Life Cycle Assessment (LCA) – Complete Beginner's Guide. Ecochain. https://ecochain.com/knowledge/life-cycle-assessment-lca-guide/

13. EPA. *National Overview: Facts and figures on Materials, Wastes and Recycling*. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#NationalPicture

14. Faber, G. (2021). *A Framework to Estimate Emissions from Virtual Conferences*. International Journal of Environmental Studies, 78(4):608-623

15. *The Waste Hierarchy*. Urban Sanitation and Solid Waste Management. The Open University. https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=80395&section=5.2 (retrieved 04/2/22)

16. Meinrenken, C.J., D. Chen, R.A. Esparza, V. Lyer, S.P. Paridis, A. Prasad and E. Whillas. (2020). *Carbon Emissions Embodied in Product Value Chains and the Role of Life Cycle Assessment in Curbing Them*. Sci Rep 10, 6184. https://doi.org/10.1038/s41598-020-62030-x

17. Wiedmann, T., M. Lenzen, L.T. KeyBer and J.K. Steinberger (2020). *Scientists' Warning on Affluence*. Nature Communications, 11:3107. https://www.nature.com/articles/s41467-020-16941-y

18. Country Overshoot Days. https://www.overshootday.org/newsroom/country-overshoot-days/

19. Segran, E. *It's Time to Stop Spending Billions on Cheap Conference Swag*. Fast Company. 11.02.18. https://www.fastcompany.com/90260185/its-time-to-stop-spending-billions-on-cheap-conference-swag

20. *How Vital is Quality When It Comes to SWAG?* WorkTucks. https://worktucks.com/how-vital-is-quality-when-it-comes-to-swag/

21. SwagCycle. https://www.swagcycle.net/

22. Khambay, A. *Garment Workers Across Asia Face Widespread Labour Rights Violations Linked to COVID-19*. Business & Human Rights Resource Centre. 9/18/2020. https://www.business-humanrights.org/en/blog/garment-workers-across-asia-face-widespread-labour-rights-violations-linked-to-covid-19/

23. Risk Indexes. https://risk-indexes.com/

24. *Swag: Done the Sustainable Way*. Yale School of the Environment. (https://environment.yale.edu/news/article/swag-done-the-sustainable-way/ (retrieved 02/15/22)

25. Environmental Labels. International Organization for Standardization (ISO). https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100323.pdf

26. IPCC. *AR6 Climate Change 2021: The Physical Science Basis*. https://www.ipcc.ch/report/ar6/wg1/#SPM

27. *A Trends Analysis Report*. West Coast Climate & Materials Management Forum. https://westcoastclimateforum.com/sites/westcoastclimateforum/files/related_documents/TA%20Final.pdf

28. *Quantifying Scope 3 Emissions & Engaging Suppliers in Energy Reduction* (webinar). Supply Chain Solutions Center. https://supplychain.edf.org/resources/webinar-quantifying-scope-3-emissions-engaging-suppliers-in-energy-reduction/

29. *Net-Zero Challenge: The Supply Chain Opportunity*. World Economic Forum. January 2021. https://www.weforum.org/reports/net-zero-challenge-the-supply-chain-opportunity

30. *Tool for the Reduction and Assessment of Chemicals and other Environmental Impacts (TRACI)*. https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci

31. *Global Warming of 1.5^{O} C*. IPCC. https://www.ipcc.ch/sr15/

32. Greenhouse Gas Emissions from a Typical Passenger Vehicle. EPA. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100U8YT.pdf

33. 16 gallons of water are used during an average shower: Save Water and Energy by Showering Better. EPA. https://www.epa.gov/sites/default/files/2017-02/documents/ws-ourwater-shower-better-learning-resource_0.pdf

34. How Much Electricity Does an American Home Use? US Energy Information Administration. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3

35. Table CE2.1: Residential Energy Consumption Survey (2015). US Energy Information Administration. https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption#summary

36. Schraufnagel, D., J.R. Balmes, C.T. Cowl, T., S. De Matteis, S-H. Jung, K. Mortimer, R. Perez-Padilla, B.B. Rice, H. Riojas-Rodriguez, A. Sood, G.D. Thurston, To, A. Vanker, D.J. Wuebbles (2018). *Air Pollution and Noncommunicable Diseases*. Chest Journal, 155(2):409-416.

37. Estimated US Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel. Bureau of Transportation Statistics. https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and; For light and heavy-duty trucks and motorcycles, the PM2.5 emissions are greater than 0.008 g/mile