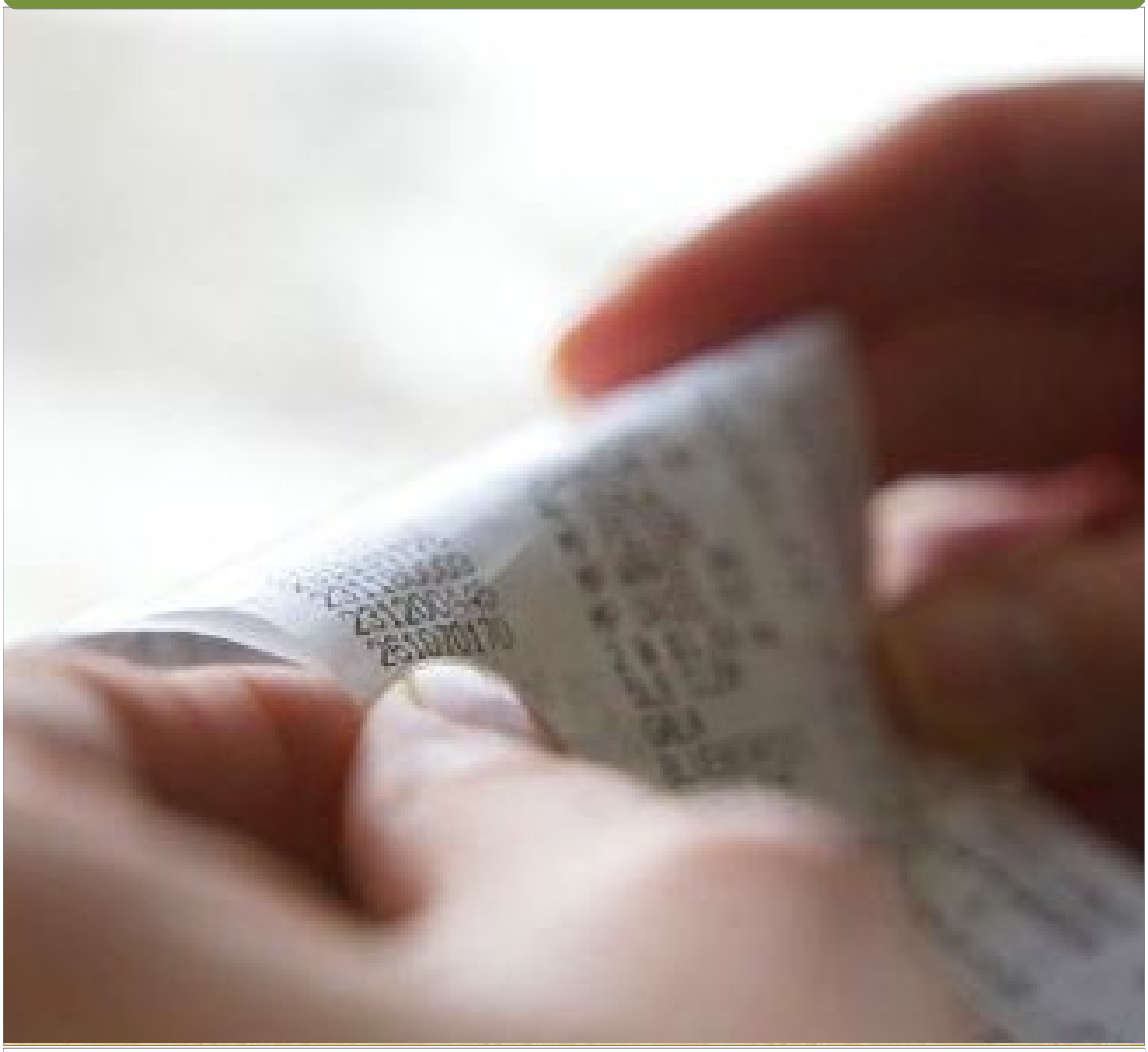
Reducing use of BPA and BPS Thermal Receipt Paper in the Hospitality Sector

BPA in Thermal Receipt Project: Whitepaper #2



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Introduction

Project overview

This whitepaper is the second of two related to the Minnesota Pollution Control Agency's (MPCA) project to better understand the amount of Bisphenol A (BPA) and Bisphenol S (BPS) in thermal receipt papers and the potential for reduction if businesses take specific actions related to their point-of-sale (POS) processes and operations.

In brief, MPCA, with funding from the U. S. Environmental Protection Agency (EPA) and the state of Minnesota, undertook a project to encourage Minnesota hospitality businesses to voluntarily reduce the amount of thermal receipt papers they use and distribute to their customers and to measure the reductions. These papers typically contain relatively high concentrations of the chemical BPA, or its chemical cousin BPS. Both BPA and BPS are endocrine active reproductive toxicants for humans and aquatic species at levels found in the environment (Rochester, 2013, Viñas, et al, 2013, Kang, 2007). They are the most commonly used chemical developers in thermal printing papers. Because they are unbound, the chemicals wipe easily off the paper and then can be absorbed through the skin. BPA is on Minnesota Department of Health's (MDH) Priority Chemical List. BPS is not currently on this list.

Research on endocrine active chemicals, including BPA, suggests that these chemicals have larger relative impacts during fetal development, infancy and puberty. The MDH says that "exposures to endocrine-active chemicals during pregnancy, infancy or puberty are of special concern." Thus, among those who handle receipts regularly as part of their job, there is particular concern for vulnerable employees such as women who are pregnant or trying to become pregnant and nursing mothers as well as teenage workers who are still developing. Their exposure in the workplace would be high-priority for reduction.

Since the initial findings of BPA in thermal paper first hit the news in about 2010, the variety of types of thermal papers on the market and the number of POS systems offering electronic or digital receipts have increased. Amidst these market changes, the EPA undertook an alternatives assessment and, in January 2014, released its report "Bisphenol A alternatives in thermal paper" (http://www.epa.gov/dfe/pubs/projects/bpa/about.htm). Their report did not identify any clearly safer chemicals for thermal paper applications.

The EPA noted that e-receipts are "becoming increasingly common" (EPA, 2014, p 6-10) but said analysis of these would require a full environmental life cycle analysis and was outside the scope of their study. The MPCA, however, decided that promotion of electronic receipts would be the best course of action. MPCA based its decision on longstanding state policy of pollution prevention (reduction at the source of contamination) and accumulated life cycle analysis research showing greenhouse gas benefits of digital products over material versions (Kim et al, 2012; Weber et al, 2010). Electronic receipts, by eliminating the need for thermal paper altogether, offer double benefit of preventing the use and release of the hazardous chemicals as well as the paper itself. Prevention is the first principle of both green chemistry and integrated waste management.

In the prior report from this project, the MPCA reported test results from 22 paper samples taken from a variety of businesses, recycled content copier paper, and paperboard.

This second report documents results of several additional paper tests, the individual actions taken by the partner businesses, and the estimated pollution prevention outcomes – specifically reductions in BPA/BPS and paper use. In addition, this paper presents stories from the partners about challenges and opportunities, cost impacts, and other lessons with hope that these will motivate and assist other businesses to make similar changes, and other government entities to promote action.

The goals of this project were to:

1. Determine if government assistance to businesses could result in voluntarily action and reductions of thermal papers and related chemicals.
2. Produce tools and information that could help other government entities and businesses take similar actions. (These tools, including information, case studies, POS vendor lists, and the first report can be found at www.pca.state.mn.us/receipts)
3. Identify best business types for future assistance efforts in thermal paper reduction.

Summary of research on BPA and BPS in thermal paper

Bisphenol A is one of the highest volume chemicals produced worldwide. Current estimates indicate that 13 billion pounds of BPA was produced in 2012 for all applications (Burridge, 2003, Vandenburg, et al., 2013, Michalowicz, 2014). Although the main use of BPA is in manufacturing polymers and epoxy resins, it is also used in a free or unbound form as a developer in thermal papers from which it is easily released (Geens et al, 2012).

Several studies have already provided scientific evidence for the contribution of sources for dermal BPA absorption from contact with paper and paper products, such as thermal paper, where BPA is used as an additive (Lu et al, 2013; Geens et al, 2012; Liao et al, 2011). BPA in thermal paper acts as a free monomer which aids dermal absorption compared to other forms found in plastic containers (Geens, et al, 2012). Health effects related to dietary exposure to BPA have been extensively investigated including several bio-monitoring studies looking at the BPA concentrations in urine (Calafat, et al, 2008). The observed exposures cannot be explained by dietary exposure alone.

Thermal paper is used in a wide variety of commercial applications including point-of-sale receipt paper, luggage tags, tickets (airplane, bus, and lottery) faxes and labels (Mendum et al, 2011; Liao et al, 2011). Thermal paper consists of two layers, a base layer and the thermal sensitive layer. The thermal sensitive layer consists of three components; the reactive dye, a weakly acidic color developer (BPA or BPS or other chemical) and a solvent to promote interaction. The process of printing uses a thermal head to melt the components causing the dye to react with the acid producing the printed dark dye (Mendum, et al, 2011; Biedermann, et al, 2010; Liao et al, 2011).

Bisphenol A and BPS have been found to be the primary chemicals used as thermal paper developers and the tests reported here add evidence to that conclusion. Initial studies looked only for BPA and found that a percentage of papers tested showed markedly less BPA or were below the limit of detection compared to others, and these studies estimated exposure specifically to BPA. Later studies found that BPS is present in some thermal papers at concentrations similar to BPA in other papers. It is not yet clear what total exposure to endocrine-active chemicals from thermal papers may be, since studies that tested only for BPA did not consider exposure to other endocrine-active chemicals from the papers that didn't contain BPA. We now know these thermal papers likely contained BPS.

Studies have reported similar ranges of concentrations for BPA in thermal paper as those found in this project. Mendum, et al (2011) found BPA concentrations of .3% to 1.7% (g BPA/100g of paper; or 3-17 mg BPA/gram paper) in 8 of 10 blank thermal paper receipts. (The other two were below the limit of detection.) Geens et al (2012) also reported finding BPA in 73% of the thermal papers they tested at concentrations of .9 and 2.1% (9-21 mg BPA/g paper). The other 27% of papers had much lower

concentrations, below .01%. Neither study tested for BPS. Similarly, Lu et al (2013) determined BPA concentrations in supermarket point-of-sale receipts collected from 42 supermarkets in Shenzhen China ranged from 2.58 to 14.7 mg/g (mean 9.38 mg/g).

Liao et al (2012) tested for BPS in thermal papers and found the chemical in concentrations similar to those of BPA in prior studies. They found a significant negative correlation; papers that had more BPA

had less BPS and vice versa. The tests in the present project add evidence that BPA and BPS remain the primary chemicals in thermal paper and that papers generally have one or the other at a concentration of about 1-2% by weight.

Lu et al (2013) used reported concentrations to estimate human exposure to BPA for the general public and supermarket cashiers. The study assumed the general public handled point-of-sale receipt paper 2-10 times a day and the cashier 20-160 times a day. The median estimated exposures of BPA were 0.69 µg/day and 40.4 µg/day, respectively. They noted that handling time and frequency time of handling would be key determinants of exposure from thermal receipts.

Liao et al (2012) reported the estimated daily intake (EDI) of BPS through dermal absorption via handling of papers and currency bills. "The median and 95th percentile EDI values, respectively, were 4.18 and 11.0 ng/kg body weight (bw)/day for the general population and 312 and 821 ng/kg bw/day for occupationally exposed individuals." Porras et al (2014) reported that typcial occupational exposure didn't raise BPA in urine levels to above the reference amount for the general population (in Finland). This report didn't note whether it raised BPA levels of individuals compared to their own baseline levels.

Biedermann et al (2010) studied 13 thermal papers and concluded 11 of the 13 contained BPA. The study further concluded that on average 1.3 µg of BPA was transferred to the pad of the finger. Moist or greasy fingers resulted in 10 times more exposure to BPA. They reported that equilibrium between BPA in the paper and the surface layer of the skin was reached, where repeated contact with fresh paper did not increase BPA concentrations on the skin. Exposure to BPA through thermal paper can occur through oral exposures from receipt to fingers to food to mouth (Hormann, et al, 2014).

BPA, BPS, and recycled paper

To the extent that BPA is found in the recycled paper stream, thermal paper is likely a major source. The 2008 European Union's Risk Assessment Report estimated that over 4 million pounds of BPA was used to manufacture thermal paper (2005/2006). Up to 10% of the paper from the production process goes directly to recycling (420,000 pounds) and the overall estimate is that 30% of used thermal paper will enter recycling streams (1.5 million pounds) (Liao & Kannan, 2011).

Recycling of thermal papers can introduce BPA into the paper production process. Rigol et al analyzed circulating waters of a paper-recycling plant for toxic compounds and reported levels of up to 100 µg/L for BPA. This shows that additives can accumulate in the water system and could end up in the final product. In general, tests of recycled content paper have found levels much lower than in thermal papers, a finding that MPCA tests corroborate, suggesting that because BPA is water soluble, much of it washes out in industrial process waste waters. Furhacker et al (2000) reported that of point sources to a municipal wastewater treatment facility, the paper industry was the primary contributor of BPA and that treatment removed about 90% of the load.

Summary of business actions and environmental outcomes

As noted in our prior report, this project involved recruitment of business partners, primarily from hospitality, that agreed to:

- provide samples of thermal receipt paper to test for presence of BPA and BPS
- provide a baseline of annual thermal paper use
- attempt some action to reduce use of the thermal paper or employee exposure to it
- provide follow up data on reductions of paper use

A summary of types of businesses and their degree of participation is presented in Table 1. A total of 23 partners participated, all of which provided baseline data and submitted samples of paper for testing. Eleven took some action to reduce use of the paper and 8 reported final paper use reduction estimates, which allowed estimation of chemical use reduction too.

In addition, three recycled content (non-thermal) papers were tested – a 100% recycled content paperboard, a 30% recycled content copy paper and a 100% recycled content copy paper. Two additional papers were tested but the sample results are not reported because they were not sampled according to the protocol specified in the Quality Assurance Project Plan (QAPP).

The paper testing was done in two rounds, in July and September of 2014. The first round test results are presented in a prior report, *BPA and BPS in Thermal Paper: Results of Testing in Minnesota Hospitality Industry* (MPCA, 2014). The results of the six tests from the second round of testing are presented in Table 2. In sum, after both rounds of testing, 9 of the tested thermal papers showed the presence of BPA and 13 of the thermal papers showed the presence of BPS.

Table 1: Summary of partner participation and paper samples

No.	Code	Description	Partner	Provided baseline paper use	Paper tested	Took new action	Provided post-action data
1	A	Recycled non-thermal paperboard	N	NA	Y	NA	NA
2	B	Recycled non-thermal copy paper	N	NA	Y	NA	NA
3	C	Higher education bookstore	Y	Y	Y	Y	Y
4	D	Public park registration	Y	Y	Y	N	N
5	E	Pay at counter cafe	Y	Y	Y	Y	N
6	F	Full service restaurant	Y	Y	Y	N	N
7	G	Pay at counter cafe	Y	Y	Y	N	N
8	H	Pay at counter cafe	Y	Y	Y	N	N
9	I	Full service restaurant	Y	Y	Y	N	N
10	J	Small grocery	Y	Y	Y	Y	Y
11	K	Higher education dining	Y	Y	Y	N	N
12	L	*Full service restaurant	Y	Y	Y	NA	NA
13	L1	Pay at counter cafe	Y	Y	Y	Y	Y
14	M	Sports facility	Y	Y	Y	N	N
15	N	Pay at counter cafe	Y	Y	Y	Y	Y
16	O	Music performing arts venue	Y	Y	Y	N	N
17	P	Pay at counter cafe	Y	Y	Y	N	N
18	Q	Small grocery (2 stores)	Y	Y	Y	Y	Y
19	R	Small grocery (2 stores)	Y	Y	Y	Y	Y
20	S	Full service restaurant	Y	Y	Y	N	N
21	T	Full service restaurant & pay at counter cafe	Y	Y	Y	N	N
22	U	Full service restaurant	Y	Y	Y	N	N
23	V	Recycled non-thermal copy paper	N	NA	Y	NA	NA
24	W	** Pay at counter coffee shop	Y	Y	Y	Y	Y

No.	Code	Description	Partner	Provided baseline paper use	Paper tested	Took new action	Provided post-action data
25	X	Pay at counter restaurant	N	N	N	Y	N
26	Y	** Pay at counter restaurant	Y	Y	Y	Y	Y
27	AA	Public park registration	Y	Y	Y	N	N
28	BB & CC	Retailer	N	N	Y (2)	Y	N
		TOTAL:	23	23	28	11	8

* Paper was bond, not thermal ** Received project grant Y=yes N=no NA=not applicable

Table 2: BPA and BPS detected in thermal paper receipts (second round of testing)

Business	BPA (µg/cm^2)	BPS (µg/cm^2)	Rolls/Year	cm^2/Roll	Total BPA/ BPS (kg/year, est.)	Total BPA/BPS (lb/year, est.)
AA	<	60	360	14,806.42	0.32	0.70
BB	Data not usable. Not sampled by protocol.					
CC	Data not usable. Not sampled by protocol.					
L1	<	58	400	53,225.68	1.23	2.72
W	<	57	700	8709.66	0.35	0.76
Y	<	74	1350	55,645.03	5.56	12.23

< Indicates less than reporting limit

Table 3 shows the projected annual reductions for just the eight partners that provided follow-up data after taking action. The eight partners that took action reported reductions that, over a year, would total just over 7,300 pounds of paper and 109 pounds of BPA and BPS.

The final net totals of pounds of chemical and paper projected to be reduced annually were dramatically affected by the reductions of one large thermal paper user, which estimated that it reduced over 80% of thermal paper and associated chemical developer from 10,400 rolls of paper/year to just 1,700 per year – an estimated reduction of 6,000 pounds of paper and almost 95 pounds of BPS. The partners in this project ranged greatly in size and type of operations. As a result, the potential for reduction also varied widely. Detail of the calculations appears in Appendix A.

To provide context for interpretation, the Tolerable Daily Intake of BPA has been set in the United States at 50 micrograms per kilogram of body weight per day, and aquatic studies look at impacts of BPA concentrations in “parts per billion” or “parts per trillion”. It is thus perhaps somewhat striking to consider quantities of free unbound endocrine-active chemicals in terms of “pounds” and percentages like 1-2.5% by weight (equal to “parts per hundred”).

In discussing the projections, it is important that readers understand the limited data on which these rough projections of chemical reductions are made. The tests themselves provide an accurate snapshot of the chemical concentration of the roll of paper sampled. The tests were conducted according to the QAPP and the field duplicate tests yielded relative percent differences of 1.6, 4.3, and 8.8% making the data usable. Our test results (BPA or BPS at concentrations of 1-2.5% of mass of the paper and tens of milligrams per gram of paper) were similar to findings from thermal paper tests reported by others (Biedermann, et al, 2010; Hormann, et al. 2014 Lunder et al, 2010; Mendum et al. 2011).

Each paper sample was tested once, not multiple times from different rolls. The projections assume that the concentration of chemical developer is consistent through all rolls used in a year. In reality, there may be variation in the concentration of chemical coating on thermal papers in different production runs, or even within a single roll. The projections also assume that the same paper would be used over

the whole year. However, if a business' paper supplier sourced paper from more than one converter or manufacturer, the type of chemical developer on the paper could change without the business knowing that.

Because of the assumptions on which the projected source reduction results are based, they are rounded to whole numbers so as not to give any false impression of detailed precision. We are confident, however, of the order of magnitude of the projections, and that if businesses take similar actions to reduce thermal receipt paper use they will get similar percentage chemical and thermal paper reductions.

Table 3: Estimates of annual chemical and paper reductions as a result of business actions

Business ID	Chemical reduction (lb/year)	Chemical reduction (%/year)	Paper reduction (lb/year)	Action(s) taken
BPA				
J	2	38	170	Stopped printing receipts when customers declined them. (This business also began offering e-receipts, but too late in the project to track any additional reduction.)
BPS				
C	94	83	6,020	Stopped printing merchant copies of receipts.
L1	1	35	78	Stopped printing duplicate receipts.
N	1	8	73	Began only printing customer receipts if requested.
Q	4*	33	415	Stopped printing receipts when customers declined them and switched to double-sided thermal paper (which reduces paper use, but not chemical use). *This reduction is based on the initial single-sided paper they started with and the reduction they reported after they made the change in operations, prior to switching to the double-sided thermal paper (with unknown chemical composition).
R	2**	11	227	Began offering e-receipt or no-receipt option to member-owners in April 2014. **This is a conservative estimate based on first quarter change when 173 customers were using e-receipts. Within 3 months, 707 customers were using e-receipts and paper/chemical use continued to drop.
W	1	99	83	Installed new POS system, using ShopKeep, and began offering e-mail and no-receipt options. New system eliminated need to print merchant copies as well. Virtually eliminated thermal paper use.
Y	4	30	243	Began asking if customers want receipt. Estimated 60% decline. Also implemented an e-receipt option-which is rarely requested.
Totals:	109		7,309	

With over 7,300 pounds of paper and an estimated 109 pounds of BPA/BPS use reduced by just eight businesses, it is clear that there is potential for pollution prevention through active promotion of strategies for using less thermal receipt paper.

If the remaining 14 project partners who reported baseline data were to take similar actions, we estimate that an additional 1,052 – 3,155 pounds of paper and 12-36 pounds of chemical use would be reduced (BPA & BPS combined), based on their achieving a 10-30% reduction from their current practices.

It is hard to estimate the potential for reduction nation-wide if concerted action to reduce use of thermal paper were undertaken at a broad scale. Using published European Union and United States thermal paper production amounts and industry estimates of thermal paper consumption, MPCA estimates that US thermal paper use may be in the vicinity of 146,000 tons annually. If the same 10-30% reduction from our effort were realized nationally, that would be 14,600 – 43,800 tons of paper source reduced. Assuming all the paper was 1.5% chemical developer by weight, that would result in 219-657 tons of reduced chemical use.

Impacts of business actions

What types of changes led to the reductions and how big a reduction bump can be expected from taking action?

Don't automatically give receipts that aren't wanted (8-37% reduction) -- The most common first action step for businesses was to stop printing customer receipts if they weren't wanted. In some cases, this meant simply having cashiers ask customers "do you want your receipt?" and not printing them if declined. In others, cashiers simply didn't print or mention receipts unless customers specifically asked for them.

At least two businesses thought their POS system required them to print customer receipts, but discovered otherwise with a simple call to the POS vendor, Catapult1. Not printing a customer receipt was an existing feature they could easily activate. Simply getting businesses to discuss the issue with their POS vendors can enable action, and often the POS vendor can provide onsite programming or other technical support to implement the change.

Several businesses that took this action found they cut about 30% of their paper use. One restaurant realized about an 8% drop in paper use. In this case however, the restaurant had also just reopened after a renovation and made a big marketing push; it is possible that the lower net reduction is in part a result of stronger sales traffic.

Don't print merchant receipts if they are kept electronically (50% or more reduction) -- In the case of one partner, the business had been printing customer receipts, merchant receipts, and long receipts that contained the whole text of rental agreements for rented goods. When they recognized that their POS system already kept an electronic copy of the merchant receipts and stopped printing them, they cut back significantly on the need for thermal paper.

This operational change not only reduced paper and chemical use, but increased efficiency and reduced employee exposure to the chemicals because the merchant receipts had previously been counted and sorted up to three times at day's end.

In the end, this partner reported an 83% reduction in paper use.

Switch to e-receipt (2-18% reduction) -- Two partners used small project grants to establish new POS systems and/or subscribe to software programs that would provide opportunity for e-receipts to

[1] Specific POS system providers are discussed in this paper as part of the description of actions taken by businesses. Such discussion does not represent endorsement of any particular company by MPCA or the State of Minnesota.

customers. These included ShopKeep and Transaction Tree. Two others worked with their POS provider to update their existing system (Catapult). Business E switched to Square with an iPad system for collecting signatures. Business X switched to Clover (hardware and software). In small cafes, customers were more likely to want no receipt at all than to take an e-receipt.

For one partner (a business of two mid-size groceries) that launched e-receipts and made no other changes, employees spent a month promoting the e-receipt option and registered some 700 customers for e-receipts. The result was 18% reduced paper use at one store, while the amount of paper stayed about the same in the other. The manager thought the difference in paper reduction was probably because increased sales in the second store was masking the reduction in paper.

In most cases, e-mail addresses need only be entered the first time, and after that, e-receipts are faster than printing receipts. Employees were happy to be able to offer e-receipts.

Switch to double-sided thermal paper (little or no chemical reduction; 40-50% or more paper reduction) -- Just one partner took this step. In combination with having switched to a receipt-on-request policy, switching to double-sided paper reduced their paper use by about 77%. Chemical reduction isn't maximized by use of double-sided paper though, since the chemical developer is applied to both sides, not just one. Cost wise, this was estimated to be a net neutral change; the paper costs about three times as much, but they are using 1/3 as much paper.

Switch to a non-phenol paper (near 100% BPA/BPS reduction; little or no paper reduction) -- This option does not source reduce thermal paper. In addition, there are significant data gaps about the health and environmental impacts of the alternative chemicals used in the available non-phenol thermal papers. However, the idea of moving away from known endocrine-active chemicals holds appeal for some businesses which are committed to the health and safety of their employees. Several smaller business partners considered a switch to a non-phenol paper but concluded that it was too expensive and instead invested their effort in source reducing paper use. For small businesses, changes in POS may be less involved, expensive and disruptive than for large businesses. For small businesses then, it is logical to reduce overall paper use and costs rather than moving to a more expensive paper.

For larger companies with many outlets where POS changes pose more complexities, the shift to a paper with no known reproductive toxicants, is a reasonable step, especially if taken with an understanding of the data gaps. (More information about the chemicals in non-phenol papers is found later in this section).

The actions taken by each business partner are detailed in Appendix B.

Other findings and options for targeting future hospitality sector assistance

Hospitality sub-sectors most likely to make changes

It is recommended that future assistance be targeted to hospitality businesses that are most likely to make changes: pay-at-counter cafes/restaurants, entertainment, and parks, or museums. In general, we found that pay-at-counter cafes and restaurants shifted to offering e-receipts or receipts-on-request relatively easily. Sit-down full-service restaurants and hotels may not be ideal primary assistance targets. Sit-down, full-service restaurants reported it was hard for them because of the nature of the interaction and the customer experience they wanted to promote. Because e-receipts often require tablets or smartphones, staff would need to remain tableside while a customer completed the transaction, which

restaurant owners deemed intrusive and contradictory to the overall "invisible service" that such restaurants strive to provide. The hotels and resorts approached for this project already offered electronic check out or provided the room receipt on non-thermal copy paper. (Retail and dining outlets within hotels and resorts, however, are still ripe for e-receipts.)

Communication to employees and customers

In cases where cashier employees already knew about the issue of BPA in thermal receipt paper, partners were eager to talk with employees and offer them information and strategies on how to reduce their potential exposure. In businesses where the issue had not been raised previously there was some hesitance to discuss it.

Methods that partners used to educate employees ranged from handing out strategies at a staff meeting to including the strategies in employee training manuals (Figure 1).

Several partners wrestled with how they should communicate their changes to customers. In general, they shied from discussing the hazardous chemicals on the papers in favor of emphasizing benefits like efficiency, reducing the annoyance and clutter of paper receipts, and the environmental benefit of reducing paper (Figure 2).

The MPCA was asked several times during the project if the Occupational Safety and Health Administration had any guidelines or role in protecting employees who handle a lot of thermal paper. Thus far the answer seems to be no, nor are papers routinely labeled with their chemical components. Safety Data Sheets (SDS), when they accompany thermal paper, do not list BPS or BPS. A chemical reaches the Hazard Communication Standard for physical health, which would require employers to communicate to employees, when there is "statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees" (https://www.osha.gov/dsg/hazcom/ghd053107.html, accessed November 21, 2014).

Safety:

In 2013, we partnered with the MPCA to examine BPA in our receipts. Most thermal receipts have BPA or BPS present. There is a risk for consumers and employees to consistently handle this chemical. Please see separate handouts from the Environmental Working Group and the MPCA.

In our efforts to lessen or stop the exposure to our employees, we have implemented an "OPT –OUT" of receipt option. You would choose this when you first enter a member's number. At any point, the customer may have their receipt reprinted. For members, we have their sales history available online and can look up items if they wish to do a return. We have permanently "Opted-out" of receipts for our reciprocating Co-ops. Again, please reprint receipt if they need a copy. We encourage you to speak with our consumers about opting out of receipts in general to lessen your exposure and lessen our paper waste.

In addition, please consider the following:

a. Refrain from utilizing alcohol based hand sanitizer and then handling receipts.
b. Do not crumple receipts; simply place them in our recycling containers.
c. Do not store receipts in wallets/purses/aprons.

Figure 1. Excerpt from employee training manual for mid-size grocery

One paper manufacturer's 2010 SDS, for all of its thermal papers, explained that thermal paper is considered an "article" by OSHA. An "article" is defined as

"… a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal

conditions of use does not release more than very small quantities, *e.g.*, minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees."

United States businesses are currently not required to discuss the potential occupational exposure to BPA or BPS through handling thermal papers, and some businesses seem hesitant to do so. Thus, government and relevant non-profit organizations can fill the gap in educating citizens and employees about the potential exposure to endocrine active compounds on many thermal papers.

Changing wait staff and food-handling procedures

Another potential target for focus and assistance is food preparation operating procedures where thermal paper comes in direct contact with food and the hands of food handlers. MPCA staff observed pizza restaurants where the thermal paper food order receipt is handed to food prep staff. They then assemble part of the pizza, place the receipt on the pizza and hand it to the next food prep employee, who repeats the process. Research on handling paper with oily fingers and then handling and eating food (Hormann et al, 2014; Biedermann, et al. 2010) suggest that this process is likely to be directly transferring chemical to the food both from the hands of staff and from the receipt to the food. In other instances, thermal paper is intentionally wetted to stick to drinking glasses, which would leave chemical behind on hands and food ware. Biedermann et al (2010) found that wet fingers could increase transfer to skin from about 1 microgram to 36-46 micrograms.

It is common for thermal paper to be used to track order preparation in kitchen lines. Some of the partners in this project used bond paper for this use, which would reduce risk of chemical transfer to food because it does not have chemical developers. More emphasis on alternative kitchen practices that would minimize use or handling of thermal papers is warranted.

Cost savings

In general, making changes to reduce paper use saved money. Reducing paper use reduced costs for partners in parallel percentages – 30% less paper use equaled 30% less cost in paper purchases. Other cost impacts depended on the change implemented. In cases where a feature of an existing POS system was activated, there was no charge for the activation. Installation of tablet-based systems like ShopKeep and Square require $1,000-$1,500 of investment for equipment for a 1-register business, and may require a

Fewer Receipts

Beginning in April, member-owners will be able to sign up for emailed receipts. All you'll need to do is give us your email address (if we don't have it already) and let your cashier know that you'd like to have your receipts emailed as the default. This means less paper AND less energy is used for each transaction!

Need your receipt for a return? Just show us your receipt on a smartphone or print the receipt from your email.

Reduce Receipt Clutter

Did you know it's easy for member-owners to opt out of receiving your receipt at checkout? The next time you're in, simply let the cashier know and the choice will be noted on your member account. If you need your receipt for any reason, a team member can assist you. This one decision provides the co-op with another avenue to positively impact the environment as fewer receipts end up in landfills. Also, look for information in early Fall regarding the option to receive receipts via email.

Figure 2. Examples of business communications to customers

monthly subscription fee for the e-receipt software. However, businesses making this change reported a return on investment of just four months to two years. One coffee shop reported saving $300/month, another $720 a year. In one case, there was no net financial change - the subscription to the e-software was about the same as the cost savings from buying less paper.

Costs could increase if a business decides to purchase a more expensive non-phenol paper and not take any paper reduction actions.

Thermal paper innovations

There are now non-phenol papers on the market. However, not all thermal paper makers are forthcoming about the chemical content of the newer papers and there remain data gaps about the health and environmental impacts of some of the non-phenol chemical alternatives (EPA, 2014).

Pergafast, urea urethane, and ascorbic acid are some of the non-phenol alternatives that seem to be in use. Pergafast and urea urethane were evaluated as part of the EPA alternatives assessment. Ascorbic acid was not.

> United States thermal paper manufacturer Appvion (formerly Appleton Papers) launched their Alpha Free thermal paper which they claim uses "vitamin C" as the developer. The SDS shows the paper contains titanium dioxide and the patent shows the product contains 4,4'-diaminodiphenylsulfone which is used in antibiotic applications.

Pergafast 201 is manufactured by BASF (BASF, 2012) and is in use in thermal papers (Cancer Prevention and Education Society, 2012). While the EPA's assessment suggests that it would be expected to have little impact on the human endocrine system, it does pose environmental hazard as a toxicant to aquatic life.

Mitsubishi HiTec Paper Europe GmbH produces a BPA-free paper, but hasn't disclosed much information except that it uses urea-based compounds instead of phenols (Cancer Prevention and Education Society, 2012).

In the face of the uncertainty over chemical alternatives, some companies have chosen to take action in order to protect vulnerable employees and customers by moving away from types showing endocrine-disrupting effects. Each company's management must weigh the potential benefits, risks, and implementation issues within their company's unique context, and make their own decisions.

Conclusions

Opportunities and challenges

Based on the experience of businesses in this project, there are some opportunities and challenges that can be anticipated and perhaps managed.

1. Take advantage of remodeling or building new facilities to change or install new POS systems. It is easiest to install the POS system or make changes to the POS system when there is a break in the action or when building a new facility.
2. Provide information in short, easily accessed pieces. In the hospitality business, the work is constant. We found that short videos, electronically-provided tips and ideas were appreciated over meetings. The exception might be conferences, where longer form information might succeed.
3. Ask questions of existing POS vendors. In this quickly-changing field, several businesses found that when they asked for more options, their vendors either already had features or new options were

coming soon. Asking vendors has the added benefit of proving market demand for no-receipt and e-receipt options.

4. Connect POS vendors to business owners. Because small hospitality businesses are so busy, having a third party help research the type of systems that might work for them can be helpful. Lack of time to research options was a common challenge.
5. Connect businesses to one another. Sharing case studies or connecting businesses to other businesses that have made changes is helpful.
6. Have patience. The changes may require input from many staff functions including counter operations, information technology, purchasing, communications, health and safety, and environmental sustainability.
7. Legal considerations. For consumers, the IRS has determined that e-receipts are acceptable for tax records. Businesses or those promoting e-receipts may want to check the rules in their state. Fifteen states and the District of Columbia have laws that restrict the information that may be collected by a retailer from a customer when the customer is paying by credit card and may prohibit collection of personal information. There have been questions raised in California recently as to whether an email address is considered personal information. In most cases, it seems these laws predated e-receipts and that e-receipts can be implemented legally, but it is wise for any business to investigate the rules in their state prior to shifting to electronic receipts.

Transferability to other sectors

There is no reason that promotion and outreach to businesses regarding thermal paper reduction need be limited to the hospitality sector. Most retail and service transactions involve receipts and most are on thermal paper. Service industries like airlines, libraries, and others have traditionally been heavy users of thermal paper, but are making electronic options more and more available. Large grocery chains are a sector using a lot of thermal paper and where e-receipt options are not yet widely offered. This project included several smaller grocery stores and suggests that having customer purchases kept electronically by the merchant, having the option to decline a receipt, or offering e-receipts could result in 10-30% reduction in that sector. Many retail businesses are already offering e-receipts or have the capacity to do so - Macy's, Home Depot, Nordstrom's, and Walgreens among them – but they are not making significant efforts to promote the option.

At a Walgreens store in Minneapolis, when an employee was asked if e-receipts were an option, MPCA staff was told "no", only to have a manager step in and correct the employee. Apparently there is an e-receipt option, but it is not routinely offered. At Home Depot, customers may request an emailed receipt, but will still automatically get a paper copy as well.

POS systems are not all alike. Those researched during this project are geared toward the hospitality sector. There are specialty POS systems that are specifically geared toward retail, to grocery, and to service sectors. Thus, future work would include tailoring POS vendor lists to the sector of interest.

Because businesses are not universally motivated to promote one type of receipt over another or to communicate about the chemicals in thermal papers, it will fall to government and non-governmental organizations to encourage increased promotion of e-receipt options where they are underutilized and to educate citizens so they can make informed decisions.

For this same reason, another target population for government or NGO outreach should be the most at-risk or vulnerable employee populations. These include teenage workers still developing, women who are pregnant or nursing, and women trying to become pregnant. As mentioned earlier, endocrine active chemicals seem to have larger relative effects on developing fetal systems, infants, and those in puberty.

In summary

This project showed that measureable reductions in BPA and BPS and thermal paper can be achieved through outreach and education to the businesses that use them. Technology substitution and changes in operational procedures were able to achieve pollution prevention results. Scaled up and shared with other sectors as well as with cashier employee groups, consumer safety groups, and citizens, this sort of assistance project has potential to make broader change and larger reductions. Local and state governments and non-governmental organizations as well as sector trade organizations are all potential diffusers of the **tools and information developed** from this project.

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Calafat, A. M., Ye, X., Wong, L.-Y., Reidy, J. A., & Needum, L. L. (2008). Exposure of U.S. Populations to Bisphenol A and 4-tertiary-octylphenol: 2003-2004. *Environmental Health Perspectives, 116*(1), 39-44.

Cancer Prevention and Education Society (2012) Just the ticket? Alternatives to BPA in receipt paper. http://healthandenvironmentonline.com/2012/08/06/just-the-ticket-alternatives-to-bpa-in-receipt-paper/ Published Aug 6, 2012. Accessed 11/23/14

Environmental Protection Agency (2014). Bisphenol A alternatives in thermal paper. http://www.epa.gov/dfe/pubs/projects/bpa/bpa-report-complete.pdf

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Geens, T., Goeyens, L., & Covaci, A. (2011). Are potential sources for human exposure to bisphenol-A overlooked? *International Journal of Hygiene and Environmental Health, 214*, 339-347.

Geens, T., Goeyens, L., Kannan, K., Neels, H., & Covaci, A. (2012). Levels of bisphenol-A in thermal paper receipts from Belgium and estimation of human exposure. *Science of the Total Environment, 435-436*, 30-33.

Geens et al (2012) also reported finding BPA in 73% of the thermal papers they tested at concentrations of .9 and 2.1% or 9-21 mg BPA/g paper. The other papers had very low concentrations, below .01%. This study did not test for other chemical developers. They estimated daily exposure of 445 ng BPA/day day (or 6.4 nanograms/kw bw/day) for the general public (about 4 orders of magnitude lower than the current TDI 50 micrograms/kg bw/). They report that exposure through canned food and beverages range from 15-48 ng/kg bw/day while thermal paper exposure could range from 6.4-18.6 ng/kg bw/day.

Hormann, A.M., vom Saal, F.S., Nagel, S.C., Stahlhut, R.W., Moyer, C.L., Ellersieck, M.R., Welshons, W.V., Toutain, P-L., & Taylor, J.A. (2014). Holding Thermal Receipt Paper and Eating Food after Using Hand Sanitizer Results in High Serum Bioactive and Urine Total Levels of Bisphenol A (BPA). *PLoS One*, 9(10): e110509. Doi: 10.1371/journal.pone.0110509.

Found that handling receipts after applying hand sanitizer with dermal penetration enhancing chemical (and not letting it dry completely) can increase absorption of BPA up to 100 fold. They also tested the scenario of applying hand sanitizer, handling a receipt, and then holding and eating greasy food and found that the combination of dermal and orgal BPA absorption increased bioactive BPA in blood and urine.

Kang, J-H., Aasi, D., & Katayama, Y. (2007). Bisphenol A in the Aquatic Environment and Its Endocrine-Disruptive Effects on Aquatic Organisms. *Critical Reviews in Toxicology*, 37:607–625, 2007

Kim, J. & Rohmer, S. (2012). Electronic billing vs. paper billing: Dematerialization, energy consumption and environmental impacts. Electronics Goes Green 2012+ (EGG), Conference proceedings, IEEE.

Liao, C., & Kannan, K. (2011). Widespread Occurence of Bisphenol A in Paper and Paper Products: Implications for Human Exposure. *Environmental Science and Technology*, 9372-9379.
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From the abstract: "All thermal receipt paper samples (n = 111) contained BPS at concentrations ranging from 0.0000138 to 22.0 mg/g (geometric mean: 0.181 mg/g). The overall mean concentrations of BPS in thermal receipt papers were similar to the concentrations reported earlier for BPA in the same set of samples. A significant negative correlation existed between BPS and BPA concentrations in thermal receipt paper samples ($r = -0.55$, $p < 0.0001$). BPS was detected in 87% of currency bill samples (n = 52) from 21 countries, at concentrations ranging from below the limit of quantification (LOQ) to 6.26 μg/g (geometric mean: 0.029 μg/g). BPS also was found in 14 other paper product types (n =105), at concentrations ranging from <LOQ to 8.38 μg/g (geometric mean: 0.0036 μg/g; detection rate: 52%). The estimated daily intake (EDI) of BPS, through dermal absorption via handling of papers and currency bills, was estimated on the basis of concentrations and frequencies of the handling of papers by humans. The median and 95th percentile EDI values, respectively, were 4.18 and 11.0 ng/kg body weight (bw)/day for the general population and 312 and 821 ng/kg bw/day for occupationally exposed individuals. Among the paper types analyzed, thermal receipt papers were found to be the major sources of human exposure to BPS (>88%).

Lu, S.-Y., Chang, W.-J., Sojinu, S. O., & Ni, H.-G. (2013). Bisphenol A in supermarket receipts and its exposure to human in Shenzhen China. *Chemosphere, 92*, 1190-1194.

Determined BPA concentrations in supermarket point of sale receipts collected from 42 supermarkets in Shenzhen China. BPA was detected in all samples with concentrations ranging from 2.58 to 14.7 mg/g (mean 9.38 mg/g). Using these concentrations and handling assumptions for the public and cashiers, the median estimated exposures of BPA were 0.69 μg/day and 40.4 μg/ day, respectively.

Lunder,S., Andrews,D., &Houlihan, J. (2010). BPA Coats Cash Register Receipts. Environmental Working Group. http://www.ewg.org/bpa-in-store-receipts Accessed 11/13/2014.

Mendum, T., Stoler, E., VanBenschoten, H., & and Warner, J. C. (2011, March). Concentration of bisphenol A in thermal paper. *Green Chemistry Letters and Reveiws, 4*(1), 81-86.

Used gas chromatograph/flame ionization detector to analyze concentration of BPA in 10 blank thermal paper receipts. Found BPA concentrations of .3% to 1.7% (g BPA/100g of paper). Two of the 10 papers analyzed were below the limit of detection. BPS was not tested for.

Michalowicz, J. (2014). Bisphenol A - Sources, toxicity and biotransformation. *Environmental Toxicology and Pharmacology, 37*, 738-758.

Minnesota Pollution Control Agency (2014). *BPA and BPS in Thermal Paper: Results of Testing in Minnesota Hospitality Industry*. http://www.pca.state.mn.us/index.php/view-document.html?gid=20831

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This study reviewed research literature published since 2007 on topic of BPA and reproductive health and concluded that because of evidence of ovarian, uterine, and testicular impacts, that BPA is a reproductive toxicant.

Porras, S.P., Heinala, M., & Santonen, T. (2014) Bisphenol A exposure via thermal paper receipts. Toxicology Letters, Volume 230(3) , Pages 413–420

Rigol, A., Latorre, A., Lacorte, S., & Barcelo, D. (2002). Determination of toxic compounds in paper-recycling process waters by gas chromatography-mass spectrometry and lquid chromatography-mass spectrometry. *Journal of Chromatography A, 963*, 265-275.

Rochester, J.R. (2013). Bisphenol A and human health: A review of the literature. *Reproductive Toxicology*. 42 (2013),132-155.

Vandenburg, L. N., Ehrlich, S., Belcher, S. M., Ben-Jonathon, N., Dolinoy, D. C., Hugo, E. R., et al. (2013). Low Dose effects of bisphenol A An integrated review of in vitro, laboratory animal, and epidemiology studies. *Endocrine Disruptors , 1*, e25078-1 - r25078-20.

Viñas, R., & Watson, C.S. (2013). Bisphenol S Disrupts Estradiol-Induced Nongenomic Signaling in a Rat Pituitary Cell Line: Effects on Cell Functions. *Environ Health Perspect*; DOI:10.1289/ehp.1205826, vol. 121(3).

The authors conclude, "BPS, once considered a safe substitute for BPA, disrupts membrane-initiated E_2-induced cell signaling, leading to altered cell proliferation, cell death, and prolactin release."

Weber, C. L., Koomey, J. G. and Matthews, H. S. (2010), The Energy and Climate Change Implications of Different Music Delivery Methods. Journal of Industrial Ecology, 14: 754–769. doi: 10.1111/j.1530-9290.2010.00269.x

Appendix A: details of reduction calculations

Red text denotes reductions.

	B	C	D	E	F	G	H	I	J	K	L
				C X D X 1/12 X 929.03		**B X E X F**	**G/1,000,000**	**H/1000**	**I X 2.2**	**Baseline # of rolls - Post Data # of rolls/Baseline # of rolls x 100**	
Business	Number of rolls/yr	width of roll	length of roll	area of roll	BPA/BPS concentration detected	BPA/BPS annually				Chemical and paper reduction from baseline	Paper reduction
		in	ft	cm^2/roll	µg/cm^2	µg/yr	gr/yr	kg/yr	lb/yr	%	lb/yr
C (baseline)	10,400	3.125	273	66,048.23	75	51,517,616,719	51,517.62	51.52	113.34		
C (post data)	1,700	3.125	273	66,048.23	75	8,421,148,887	8,421.15	8.42	18.53		
C (net reduction)	8,700	3.125	273	66,048.23	75	43,096,467,832	43,096.47	43.10	94.81	84	6020
J	800	3.125	220	53,225.68	57	2,427,090,875	2,427.09	2.43	5.34	na	
J	500	3.125	220	53,225.68	57	1,516,931,797	1,516.93	1.52	3.34	na	
J	300	3.125	220	53,225.68	57	910,159,078	910.16	0.91	2.00	38	170
L1	400	3.125	220	53,225.68	58	1,234,835,708	1,234.84	1.23	2.72		
L1	262	3.125	220	53,225.68	58	808,817,389	808.82	0.81	1.78		
L1	138	3.125	220	53,225.68	58	426,018,319	426.02	0.43	0.94	35	78
N	1,560	3.125	200	48,386.98	44	3,321,282,250	3,321.28	3.32	7.31		
N	1,430	3.125	200	48,386.98	44	3,044,508,729	3,044.51	3.04	6.70		
N	130	3.125	200	48,386.98	44	276,773,521	276.77	0.28	0.61	8	73

Q	2,600	3.125	220	53,225.68	41	5,673,857,177	5,673.86	5.67	12.48		
Q	1,742	3.125	220	53,225.68	41	3,801,484,309	3,801.48	3.80	8.36		
Q (one-sided paper, post data)	858	3.125	220	53,225.68	41	1,872,372,868	1,872.37	1.87	4.12	33 (chemical reduction)*	
Q2 (new double-sided paper, post data)	600	3.125	273	66,048.23	unknown					77 (paper reduction)**	415
R	3,600	3.125	220	53,225.68	38	7,281,272,625	7,281.27	7.28	16.02		
R	3,200	3.125	220	53,225.68	38	6,472,242,333	6,472.24	6.47	14.24		
R	400	3.125	220	53,225.68	38	809,030,292	809.03	0.81	1.78	11	227
W	700	2.25	50	8709.66	57	347,515,284.38	347.52	0.35	0.76		
W	10	2.25	50	8709.66	57	4,964,504.06	4.96	0.00	0.01		
W	690	2.25	50	8709.66	57	342,550,780.31	342.55	0.34	0.75	99	83
Y	1,350	3.125	230	55,645.03	74	5,558,938,102	5,558.94	5.56	12.23		
Y	945***	3.125	230	55,645.03	74	3,891,256,671	3,891.26	3.89	8.56		
Y	405****	3.125	230	55,645.03	74	1,667,681,430	1,667.68	1.67	3.67	30	227

*Chemical reduction based on estimated paper reduction of 1/3 (33%)

** Changed to doubled sided thermal paper, of unknown chemical, which cut paper use by another 50+%

*** Estimated post change use (calculated before business sales growth).

**** Reduction based on prior year pre-growth. In 2014, they would've used at least 405 rolls more than they are now.

Appendix B: details of business actions

Business C: College/university bookstore

POS system: Ratex Business Systems

Business changes:

1. Eliminated paper merchant receipts. This business realized that because merchant copies of sales receipts were kept electronically, they didn't need to be printed as well, and in August, 2013, stopped printing merchant copies of receipts. This reduced the amount of paper used and reduced the handling of merchant receipts. Previously, employees sorted merchant copies into three bins as the receipts were issued, and then re-sorted them at the end of the day for quality control. Each merchant receipt was handled three times.
2. Requested e-receipt capability in POS software update. Because the POS system code was being updated, this business requested that the update include an option for e-receipt to allow for digital receipts at a future date.

Possible future actions:

1. Educate employees. Employees of this business are often young women of childbearing age, one of the target populations for reducing exposure to BPA because of mounting evidence that fetal exposure can cause significant health impacts.
2. Eliminate paper rental receipts. Upon renting books, customers currently get copies of rental receipts, which are quite long because they include the whole rental agreement. This business was considering not printing a copy for the customer, since the rental record is also stored electronically for the merchant.

Barriers:

1. Customers' receipts needed for theft prevention. Receipts are often checked at the door if a book's security tag should trip the sensor. For this reason, it is current policy that employees must give receipts.

Baseline:
Pounds of paper: 7,196
Pounds of chemical: 113 (BPS)
Cost of paper: Unknown

Business D: Public park reservation system

POS system): Unknown.

Business changes: None.

Potential changes: Issue e-receipts.

Barriers: This business was under contract with their current POS system vendor for five years, so was not at liberty to make changes to e-receipts.

Baseline:
Pounds of paper: 1,950
Pounds of chemical: 19.89 (BPS)
Cost of paper: Unknown

Business E: Pay-at-counter cafe

POS system: Unknown initial system. Switched to Square.

Business changes:

1. This business made two changes prior to this project. They began issuing receipts only on request. The POS system was reconfigured so that for a cash transaction a "print receipt" button pops up on the screen. They provide receipts only upon request from the customer. Only about 5% of customers ask for receipts. Employees found the new process intuitive and adapted easily.
2. The second change was they reduced number of words on receipts. For credit card transactions they shortened the language on the receipts so that less paper is used.
3. During this project, they switched their POS system to Square, now allowing e-receipts.

Possible future changes: Change POS systems to allow for e-receipts.

Barriers: The merchant copy of the receipt is still printed to capture the signature.

Baseline:
Pounds of paper: 330
Pounds of chemical: 5.32 (BPA)
Cost of paper: Unknown

Business F: Full service restaurant

POS system: Unknown.

Business changes: None.

Possible future changes: None.

Barriers: Staff changed between the time the project was introduced and the time the test results were returned to them. New staff was less interested in making changes.

Baseline:
Pounds of paper: 60
Pounds of chemical: .63 (BPA)
Cost of paper: Unknown

Business G: Pay-at-counter cafe

POS system: Unknown.

Business changes:

1. Shared exposure reduction strategies with employees.

Possible future changes:

1. E-receipts using iProcess: The owner used iProcess for off-site events, a system which allowed for e-receipts. He thought he would be able to use iProcess for the café as well, but wasn't going to implement any changes until a remodel planned for 2015.

Barriers: Waiting for 2015 remodel of café interior to make changes to POS system.

Baseline:
Pounds of paper: 18.7
Pounds of chemical: .15 (BPS)
Cost of paper: Unknown

Business H: Pay-at-counter café/restaurant

POS system: Unknown.

Business changes: None.

Possible future changes: None identified.

Barriers: Staff changed between the time the project was introduced and the time the test results were returned to them. The restaurant was also expanding.

Baseline:
Pounds of paper: Unknown, not provided.
Pounds of chemical: Paper contained BPA. Amount used is unknown, insufficient data to calculate.
Cost of paper: Unknown.

Business I: Full service bar/restaurant

POS system: Dinerware POS. The system allows them to issue one or two receipts, but they must issue at least one receipt. They can't let diners opt out of a receipt.

Business changes: None.

Possible future changes:
1. Education for wait staff about better receipt handling habits.
2. Changing POS systems to one that allows duplicate receipt override for when customers don't want them.

Barriers: This business used paper for daily sales record for individual staff and for the restaurant as a whole, and for daily time records of employees. Restaurant would need a digital system that kept all this data. Our contact stated "I looked into some iPad type POS that would allow us to do paperless transactions but the cost was too high and to get them to interface with existing technology was daunting." This small chef-owned/operated restaurant needed more consultation about options and information technology (IT) support to make a switch simple.

Baseline:
Pounds of paper: 727
Pounds of chemical: 9.4 (BPA)
Cost of paper: $1,139

Business J: Mid-size grocery

POS system: Catapult POS.

Business changes:

1. Incorporated information about better thermal paper handling behaviors into staff training manual.
2. Activated POS system's "no receipt" feature. Upon inquiry to their POS vendor, they found out they already had a feature for "no receipt". The business activated the feature, at no cost, and began offering the option for customers to decline a paper receipt.
3. Began offering e-receipts. Worked with POS system and IT staff to begin offering e-receipts.
4. Advertised no-receipt option to customers through newsletter.

Possible future changes: Additional promotion of e-receipts through marketing to customers.

Barriers: Few. This business was health and environment focused to begin with and motivated to make changes. Staff and employees were eager to make changes. The main barrier was in finding time to work with the IT staff and get the new e-receipt offering to integrate with the larger computer records system and firewalls.

Baseline:
Pounds of paper: 454
Pounds of chemical: 5.34 (BPS)
Cost of paper: Unknown

Business K: Higher education dining

POS system: Unknown.

Business changes: None.

Possible future changes: Eliminate automatic printing of duplicate receipts for customers.

Barriers:

1. A contracted vendor runs the dining services and this was not a priority for them.
2. Competing work projects.

Baseline:
Pounds of paper: 3,240
Pounds of chemical: 28.14
Cost of paper: Unknown

Business L1: Pay-at-counter restaurant (one of eight dining establishments with same ownership; L1 – L8)

POS system: Unknown.

Business changes:

1. Receipt only on request. This business modified its POS system to not automatically print duplicate receipts, and instead they give out paper receipts only upon customer request. This resulted in 37% paper reduction. Same will be implemented at two other businesses in the group that use thermal papers. (Some of the businesses use bond paper).

Possible future changes:

1. Implement receipt only on request at the two other businesses in the group that use thermal papers. (Other use bond paper).

Barriers: None.

Baseline:
Pounds of paper: 227
Pounds of chemical: 2.7 (BPS)
Cost of paper: $480

Business M: Professional sports venue

POS system: Unknown.

Business changes:

1. No receipts for purchases under $50 at most concessions. Prior to this project, the sports venue had already taken several steps; including programing POS systems at most concessions so that no signed copy was needed for small purchases and no customer receipts are generally printed. A merchant copy of the receipt, without signature, is still printed for record keeping.
2. E-receipts. At gift stores, this business used the "line busting" strategy of having personnel use handheld POS systems on the floor for making sales and providing e-receipts. This system proved faster than doing all counter sales.

Possible future changes: None.

Barriers: None.

Baseline:
Pounds of paper: 2,250
Pounds of chemical: 34
Cost of paper: unknown

Business N: Pay at counter restaurant

POS system: Unknown.

Business changes:

1. Receipt upon request. Prior to the project, this business had to print a guest receipt for every credit card customer. They reprogrammed their existing point-of-sale system which gave them more flexibility in printing receipts. Now, they no longer automatically print a copy of a credit card receipt for a guest; they only print one if the customer asks for it. They continue to print merchant copies.
2. Saved $195/year in paper purchases.

Possible future changes:

1. Switch to e-receipts. POS vendor changes, coming in Summer/Fall 2015, will allow a paperless receipt / e-receipt option.

Barriers: They waited to make POS changes until they were closed for remodeling to take advantage of that downtime to work through the system changes.

Baseline:
Pounds of paper: 873.6
Pounds of chemical: 7.3 (BPS)
Cost of paper: $2,283

Business O: Non-profit entertainment and concert venue

POS system: Unknown.

Business changes: None.

Possible future changes:

1. Reprogram current POS system to not automatically print customer copy of receipt.
2. With facility upgrade, add POS with hand-held device and e-receipt option to help business pull in e-mail addresses for future marketing of events.

Barriers:
1. Other pressing demands on time, including a fundraising campaign for facility upgrades.
2. They don't use much paper.

Baseline:
Pounds of paper: 9.6
Pounds of chemical: .07 (BPS)
Cost of paper: Unknown

Business P: Pay-at-counter café and health-food shop

POS system: Unknown.

Business changes:
1. Shared handling strategies with employees.
2. Reviewed POS capabilities.

Possible future changes:
1. Could switch to e-receipt POS system in café portion of business.

Barriers: None.

Baseline:
Pounds of paper: 30
Pounds of chemical: .42 (BPA)
Cost of paper: Unknown

Business Q: Mid-size grocery

POS system: Unknown.

Business changes:

1. Educated employees about chemicals in thermal paper (beginning in 2009, pre-dating this project).
2. Receipt upon request. This business instructed cashiers to ask customers if they wanted a receipt, and if declined, no receipt was printed. This change resulted in reduction of about 33% of paper use.
3. Switched to double-sided thermal paper, which reduces the total amount of paper needed, but costs 3 times as much as the single-sided. This resulted in about a 77% reduction in paper use.

Possible future changes:
1. Change POS systems to allow for e-receipts.

Barriers:
Current POS system does not allow for e-receipts of any kind. Staff is occupied with planning and building a second store, where they hope to have e-receipts in place at store opening.

Baseline:
Pounds of paper: 1,477
Pounds of chemical: 12.48 (BPS)
Cost of paper: Unknown

Business R: Two mid-sized grocery stores

POS system: Catapult.

Business changes:
1. Established e-receipt option via a no-cost upgrade to their existing POS software.
2. Trained employees on how to issue e-receipts.
3. Gave employees information about BPA and BPS in thermal paper and tips for better handling habits.
4. Employees actively promoted e-receipt option to customers.
5. Created customer-facing communication about e-receipts.
6. Reduced overall chemical and paper use by 11% across two stores.

Possible future changes:
1. Continue to promote e-receipts with customers.

Barriers:
1. Considered switching to a phenol-free paper, but found it cost prohibitive.
2. E-receipts are only an option for co-op member customers; non-members do not have this option.

Baseline:
Pounds of paper: 2,045
Pounds of chemical: 16 (BPS)
Cost of paper: Unknown

Business S: Sit down restaurant in residential hotel

POS system: Unknown

Business changes:
1. Shared selected behavioral strategies with their employees.

Possible future changes:
1. Subscribe to a software service that allows electronic receipts.

Barriers:
1. Had purchased new POS system within the last five years and didn't think they could switch again so soon.
2. Concerns that asking for an e-mail address could add time and stress to the payment process. However, they considered asking repeat customers and employees for feedback about the e-receipt idea.
3. The credit card customer receives both the itemized and credit card receipt. Manager felt e-receipts would be too much of a change in their operations/business model. Credit card payments are 70% to 90% of transactions.

Baseline:
Pounds of paper: 485
Pounds of chemical: 4 (BPS)
Cost of paper: Unknown

Business T: Sit down restaurant and carry out lunch counter

POS system: Unknown.

Business changes: None.

Possible future changes: Duplicate receipt reduction.

Barriers: Unknown.

Baseline:
Pounds of paper: 720
Pounds of chemical: 9 (BPA)
Cost of paper: Unknown

Business U: Resort restaurant

POS system: Unknown.

Business changes: None.
Possible future changes: None considered.

Barriers:
1. Resistance from manager.

Baseline:
Pounds of paper: 364
Pounds of chemical: 4 (BPA)
Cost of paper: Unknown

Business W: Coffee shop

POS system: Initial POS system unknown. Switched to ShopKeep.

Business changes:
1. Received MPCA grant for electronic transaction subscription service.
2. Bought $1,400 of iPad and subscribed to e-receipt software program.
3. Monthly subscription to ShopKeep is balances any savings with paper purchase costs.
4. No longer print any receipts and save $720/year by not having to lease credit card machine.
5. Eliminated need to print merchant and nearly all customer receipts. Ninety five percent of customers decline receipts. Two percent get e-receipts and about 3% get paper receipts. The small amount of thermal paper they still use (about 10 rolls a year, down from 700) is provided free to them from their new POS vendor.
6. Kept bond/ink printer for kitchen use.

Possible future changes: None.

Barriers: None.

Baseline:
Pounds of paper: 83
Pounds of chemical: 1 (BPS)
Cost of paper: $590/yr (estimated)

Business Y: Fast food franchise pay at counter

POS system: POSitouch Point of Sale (POS) system. Added subscription to Transaction Tree to offer e-receipt option.

Business changes:
1. Received grant from MPCA to subscribe to Transaction Tree, allowing them to offer e-receipts.
2. Asked POSitouch if there was an option for not printing receipts, and easily reprogrammed their POS system so that a receipt is not automatically printed with each transaction. Previously they printed receipts for every sale, 100% of the time. They now ask if customers want a receipt, and if not, it is not printed. About 60% of customers decline the receipt. (Affects 3 thermal receipt machines at counter).
3. Discussed paper handling strategies and tips at employee meeting.
4. Trained employees to offer e-receipts if a receipt is requested.
5. Owner reports “It was great to see how much paper we can eliminate the use of and to try different methods of reducing our waste and exposure to the thermal paper.”

Possible future changes: None.

Barriers:
1. Only about 1% of customers asks for or uses the e-receipt option.
2. Two thermal printers used in kitchen to track food orders remain unchanged.

Baseline:
Pounds of paper: 810
Pounds of chemical: 12 (BPS)
Cost of paper: Unknown

Business AA: Local park system

POS system: CLASS. Expect to change to RecTrack by Vermont systems.

Business changes:
1. This business already asked "Do you want a receipt?" as standard operating procedure for all transactions.
2. Business uses POGO currently to take payments at events (mobile system). POGO allows e-receipts.

Possible future changes:
1. Change to RecTrack system (anticipated spring 2015) which will and option for e-receipts.
2. Will promote e-receipt option when it launches.

Barriers:
1. Any change has to continue to allow them to integrate class and camping registrations and reservations as part of the POS system.

Baseline:
Pounds of paper: 107
Pounds of chemical: 1 (BPS)
Cost of paper: Unknown