EXTENDED PRODUCER RESPONSIBILITY AS A MANAGEMENT PRACTICE FOR WASTE MATTRESSES IN BRITISH COLUMBIA

By

MILES GREY HUME

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We accept this thesis as conforming
to the required standard

.....
Judy Carter, Thesis Supervisor
Royal Roads University

.....
Dr. Chris Ling, Thesis Coordinator
School of Environment and Sustainability

.....
Dr. Matthew Heinz, Dean
Faculty of Social and Applied Sciences

ROYAL ROADS UNIVERSITY

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ABSTRACT

Development of stewardship programs for management of end-of-life mattresses (ELM) is a global challenge for governments. Metro Vancouver is the first Canadian regional government to ban mattresses at local landfills. The next step is for manufacturers and retailers to work with local governments in developing stewardship programs that successfully divert and recycle mattresses across British Columbia (BC). This thesis examines how mattress industry stakeholders in BC could effectively implement province wide mattress stewardship policy that will ensure maximum public participation and will be environmentally sound as well as cost effective. Research was conducted by way of a literature review, a case study approach of Metro Vancouver's mattress recycling bylaw and model, and exploratory interviews with BC stewardship program leaders, Sleep Country Canada, government waste management planners, and mattress recyclers.

Key Words:

Extended producer responsibility, product stewardship, mattress recycling, furniture recycling, materials management

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CHAPTER 1 INTRODUCTION

This thesis seeks to investigate "How mattress industry stakeholders operating in BC can effectively implement province wide mattress stewardship policy that will ensure maximum public participation and will be environmentally sound as well as cost effective?"

The following introduction will outline the problem of waste in Canada and more specifically, the issue of mattresses in the waste stream. Additionally, extended producer responsibility/product stewardship (EPR/PS) will be introduced as a management practice that has helped to successfully manage many consumer goods at the end of their useful life. Government mandated EPR/PS for mattresses is a relatively new practice in Canada, however many regional governments are now looking at this model to manage sleep products. Reasoning for mattress stewardship is explained throughout the introduction and more specifically in the literature review and case study analysis of Metro Vancouver's mattress tipping fee bylaw.

Waste in Canada

In 2010, Statistics Canada revealed that Canadian per capita waste disposal equaled 725 kg, a noticeable reduction from the 770 kg generated in 2008 (Statistics Canada, 2013). This is encouraging news from a municipal planning standpoint, however when it comes to municipal solid waste (MSW) diversion, Canada is noticeably behind other G8 and Organization for Economic Cooperation and Development (OECD)

countries (Canadian Council of Ministers of the Environment [CCME], 2009). Traditional linear waste management systems (e.g. incineration and landfilling) are no longer proving to be adequate waste management solutions, and so practices are beginning to take on a more natural, circular flow (Lifeset et al., 2013, p. 162), utilizing a combination of source reduction, recycling and composting; this in an attempt to curb the growing waste generation associated with an increasing national population. Recycling 50-60% of waste is an achievable standard for many cities. The Brazilian city of Curitiba has been able to recycle over 70% of its waste since 2000; and in 2010 the American city of San Francisco reached a waste diversion rate of 77% percent (Lehmann, 2011, p. 29).

Canadian municipalities have started to adopt more diversion programs to recycle items that have traditionally been sent to landfills and incinerators; this in an attempt to reach waste diversion targets set out by municipal solid waste waste planners and higher levels of government. For example, the Province of BC has established waste diversion policy programs such as extended producer responsibility/product stewardship (EPR/PS) laws, which have been instrumental in recycling products such as tires, electronics, paints, and beverage containers (British Columbia Ministry of Environment [BCMoE], 2013). These items fall under phase 1 of the CCME Canada-wide Action Plan for EPR; a plan which has set various EPR targets and deadlines, along with tools and recommendations, across Canada to help mitigate the increasing strain on traditional waste management systems.

Mattresses in the Waste Stream

Mattresses, which fall under (furniture) phase 2 of the CCME Action Plan, are one of many consumer goods that pose a waste management challenge. According to a Representative of Metro Vancouver's solid waste department, roughly 135,000 mattresses were diverted from local landfills in 2011 in Metro Vancouver, BC's largest regional district (personal communication, February 23, 2012), and nearly 150,000 in 2012 (F. Scaldaferri, personal communication, April 23, 2013). Mattresses are recycled at one of three facilities within the region; a product of regional public policy banning mattresses in local landfills. The combined amount of mattresses equates to roughly 8.5 million cubic feet of landfill space (based on the average mattress size of 6' by 5' by 1').

Mattresses contribute significantly to the depletion of already limited air space at municipal landfills. They also contain hazardous substances such as polyurethane and other synthetic polymers made from diisocyanates, a range of substances that when exposed to in high concentrations can cause irritation to eyes, nose, throat and skin, and can cause respiratory sensitization and asthma (Bernstein, 1996, p. 183). Researcher Jonathan A. Bernstein of the University of Cincinnati's Department of Medicine estimated that between 5-10% of America's 100,000 workers exposed to diisocyanates developed occupational asthma (1996, p.184); an issue that will need to be addressed as recycling mattresses may increase human exposure to these substances. Furthermore, mattresses are big, bulky and hazardous, creating major problems and substantial costs when transporting and processing them in traditional waste streams (Metro Vancouver Representative, personal communication, February 23, 2012). Landfilling mattresses is

quickly becoming a thing of the past, and in the United States (USA) various States are passing stewardship legislation requiring that mattress producers (manufacturers and retailers) establish a system to divert end-of-life mattresses (ELM's) from the waste stream and properly recycle them (International Sleep Products Association [ISPA], 2012).

Mattress Product Stewardship in Canada

The development of stewardship initiatives for sleep products has progressed in Canada over the last five years. Whether government mandated or voluntary, ELM stewardship initiatives are proving to successfully remove beds from landfills and recycle up to ninety five percent of mattress components (Pacific Mattress Recycling Inc. [PMR Inc.], 2013; Guilfoil, 2008, p.44; PPL Industries, 2008). Stewardship of ELM may include EPR/PS programs, where producers, retailers, and consumers are charged with handling and recycling of end-of-life (EoL) products through ongoing involvement at the post-consumer phase. EPR/PS requires that those individuals who create and/or consume a product must be responsible for the product at the end of its useful life. Specifically, they must find new uses for obsolete products and/or their components so that material diversion from these products is maximized. Successful EPR/PS programs shift the burden of waste away from municipalities and taxpayers and onto those individuals who produce and/or consume the product (CCME, 2009, p. 10).

Stewardship programs for mattresses in Canada are limited, however municipalities and businesses are starting to implement programs and enhance capacity to remove mattresses and box springs from landfills. In 2007, a Montreal, Quebec based

company started finding innovative solutions to recycle ELM's. The company operates through a voluntary recycling fee for mattresses, paid by consumers and businesses. The venture has been instrumental in proving that recycling mattresses is realistic, economically feasible and provides many benefits to society (Recyc-Mattresses, 2013).

In partnership with the aforementioned Montreal mattress recycling company, Sleep Country Canada recycles all its used mattresses on a voluntary basis. Sleep Country is a Canadian mattress retailer that claims they are the only retailer in Canada to commit to a comprehensive recycling program. If old mattresses they pickup are in good shape, they will be donated; otherwise all mattresses are completely broken down and recycled (Sleep Country Canada, 2013) at one of Recyc-Mattresses facilities. This is encouraging news for mattress recycling advocates, as Sleep Country Canada is one of the major sleep product retailers in North America. The recycling model Sleep Country has set up provides valuable insights regarding operational aspects of stewardship program development and management.

Mattress Recycling in Metro Vancouver

In January 2011, Metro Vancouver enacted a mattress tipping fee bylaw (now the Greater Vancouver Sewerage and Drainage District Bylaw No. 275, 2012), which bans mattresses from the regional landfills. Mattresses are diverted to one of three recycling facilities in the region where they are completely dismantled and recycled. Recycling fees range from $10.00 to $15.00 charge (per mattress piece) to the consumer. Metro Vancouver initiated communications with ELM industry stakeholders and local waste management professionals in the years leading up to the 2011 bylaw. Since this bylaw

imposes a tipping fee to consumers, the program is not considered an EPR initiative, but rather a regional government stewardship initiative, which works to help Metro Vancouver achieve waste reduction goals. This being said, discussions and consultation leading up to the bylaw largely focused on the logistics of the program. Metro Vancouver would pass the bylaw; it was just a matter of being prepared logistically (F. Scaldaferri, personal communication, April 23, 2013). Pacific Mattress Recycling Inc. (PMR Inc.) has worked with Metro Vancouver in the lead-up to the bylaw, and has maintained a working relationship into 2014. The company has an estimated 50% market share of recycled mattresses in the Metro Region (Metro Vancouver Representative, personal communication, February 23, 2012; F. Scaldaferri, personal communication, April 23, 2013). Consequently, much of the Metro Vancouver case study data collected for this paper is company data from their records.

Roughly 135,000 mattresses (4 million cubic feet) were successfully diverted and recycled in Metro Vancouver during the first year of the program (2011). The program has had a significant social, economic and environmental impact, directly created jobs and economic activity, reducing pressures on local landfills in Metro Vancouver and lessening the need for fiber, petroleum and mineral extraction. Along with program benefits there are also various problems associated with this 'back-end' disposal fee, such as increased illegal dumping of unwanted mattresses, which are burdensome enough to dispose of without an additional fee. This issue alone is a major problem for municipalities, which are faced with the clean-up costs associated with unsanctioned, illegal dumping (Reschovsky et al., 1994, p. 124).

Moving Forward on EPR/PS for Mattresses

As BC starts to implement a province-wide stewardship program for mattresses, some key challenges need to be addressed. Mattresses would be the first furniture item to be managed by EPR laws in BC. This process generally begins as the province of BC initiates and facilitates stakeholder engagement events, where consumers, producers/retailers, recyclers, and waste professionals can discuss the elements of the program. The formation of a mattress stewardship organization, comprised of mattress producers (manufacturers, retailers and first importers) operating in BC, will likely be established, to unify the industry and create a level playing field for all producers. Similar to many not-for-profit (NFP) organizations managing EPR programs for a variety of products, the mattress product responsibility organization (PRO), or a contracted stewardship program agency, will develop a stewardship plan. The plan outlines various program attributes such as: how waste mattresses will be collected and recycled, key program performance indicators, recovery rate targets, timelines for implementation and reporting protocols. The PRO will also be responsible for management of the program, ensuring research and development for product life-cycle design improvements, and assuming full program costs or charging a recycling fee to consumers (CCME, 2009, p.16).

Stewardship planners must also determine how program cost and logistics will be assessed. Developing a stewardship plan means assisting lawmakers and the stewardship body to understand how factors such as population density, collection mechanisms, infrastructure requirements, and many other influences will affect the program costs.

Program planners will need to determine whether the program should be uniform across BC, or be focused in more densely populated regions where transportation of mattresses is more economically viable due to economies of scale. Also, what collection mechanisms would be employed to successfully divert collection targets set out in the stewardship plan?

As the mattress industry becomes responsible for their products through EPR/PS policy, individual organizations will have to determine whether it is in their collective interest to work together to manage the program and find new design and dismantling efficiencies to consolidate resources and make it easier to reuse or recycle components of their products. Since 1992 over twenty products, including motor oil, tires, bottles/cans, and electronics have been managed under an EPR/PS program in BC (Recycling Council of British Columbia [RCBC], 2013). According to the RCBC, recycling all household newsprint, cardboard, glass, and metal alone can reduce household carbon dioxide emissions by 400 kg in one year (RCBC, 2013). In a world where over-consumption, pollution and resource depletion threaten sustainability, product stewardship for mattresses will expand household GHG reductions and resource reuse, as mattresses are composed of recyclable materials such as untreated wood, steel, synthetic polymers, plastics, and natural fibers like cotton and coconut husks.

CHAPTER 2 LITERATURE REVIEW

The literature review investigates lessons learned from development and management of various product stewardship programs, and their associated social, economic, environmental and political outcomes. It was found that the benefits and costs associated with EPR/PS for consumer goods are not yet fully understood, however the practice is largely regarded to be the best waste reduction practices available to governments. Along with academic sources on EPR/PS programs, this thesis incorporates information from provincial and federal databases, manufacturing and recycling companies, product stewardship organizations, and publications in waste management/recycling news sources. The majority of information and data pertaining to the Metro Vancouver mattress recycling bylaw case study was retrieved from the company records of PMR Inc., as this company has worked with the regional government in the lead-up to the bylaw as well as into 2013. The company also holds roughly 50% of the market share of recycled mattresses in the region, which makes for straightforward estimation of regional mattress recycling figures (Metro Vancouver Representative, personal communication, February 23, 2012; F. Scaldaferri, personal communication, April 23, 2013).

Prior to the Metro Vancouver mattress recycling case study the literature review will introduce EPR/PS in general, problems associated with mattresses in the waste stream as well as various handling practices for mattresses to date. Forecasting product waste and understanding the life cycle of mattresses will also be discussed, and the literature review concludes with a discussion about EPR/PS for mattresses in BC.

Extended Producer Responsibility

The Organization for Economic Cooperation and Development (OECD) defines Extended Producer Responsibility as ‘‘an environmental policy approach in which a producer’s responsibility, physical and/or financial, for a product is ex-tended to the post-consumer stage of a product’s life cycle’’ (2013). Initially coined in Sweden (Walls, 2006, p. 1), the concept of extended producer responsibility was put to practice in Germany in 1991 through its Packaging Ordinance law for product packaging. The legislation assigned responsibility to retailers to take back product packaging from consumers and established refundable deposits on some packaging types to incentivize the return of the material. Retailers then put pressure on manufacturers of products, ultimately making them assume responsibility for product packaging (Sachs, 2001, p.68). The ultimate result of this legislation saw the development of a Producer Responsibility Organization (PRO), a non-profit entity composed of over six hundred German companies, which manages the packaging take-back system in the country. EPR policy has since become a popular government waste diversion tool across the EU, utilized to sustainably manage EoL automobiles (France), batteries (France and Norway), major appliances (Austria, Netherlands, Denmark), and e-waste (Belgium, Sweden, Norway, Denmark, Italy, Switzerland, and the Netherlands), and packaging (France) (Sachs, 2001, p.69).

Until recently, EPR/PS has not been very popular in the US compared to Canada and the EU. US environmental law has focused more on regulation of industrial pollution and often neglected the negative externalities from consumer products themselves (Sachs,

2006, p. 53). In recent years however, the US government has enacted legislation mandating product stewardship for a number of consumer goods. US lawmakers have targeted products, including electronic waste (e-waste), mercury lights, carpets, packaging, paint, and pharmaceuticals (Gui et al., 2013, p.262). By embracing EPR/PS initiatives the US will effectively increase job creation, salvage reusable materials, and experience associated environmental benefits of landfill longevity and emissions reductions.

EPR is generally implemented through government legislation, however companies do enact various voluntary EPR programs to take back obsolete products for refurbishment and material reuse. When producers internalize the environmental costs (raw materials processing, production usage, post consumer take-back, recovery, re-use, or disposal) of their products, whether through policy or voluntarily, they are predominantly attempting to keep their EoL products out of the waste stream, and incentivize for Design for Environment (DfE), which encourages innovative pollution prevention activities such as:

- Reducing materials, resources and energy usage;
- Minimizing the use of toxic chemicals/materials in the product;
- Increase product recyclability;
- Improving the transportation and production processes;
- Extending the lifespan of products;
- Increase the opportunities for recovery and re-use of end-of-life products;

- Creating new product delivery schemes such as leasing or product service systems.

(McKerlie et al., 2006, p. 617).

EPR programs have proven to reduce waste and increase recycling rates associated with consumer products in all countries employing the programs. There is some debate however, regarding the effectiveness of EPR policy in motivating producers to design more environmentally friendly products (Walls, 2006, p.41). In the article *Extended Producer Responsibility: National, International, and Practical Perspectives*, the authors conclude that, while EPR enhances recycling and waste diversion, it may hinder product reuse. The article also acknowledges a knowledge gap regarding the cost-effectiveness of EPR programs, arguing that there is not yet defensible numbers on the costs and benefits of such programs (Lifset et al., 2013, p. 165). While there have been various challenges and issues around implementing EPR programs, whether due to industry pushback or the politicization of EPR initiatives, the debate about the appropriateness and effectiveness of EPR policy in Canada is largely over. Canadian EPR professionals have even gone so far as to develop an NFP organization called EPR Canada, which evaluates provinces on their implementation and commitments to the policy approach (Bury, 2013, p. 167). Developed by EPR Canada to rate provinces and territories on their EPR commitments and implementation, the EPR Canada report card, released in July 2012, presented British Columbia with the highest rating of A−, followed by Manitoba, Quebec, and Nova Scotia who all scored a B− rating (EPR Canada, 2012).

EPR started gaining momentum in BC in 1992 when the province implemented EPR for household hazardous wastes (HHWs) to move away from costly special collection efforts (manually segregating HHW from normal trash). More than 40 million liters of used oil (lube oil) have been reclaimed annually through the EPR program under this regulation. Two years later a regulation was established to manage postconsumer paints, and in 1997 EPR legislation was established for solvents/flammable liquids, pesticides, gasoline, and pharmaceuticals (Driedger, 2002, p. 89). These programs have resulted in reduced waste management costs to local governments and large volumes of HHW being removed from traditional waste streams. The programs were mandated in response to a municipal solid waste management strategy initiated in 1989, where the BC provincial government required all 27 regional districts to prepare a waste management plan that would achieve a 50% per capita reduction in solid waste reaching landfills (Driedger, 2002, p. 91; McKerlie et al., 2006, p. 622). Since then, over 20 formal product stewardship programs have been implemented in the province, including such items as tires, e-waste, thermostats, and large appliances (RCBC, 2013).

According to the OECD Review of Canada's Environmental Performance, good progress in being made towards achieving its domestic environmental objectives and international commitments since 1995 (2004). The report recommends that there is still work to be done regarding implementation of the polluter pays & user pays principles. These principles are achieved through EPR for consumer products, showing that there is still opportunity to manage more products at end-of-life (McKerlie et al., 2006, 617) in Canada. Given this fact, and considering recent advances in stewardship for mattresses

across North America, there is an opportunity to start looking at EoL sleep products as a resources, rather than send these items to landfills.

End of Life Mattresses (ELM): Problem Analysis

The Grass Roots Recycling Network produced a fact sheet *Eliminating Waste Through Producer Responsibility,* which explains that "our current system of municipal garbage collection was designed for the turn-of the Century world [1900's] where only 7% of household trash was made up of manufactured products and packaging" (2008). Today, "disposable" single-use products make up almost 80% of the municipal solid waste stream (Grass Roots Recycling Network (GRRN), 2008). Increasingly, regulation of solid waste has become a burden on local governments, who are left responsible for the collection and disposal of single use products in the waste stream (GRRN, 2008).

The sleep products sector is a substantial contributor to annual volumes flowing into the solid waste stream across the world. In a recent interview with Simon Zysman, Managing Consultant with a mattress recycling company called Recover Canada based out of Toronto, it was stated that roughly 70% of mattresses in Canada are either burned or sent to landfills (VOCCompliance.com, 2013). A rough estimate of the number of ELM's discarded annually in BC, prior to the 2011 Metro Vancouver mattress recycling bylaw, can be obtained by dividing 150,000 (a conservative estimate of total ELM's in Metro Vancouver Region (F. Scaldaferri, personal communication, April 23, 2013)) by 0.5 as Metro Vancouver represents roughly half of the population of BC (Statistics Canada, 2008) to reach approximately 300,000 units. Considering the average mattress

size is 6’ by 5’ by 1’ this amount/volume of mattresses represents an estimated 9 million cubic feet reaching landfills in BC annually.

ELM’s are large, bulky, hazardous, and many people have a difficult time trying to dispose of them responsibly. Logistically, shipping mattresses is “very costly… as you are pretty much shipping air” (F. Scaldaferri, personal communication, April 23, 2013). The size of mattresses also poses a problem with designating collection site storage. Being large, hazardous, and often unsanitary, used mattresses are challenging to store at satellite drop-off locations, retail centers, and transfer stations (F. Scaldaferri, personal communication, April 23, 2013). In recent years, municipalities across Metro Vancouver have implemented large pickup items (up to 3-4 items per year), in which residents of single family homes can arrange for unwanted mattresses, and other large household goods, to be collected (Metro Vancouver, 2013). This service is, however, taxpayer funded and removes the burden of waste disposal away from mattress manufacturers, retailers and consumers. Another limitation of this program is that it does not apply to multi-family residencies, which often include people who don’t have vehicles, or the financial ability to transport furniture (M. Kosmac, personal communication, February 23, 2012).

In addition to problems of space for shipping and storing ELM’s is the fact that they contain hazardous materials, and if not contained properly, can pose risks to groundwater, air quality, and terrestrial ecosystems adjacent to landfills. Toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI) are used to make polyurethane foam, which is a major component of mattresses. Both substances are

mutagenic and TDI was found to be a carcinogenic to animals (Hagmar, Welinder, & Mikoczy, 1993, p. 537). Also, regular diisocyanate exposure can cause irritation to eyes, nose, throat and skin, and can cause respiratory sensitization and asthma (Bernstein, 1996, p. 183). Similar to the disposal of countless other household consumer goods, the health related issues associated with mattress disposal in landfills have not been studied in depth.

Pre-Stewardship Handling of ELM's

Until recently, the only mattress disposal practices have been the traditional methods of landfilling, incineration, or unregulated voluntary recycling. As previously stated, the risks and environmental problems associated with these management practices are problematic with landfilling and incineration considered to most harmful to the environment.

Landfilling waste is the most universally accepted method of disposal. It is widely accepted that landfills, including new state of the art facilities, experience the problem of leachate containment and gas generation (methane gas and carbon dioxide). Leachate is a combination of heavy metals, organics and water that combine to form a 'slurry', which can leach off-site to neighboring environments and ground water supplies (Christiensen, 2010, p. 687; Daskalopoulos et al., 1997, p. 9). Incineration of municipal solid waste is an alternative waste management solution with problems of its own. The combustion of solid waste emits micropollutants such as chlorinated dioxins and furans, which are highly toxic, causing adverse health effects (Buekens & Huang, 1998, p. 1).

Voluntary ELM Stewardship initiatives

In the USA, various private and not-for-profit organizations have started to recycle mattresses and salvage reusable materials. St. Vincent de Paul is a charity organization which funds and organizes many social programs across North America. Between the California facility (DR3), and the Eugene, Oregon location, the organization recycled 170,000 mattresses in 2010; this without any laws mandating that they be recycled. In addition to alleviating environmental stress, St. Vincent de Paul's mattress recycling program creates entry-level jobs for ex-offenders and others facing barriers to employment (Saint Vincent de Paul, 2013).

In the private realm, a company called Conigliaro Industries in Massachusetts will recycle used mattresses in a process that they developed, which rips apart mattresses, box springs, as well as upholstered furniture (Guilfoil, 2011, p. 44). This was one of the first recycling companies in North America to see an opportunity in recycling mattresses.

There are many other companies in the USA that recycle mattresses, and in Canada, the first voluntary mattress recycling initiative commenced in 2006 when a Montreal, Quebec based company started finding innovative solutions to recycle used mattresses and box springs. Recyc-Mattresses operates through voluntary recycling fees, and in 2007 the company supported a mattress recycling pilot project for Sleep Country Canada, Canada's largest sleep products retailer. Sieg Will, Senior Vice President of Operations with Sleep Country notes that in 2008, the retail giant provided funding for a 16,000 square foot facility to recycle all ELM's from customers across Eastern Canada. In 2010, this program was expanded to include Western Canada as Recyc-Mattresses established a

facility in Langley, BC (S. Will, personal communication, September 6, 2013). The Sleep Country/Recyc-Mattresses partnership has championed mattresses recycling at the retail level in Canada, proving the retail and recycling facility business case (which recycles 92% of mattress materials), and also demonstrating that consumers are behind this type of initiative. In recent years, Recyc-Mattresses has expanded to the USA and France to take part in mattress recycling initiatives outside of Canada (Recyc-Mattresses, 2013).

Government Mandated Mattress Product Stewardship

Some jurisdictions are making mattress recycling mandatory. For example, Connecticut and Rhode Island have recently enacted state-wide mattress recycling bills, being the first of their kind in the USA. California is not far behind, making progress on State legislation of its own. The three above-mentioned examples signify that governments are currently in the process of developing a viable product stewardship programs that consider the requirements of all stakeholders (International Sleep Products Association (ISPA), 2012). The International Sleep Products Association (ISPA) represents most of the sleep products manufacturing industry in the United States and Canada. Negotiations between the ISPA, state legislators and officials have been going on for years, with the end goal being establishment of an industry-led nonprofit that will be responsible for mattress recycling systems in the mentioned states. An ISPA statement suggests that the long-term goal of the US mattress industry has been to establish a national recycling system, however for the time being it is responding to those states wishing to achieve efficient mattress recycling programs (ISPA, 2012).

Forecasting the Mattress Waste Stream

Establishing a sustainable mattress recycling industry requires the collection of information about future volumes of mattress waste, as well as the quality and composition of that waste. Good forecasting estimates will make it easier to accurately plan collection, storage, and recycling strategies. Optimizing the location of facilities will mean that transportation costs and other costs are minimized. Also, understanding regional volumes and distribution of ELM's will assist in the selection of efficient recycling technologies and potential markets for secondary materials (National Textile Center, 2000, p.2).

In the past, forecasting primarily utilized historical data. Firms are now using point-of-sale data and other inventory management technologies, which have allowed them to retrieve accurate information about product inventories and sales across geographies at any given time. Improved communications, information technology, inventory management, and overall supply chain coordination has allowed for accurate estimations of products and their life span (Chandra & Kumar, 2000, p. 102). With mattresses, these technologies will prove very useful when it comes time to gather distribution data in BC.

When estimating the average lifespan of mattresses, the most practical method would likely be similar to methods utilized for other large consumer goods that are recycled, such as major appliances. In the BC Major Appliance Stewardship Plan (2012), the lifespan of large appliances were estimated using a combination of historical and forecasted industry shipment data for the BC market, and average lifespan data obtained

through a Beck and Weston study (2005) that collected 2,000 retired major appliances in order to determine the date of manufacture (AHAM Canada & RCC, 2012, p. 7). This type of study could be conducted at mattress recycling facilities in Metro Vancouver as ELM's generally have tags providing their date of manufacture. For those units that do not, a model number would likely be used to determine date of manufacture from company databases, as was the case with the large appliance study mentioned above.

In the Southeastern US, the Carpet America Recovery Effort (CARE), a post consumer carpet (PCC) recycling network, has established a model that incorporates CARE's collection, sorting and recycling using zip codes to distribute annual PCC supply based on population density and demographic information. The model also estimates profitability of recycling the PCC through analysis of processing, holding, and transportation costs, as well as analysis of market values of the recycled materials (National Textile Center, 2000, p. 5). This type of model will prove to be an important tool for the stewardship organization forecasting ELM program attributes in BC, as it will drive efficiencies within the closed-loop system. Forecasting program metrics will likely take place soon after the BC recycling regulation is amended to include mandatory product stewardship for mattresses.

Metro Vancouver Mattress Tipping Fee Bylaw Case Study

Stakeholder Engagement and Public Consultation

The Metro Vancouver Integrated Solid Waste and Resource Management Plan (ISWRMP) acknowledges the need to create a sustainable and livable metropolitan region, and that this development process should be collaborative and incorporate citizen engagement (2010, p. 4). In the lead-up to the 2011 mattress tipping-fee bylaw, public citizen consultation was largely non-existent. The regional government had set various waste reduction and resource recovery goals in the ISWRMP and so the only engagement process occurring at this time was amongst the stakeholders responsible for moving the program forward. This included regional and municipal waste managers, shipping/logistical contractors and mattress recyclers (F. Scaldaferri, personal communication, April 23, 2013). This resource recovery program operates through recycling fees applied to ELM's, and so mattress producers were not required for this consultation process.

When EPR/PS laws are applied to products, such as mattresses and box springs, then consultation between producers, regulators (BC government), and private contractors will occur. According to a BCMoE Representative, and various stewardship program managers/directors, the stakeholder engagement process is generally the responsibility of product producers, and that the province of BC is fairly hands off aside from amending the recycling regulation and providing a timeline (personal communication, August 22, 2013). From this point producers must collaborate to figure out amongst themselves what the stewardship plan will look like (M. Hennessey,

personal communication, August 28, 2013; J. Illingworth, personal communication, Jan 17, 2013).

Establishing Collection Mechanisms and Logistical Capacity

Up until January 1st, 2011, all mattresses ended up in Vancouver landfills. Regional transfer stations and landfills have always maintained the capacity to deal with mattresses within their compounds. These facilities would remain the main centers for ELM collection, from where they would be redistributed to local recyclers. In addition to these government operated centers, a combination of return to retailer, return to recycling depot, municipal large item pickup services, and the many waste removal companies all contribute to collection of ELM's (F. Scaldaferri, personal communication, April 23, 2013; Metro Vancouver Representative, personal communication, February 23, 2012).

As mentioned earlier in this paper, up until now there are three mattress recycling companies established across the Metro Vancouver region. PMR Inc. maintains roughly 50% of the regional market and is located in South Vancouver (Pacific Mattress Recycling Inc., 2013). Recyc-mattresses and Canadian Mattress Recycling are located in Langley and Delta respectively (Recyc-mattress, 2013; Canadian Mattress Recycling, 2013), which distributes the companies fairly well to service the entire region.

Material Recovery and Reuse

Material recovery rates for mattress materials and components are estimated to be roughly 90 – 95 %, based on various company claims (F. Scaldaferri, personal communication, April 23, 2013; S. Will, personal communication, September 6, 2013,

Recyc-Mattresses, 2013; Canadian Mattress Recycling, 2013). Below is a list of mattress material components, and some of the different reuses for these materials by PMR (2013):

Steel

Steel is sent to local metal recyclers such as ABC recycling, who then send sorted reclaimed metals to smelters in Northern BC, Oregon, Washington or overseas. Steel is the most valuable component found in mattresses as it can be reconstituted into raw steel for sale on the market.

Wood

Mattress wood is generally untreated fir or spruce, which is sent to local wood recyclers such as Urban Wood Waste, a company owned by Harvest Power. The untreated wood has a variety of different reuses, generally as a fuel for pulp and paper, hot-house (agriculture) fuel, or as kiln fuel for concrete manufacturing.

Foam (Polyeurethane)

Foam products are sent to 3rd party foam manufacturers who typically shred and rebind the used materials into new products such as carpet underlay or upholstery cushioning. There is also a new technology in development that looks to liquefy used foam and recreate foam products from the broken down elements.

Toppers (Polyurethane and Polyester weave)

Mattress toppers are a difficult component to recycle given the challenge in separating the polyurethane foam from the polyester fabric. These materials are heavily

stitched together, and currently toppers have been sent to the Metro Vancouver waste-to-energy facility. The waste-to-energy practice is considered material reuse/recycling, which enables material recovery rates of 95% in Metro Vancouver.

There are other uses for mattress toppers, however this is based on the secondary and tertiary market opportunities available regionally. Toppers can be bailed and sold to 3rd party foam manufacturers, such as the case with foam. Recycled material markets are often kept confidential, as profit margins in the recycling sector tend to be quite marginal, however F. Scaldaferri of PMR notes that upon meeting the Executive Director of the St. Vincent de Paul Society, an NFP that recycles mattresses in Eugene Oregon, it was established that there are various opportunities for this material. Recyc-Matresses, located in Langley, has been recycling mattresses in Eastern Canada for years, and according to Seig Will of Sleep Country Canada, the Recyc-Mattresses owner has enhanced the recycling model with the use of specialized chipping and shredding equipment which has driven efficiencies and opened up new material markets (personal communication, September 6, 2013).

Felt Blankets

The felt blankets are another mattress component that are generally sent to the Metro Vancouver waste-to-energy facility. These materials are often referred to as 'shoddy cloths', and contain a mix of recycled cloth. Felt blankets are easily shredded and can be mixed with wood and other fibers to be used as a fuel, stuffing for pet sleeping mats and a variety of other uses.

Cotton

Cotton from mattresses is bailed and sent to a local cotton recycler. The cotton recycler will sanitize the used material and mix it with virgin cotton to make cotton badding, a product used for making upholstery.

Plastics

Mattresses contain very little in the way of plastic, however they do often come in large plastic bags. All plastic from mattress recycling facilities is bailed and sold to local plastic recyclers who pelletize it and resell the recycled plastic on the market.

Coir (coconut husk blankets)

Coir blankets are found in some of the older mattresses being recycled, and since these blankets are made from organic material (coconut husks), they can be composted. PMR Inc. has maintained a partnership with Urban Digs Farm in Burnaby, which gladly takes the coir blankets and uses them for weed suppression at their farm.

Incineration of Mattress Components

Waste-to-energy is a waste management practice that Metro Vancouver seeks to expand in the coming years. The regional government claims that after waste reduction, reuse, and recycling practices, waste-to-energy recovery is the best approach for handling any solid waste that remains. Additional waste-to-energy capacity, which is to be commissioned in 2018, will create more district heating and electricity sources for the city, and help the region reach its targeted waste diversion rate of 80% by 2020 (metrovancouver.org, 2013).

Waste-to-energy is a contentious issue for residents across the region, specifically when the location of a facility is planned for development in close proximity to residential areas (often characterized as the NIMBY factor). Incineration of MSW in Metro Vancouver is state-of-the-art, and the facility operates below the standard acceptable limit for all emissions (metrovancouver.org, 2013). Nonetheless, there is an extensive list of harmful substances that are emitted from incinerators, including: particulate matter, carbon monoxide, acidic gases/particles, certain metals (cadmium, lead, mercury, chromium, arsenic, and beryllium), dioxins and furans, Polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs) (Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Research Council, 2000, p. 113).

Ideally, mattress materials such as toppers and felt blankets will not be incinerated but rather reused directly in the manufacturing of new products and fuels. However, since this industry is relatively new to Vancouver and the rest of the world, there are still unexplored opportunities and markets for these materials (F. Scaldaferri, personal communication April 23, 2013).

Business Case for Mattress Recycling in Metro Vancouver

Currently in Metro Vancouver, there is a viable business model in mattress recycling given a recycling fee of between ten and fifteen dollars (Recyc-Mattresses, 2013; PMR Inc., 2013; Canadianmattressrecycling.ca, 2013). Mattress recycling is a volume driven industry, and the three mattress recycling companies operating in Metro Vancouver are benefiting from economies of scale, as this is a high-density region.

Along with recycling fees, recycling companies are generating revenue through the sale of various mattress materials. Steel is valuable and generates roughly $150 per ton, whereas other materials like cotton, foam and plastics generate around five to fifteen cents a pound (F. Scaldaferri, personal communication April 23, 2013). Increasing efficiencies through mechanization, systems management and the establishment of new markets for recycled materials is the goal in many recycling industries, and the increased prevalence of mattress recycling initiatives will help to create awareness and information sharing with regards to material reuse.

Results from a Zero Waste Business Case study produced for the BCMoE demonstrate that there is a positive business case for increasing waste diversion in BC. Depending on how aggressively zero waste principles are implemented (i.e., 62% vs 81% diversion), the study suggests that by 2025 a Zero Waste Strategy will produce between $56 million and $126 million in annual net economic benefit; will create between $27 million and $89 million in additional annual GDP and generate between $755,000 and $2.5 million in new annual income tax revenue for the province. This report further validates the need for recycling of EoL products such as mattresses, and the document also identifies potential GHG reductions (1,047 to 2,277 kT/yr) that would accompany the economic and social benefits (Innes Hood Consulting Inc., 2013).

Social and Environmental Benefits

There are many social and environmental benefits associated with ELM stewardship, and in Metro Vancouver, these benefits are being realized. By banning mattresses in local landfills Metro Vancouver has generated many jobs in the recycling

sector. PMR Inc. employs roughly forty full time employees, some with barriers to entry in the workforce (F. Scaldaferri, personal communication April 23, 2013). Many jobs are created throughout the supply chain and end market processing of recycled materials in Metro Vancouver, and the local recycling industry in the region is worth well over $500 million per year (metrovancouver.org, 2013). Mattress recycling also increases the lifespan of local landfills, which in turn helps to maximize land available for protection, leisure space, development or agriculture.

As stated earlier, the pre-stewardship landfilling of mattresses also contributes to the problem of leachate contamination and greenhouse gas generation (Christensen, 2010, p. 687). By banning mattresses from Metro Vancouver landfills, citizens will benefit from extended landfill lifespan, and a subsequent reduction in pollution associated with landfill emissions, into the future.

Though not specific to mattresses, a report was produced in 2008 (Economic Impacts of the BC Recycling Regulation) for BC's MoE, which indicates, "almost all recycling processes achieve significant energy savings compared to production using virgin materials" (Gardner Pinfold Consulting, 2008, p. 46). The report used a model created and supported by the US Environmental Protection Agency (EPA) called the Waste Reduction Model (WARM) to calculate and compare total GHG emissions and energy use of a baseline waste management practice (landfilling) with an alternative waste management practice (a combination of source reduction, recycling, combustion, composting, and landfilling). The model calculates the metric tons of carbon equivalent (MTCE), metric tones of carbon dioxide equivalent (MTCO2E), and energy units

(million BTU) and the reductions in these output variables through switching practices. Items used in the study include aluminum cans, glass, mixed paper, plastics, personal computers, and tires (Gardner Pinfold Consulting, 2008, p. 47).

The baseline MTCO2E assumes that all materials are landfilled, which exhibits GHG emissions of 7,030 MTCO2E, whereas the alternative waste management scenario, where materials are recycled through BC stewardship organizations, estimates a reduction of 259,520 MTCO2E. 83% of this reduction is accounted for through the recycling of aluminum cans and tires, and the total change in GHG emissions is a reduction of 266,520 MTCE (Gardner Pinfold Consulting, p. 48).

Tables were also provided for metric tonnes of carbon equivalent (MTCE) reductions and energy unit reductions (million BTU), which indicate a total reduction in GHG emissions of 72,695 MTCE and a total reduction in energy use of 5,255,969 gigajoules respectively. Based on national average coefficients used in this study, the overall equivalent is equal to 858,913 barrels of oil (Gardner Pinfold Consulting, 2008, p. 49). Mattresses consist of metals, forestry products, petroleum products, and natural fibers. Being similar to various materials analyzed in this study it strengthens the argument that recycling ELM's is a carbon and energy use reduction strategy.

Problems Associated with Metro Vancouver Bylaw

One problem that has always faced municipalities is the issue of illegal dumping. For the City of Vancouver, the problem of illegal mattress dumping in back alleys is a serious financial strain to the municipality, costing anywhere between $100 and $150 to pick up a single mattress unit (J. McDermott, personal communication, September 30,

2013). The Metro Vancouver decision to introduce a recycling fee (back-end cost) of fifteen to twenty dollars for mattresses exacerbated the problem of illegal mattress dumping, specifically amongst citizens in multi-family dwellings (MFD). MFD residents generally lack recycling programs such as large item pickup services offered to single-family properties. It is also often the case that MFD residents lack access to a vehicle or are hard-pressed financially, making it difficult to properly dispose of large household items (M. Kosmac, personal communication, February 20, 2012). As a result, MFD's in Metro Vancouver divert only an estimated 15% of MSW compared to SFD's, which divert 50% (Metro Vancouver, Recycling and Solid Waste Management Report, 2011, p. 3). The Vancouver Sun published an article on this matter, in which City of Vancouver spokeswoman Alex Russell explains that in 2011 (introduction of the mattress recycling fee), illegal mattress dumping equated to 5,000, up from 1,500 in the previous year (Sinoski, 2011). More recently, a CBC news article states that, according to City of Vancouver records and since the introduction of the $15 mattress recycling fee, the total number of abandoned garbage calls to the city has almost doubled, with 9,300 in 2012 – up from 5,000 in 2010 (CBC, 2013, http://www.cbc.ca/news/canada/british-columbia/vancouver-to-tackle-epidemic-of-abandoned-garbage-1.2432904).

Another problem, which is more specific to the mattress recycling process, is the increased exposure to bedbugs, biohazard substances, and micro particles. A Vancouver Sun report indicated that bed bug infestations are on the rise in Metro Vancouver, and that since the insects can't fly, they tend to move around by clinging to clothes and bedding in an attempt to locate new food sources (Kells, 2006, p. 107; Baglole, 2005, p.

B5). Increased handling and disassembly of mattresses will mean that there are more opportunities for bedbugs to disperse. There has been at least one bed bug 'bloom' at the PMR facility, which required the application of insecticides, however no staff members reported taking the pests home. Mattress recyclers must also be aware of the fact that mattress disassembly exposes employees to various forms of biohazard substances, micro particles (dust), and degraded polyurethane foam (F. Scaldaferri, personal communication, April 23, 2013).

Finally, it could be argued that the mattress recycling bylaw creates increased trucking traffic within the region. Increased trucking traffic will increase congestion of transportation infrastructure as well as increase immediate CO_2 emissions. The CO_2 emissions argument is weak, given the information provided in the Economic Impacts of the BC Recycling Regulation study (Gardner Pinfold Consulting, 2008) discussed in the social and environmental benefits section of this paper. Nonetheless, the emissions topic requires further research, specifically with regards to mattress components and the fact that shipping mattresses is not cost effective over large distances; this given that a mattress' volume is comprised mainly of air. (F. Scaldaferri, personal communication, April 23, 2013; Driedger, personal communication August 29, 2013).

Extended Producer Responsibility for Mattresses in BC

The Province of BC has a goal of rolling out mattress product stewardship in 2017, which is the date set for phase 2 of the Canada-Wide Action Plan for Extended Producer Responsibility (CCME, 2009; BCMoE Representative, personal communication, August 22, 2013). The goal of the mattress stewardship program will

likely be similar to many other programs, where citizens have free and convenient access to collection mechanisms and recycling services. This may include both urban and rural areas across the province with a uniform recycling fee, which is paid by producers (typically passed on to consumers) at the point of purchase. The process of initiating a province-wide stewardship program is generally quite hands-off for the BC government. Regulators and planners are responsible for initiating a scoping phase, where they will identify the industry and facilitate communications about program implementation, achievable recovery rates, creating a level playing field, providing a general industry warning of the upcoming recycling regulation amendment. From this point, and with consideration to all relevant variables and stakeholder feedback, the government amends the recycling regulation to include the appropriate product category (mattresses and boxsprings). The recycling regulation is a legal document that sets performance targets, deadlines, program management and overall duties of producers with regards to stewardship of their products (BCMoE representative, personal communication, August 22, 2013; Ministry of Water, Land and Air Protection [MWLAP], 2004).

Mattress recycling as a responsible waste recovery solution has proven to be the best management practice for ELM's. Voluntary recycling programs, the Metro Vancouver tipping fee bylaw, and now US State legislation governing that ELM's be recycled, shows that momentum is building for this pactice. Mattress recycling case studies from across North America can provide information and the experience base required to move forward on mandated stewardship initiatives. The next big step for BC will be the formation of a provincial sleep products stewardship group that can represent

all producers operating in the province. This will include all companies selling mattresses in the province, including any foreign based companies (BCMoE Representative, personal communication, August 22, 2013). This organization, or an appointed agency, will be responsible for the submission of a stewardship plan, which incorporates the following program attributes:

- Recycling fees
- Logistics and collection mechanisms
- Target recycling rates
- Infrastructure requirements
- End markets for materials
- Assurance
- Health and safety
- Yearly reporting with comprehensive third-party audit

(OECD, 2001, p. 9; BCMoE Representative, personal communication, August 22, 2013; MWLAP, 2004).

CHAPTER 3 RESEARCH METHODOLOGY

Literature Review

In order to fully understand the current state of mattress product stewardship, this research project began with a literature review. Examination of the various voluntary and mandated mattress stewardship programs operating across North America helped to uncover benefits and problems associated with mattress recycling initiatives. Since mattress EPR/PS is still in the scoping phase in various US States, there is not currently a great deal of information regarding program costs, logistics, and overall implementation of these programs. Much of this information was obtained through the case study analysis of the Metro Vancouver tipping fee bylaw and subsequent recycling program, where mandated mattress recycling has taken place for nearly three years.

Specific documents, such as the Canada-Wide Action Plan for Extended Producer Responsibility (CCME, 2009), and the Extended Producer Responsibility: a Guidance Manual for Governments (OECD, 2001) were important tools in determining characteristics of a EPR/PS models, and how these programs might incorporate mattress products. Additionally, various mattress recycling programs in the United States (USA) have been documented in waste and recycling magazines. Recycling consultant Arthur Boone examines the value of disassembled bed and couch materials, and the end markets for these materials (1994). Though somewhat dated, this article reinforces the business case for mattress recycling in North America with specific case studies from cities like Phoenix, Arizona and Alameda County, California. Academically, many articles used in

this thesis were obtained from the Journal of Industrial Ecology. This journal provides an international and multi-disciplinary analysis of local, regional and global materials and energy uses and flows in products, processes, industrial sectors and economies. Industrial Ecology focuses on the potential role of industry in reducing negative environmental externalities throughout the product life cycle, from the extraction of raw materials, to the production of goods and the management of resulting wastes (Yale School of Forestry and Envrionmental Studies, 2009).

Further literature was gathered from various studies documenting the economic, social and environmental benefits of recycling rather than using virgin materials in manufacturing. Specific economic and environmental benefits such as increased GDP and GHG emissions reductions through recycling are documented in BCMoE reports (Economic Impacts of the BC Recycling Regulation and the Zero Waste Business Case, 2008). Overall, the literature review provides background information about the shift to recycling economies in Canada, and more specifically, the growth and necessity of EPR/PS programs in BC and abroad.

Case Study Analysis: Metro Vancouver Mattress Tipping Fee Bylaw

The case study analysis of the Metro Vancouver mattress recycling program is the second research component of this thesis and is embedded in the literature review section of this paper. The case study outlines the implementation of the mattress bylaw in the city, identify pros and cons of a tipping fee/bylaw based program, introduces the business case and social, environmental and economic benefits associated with mattress recycling in Metro Vancouver, as well as the current end markets for mattress components and

materials; a significant element in determining whether a product can be successfully managed by an EPR/PS program in BC (CCME, EPR Product Evaluation Tool, 2008). As roughly half of BC's population resides in Metro Vancouver (Statistics Canada, 2008), the case study provides valuable logistical, financial, and implementation-based information relating to future province-wide EPR programs for mattresses and box springs.

In his book *Case Study Research: Design and Methods,* author Robert Yin says that case study analysis is a valuable research method for investigating and understanding the structure of a given industry or the economy of a city or region, allowing the investigator to obtain a holistic understanding of real-life events (2009, p.4). As research for this thesis is very much exploratory, seeking to understand how the Metro Vancouver bylaw program has set the stage for province-wide EPR for mattresses, it was determined that a case study would work to provide information needed regarding program economics, planning, implementation, management and refining.

The primary method used to obtain case study information was the interview. The reasons for using interviews to obtain case study information are summarized well by Helen Simons in her book *Case Study Research in Practice*. She explains that interviews are beneficial to case studies because they work to document interviewee's perspectives, actively engage interviewer and interviewee learning and analyzing of the issue, offer flexibility and openness to the pursuit of emergent issues, and potentially uncover feelings and events that are difficult to detect or reliably assume through observation (2009, p. 43) The case study has highlighted the knowledge of individuals and

organizations responsible for implementation and management of the mattress recycling program in Metro Vancouver, and combined with the literature review and interview research, the case study has helped to acknowledge program shortcomings and opportunities that will assist in the development of provincial mattress EPR.

Interviews with Key Stakeholders

In addition to the literature review, and utilized to obtain information in the case study analysis of the Metro Vancouver recycling bylaw, ten qualitative, semi-structured exploratory interviews were conducted to obtain additional information and experiential knowledge of programs and products already managed under EPR/PS policy, as well as the opportunities and limitations for mattress recycling across the province of BC. Although there was overlap in knowledge across interview respondents, half of the ten interviews were conducted to obtain information for the Metro Vancouver case study analysis, while the other half focused more on EPR/PS in general, and how EPR/PS policy could function to divert mattresses from the waste stream across BC. Given the relative shortage of academic literature on mattress recycling programs, interviews have helped provide a snapshot of the industry from the perspective of stakeholders involved. Interviews were qualitative, exploratory and semi-structured and have provided a professional and practical overview of the mattress recycling program in Vancouver, and EPR programs in Canada, including the logistical and functional aspects of the recycling system.

Below is a list of the ten interview respondents in this study:

1. Brock McDonald, CEO – Recycling Council of BC
2. Fabio Scaldaferri, Co-Founder/CEO – Pacific Mattress Recycling Inc.
3. Jay Illingworth, Harmonization Director – Electronic Products Recycling Association
4. Jonathan McDermott, Project Engineer, Solid Waste Management – City of Vancouver
5. Representative – BC Ministry of Environment (BCMoE)
6. Representative, Solid Waste – Metro Vancouver
7. Mike Hennessey, Executive Director – Tire Stewardship BC
8. Monica Kosmak, Zero Waste Program Planner – City of Vancouver
9. Ron Driedger, Executive Director – BC Used Oil Management Association
10. Seig Will, Vice-President of Operations – Sleep Country Canada

Interviews have helped to uncover all aspects of the mattress recycling program within Metro Vancouver, as well as the potential for a province wide EPR/PS program for mattresses in BC. Analyzing the interview data required the grouping of common themes within respondent data, identifying and discussing differing opinions and answers to questions, and the organizing of EPR/PS program attributes and processes in order to establish a best practice model and implementation process for mattress EPR/PS policy. Triangulating between interview results and the case study analysis and literature review

components of this paper has helped to further validate the overall study and recommendations.

Project Participants

Ten individuals were interviewed based on their involvement in stewardship programs, knowledge of the mattress industry, and experience in the BC waste management sector. These individuals were selected for one of five reasons:

1. They are involved with regional or provincial government waste planning, engineering and policy
2. They are executive level managers for product stewardship organizations and have extensive knowledge about EPR/PS programs
3. They represent mattress producers (manufacturers and/or retailers) operating in BC
4. They are ELM recyclers or waste managers who deal with the logistics and waste management operations
5. They have extensive knowledge about EPR/PS programs

CHAPTER 4 RESULTS

Research results provided valuable information relating to the effective implementation of a province wide mattress stewardship program. The literature review produced information on why mattress EPR/PS would be environmentally, socially, economically, and politically beneficial, with examples of ELM stewardship initiatives from various regions across North America. Examining literature also uncovered requirements of stewardship programs, including implementation, program management and outreach/communications, as well as the business case associated with waste diversion and recycling. The Metro Vancouver recycling bylaw case study incorporated elements of literary analysis, but more importantly it obtained experiential knowledge through interviews with key players involved in the 2011 bylaw implementation and management. Results from the literature review, case study analysis and semi-structured interviews are presented in the following sections.

Metro Vancouver's Mattress Recycling Bylaw as a Waste Management Solution

A major component of this thesis is the examination of Metro Vancouver's mattress recycling bylaw, implemented by the regional government on January 1st, 2011. From the start date of this program, through to January 2014, the program will have diverted an estimated 435,000 mattress or boxspring units (over 14 million cubic feet of space) from regional landfills. This conservative estimate was obtained through interviews with a Metro Vancouver Senior Waste Engineer, and Fabio Scaldaferri, who is the owner and CEO of Pacific Mattress Recycling Inc., the principal mattress recycling

company operating in conjunction with Metro Vancouver (Metro Vancouver Representative, personal communication, February 23, 2012; F. Scaldaferri, personal communication, April 23, 2013).

The mattress bylaw program was primarily initiated as one response to a growing regional population, and the associated pressure on local landfills. From interviews with key Metro Vancouver stakeholders it became clear that mattress recycling was generally considered a 'low-hanging fruit' program, where the associated social, economic and environmental benefits would be realized quickly, as well as instant relief of many problems associated with mattresses in the landfill (M. Kosmac, personal communication, February 20, 2012; F. Scaldaferri, personal communication, April 23, 2013). During a *Round Table: Eliminating Vancouver's Waste* event in 2012, the Manager of Metro Vancouver's Solid Waste Department and the General Manager of Engineering with the City of Vancouver were asked how long the Cache Creek and Delta landfills would last under current consumption patterns and waste management practices. They agreed that landfills would probably reach capacity in around 50 years (BCBusiness.ca, 2012), and so expanding diversion and recycling programs will be vital from a regional waste management standpoint. There is very little space for new landfill operations within the region. Metro Vancouver has adopted Canadian waste reduction targets outlined in the Canadian-Wide Action Plan for EPR (CCME, 2009), which the regional government has further defined in it's ISWRMP (2010). The mattress recycling bylaw is just one of many regional programs initiated to help reach its targets and increase landfill longevity.

Through this study it has become evident that the mattress recycling bylaw in Vancouver has created jobs, significantly reduced MSW reaching landfills, and given new life to materials that have normally been buried forever. However, there are also the known problems, explained earlier in this paper, with regards to the increased disposal costs and the difficulty in transporting used mattresses, specifically for Vancouver residents living in MFD's and rural areas. Increased illegal dumping as a result of the bylaw is a significant problem for the city. The bylaw has also resulted in a heightened awareness around the risks to human health, as exposure to mattresses means exposure to bed bugs, biohazards, dust, and degraded materials that may become airborne in the dismantling process (F. Scaldaferri, personal communication, April 23, 2013).

Literature review and interview respondent information regarding the Metro Vancouver tipping fee bylaw program suggest that the model is a good first step towards the ultimate end goal of province-wide EPR/PS for mattresses. The next step for the province, or manufacturers themselves, is to initiate discussions about amending the recycling bylaw and forecasting program metrics so that all stakeholders are prepared for province wide mattress EPR/PS.

Interview Responses

As explained in the methodology portion of this paper, Interviews have helped to uncover important features of the mattress recycling program within Metro Vancouver, as well as the potential for a province wide EPR/PS program for mattresses in BC. Analyzing the interview data required the grouping of common themes within respondent data, identifying and discussing differing opinions and answers to questions, and the

organizing of EPR/PS program attributes and processes in order to find a good starting point model and implementation process for a mattress EPR/PS program.

Interviewees consisted of four groups: Product stewardship professionals, government waste planners, Metro Vancouver's partner mattress recycling company, and the mattress retailer Sleep Country Canada. Individuals were asked up to sixteen questions relating to either the Metro Vancouver mattress recycling bylaw, individual experience and knowledge of stewardship planning, mattress recycling business planning information and data, and information pertaining to stewardship at the retail level. Respondents offered overwhelming support for EPR/PS for mattresses in BC, which was predicted given respondent inclusion in this industry. In terms of benefits brought on following EPR/PS policy, all respondents acknowledged the triple bottom-line benefits such as, employment (social), the business case (economic), and the environmental benefits such as increased landfill space and the removal of hazardous materials from the MSW stream. In terms of perceived and real challenges to EPR/PS for mattresses in BC, stewardship program professionals and government waste planners provided the most detailed information. EPR/PS professionals all referenced the fact that, in BC, public backlash to EPR/PS is no longer a major issue. Most people have started to accept this type of program as the best waste management practice, no matter where their involvement is in a product's life cycle. This is apparently a major problem in Ontario, where, in the past, eco-fees have often become a political issue causing public polarization and political interference (M. Hennessey, personal communication, August 28, 2013; R. Driedger, personal communication, August 29, 2013; J. Illingworth,

personal communication, Jan 17, 2013; M. Kosmac, personal communication, February 20, 2012). From interviews it was found that product stewardship is very much embedded in the BC waste management culture, and many other nations and provinces see BC as a world leader in this waste and resource management practice.

The biggest validating feature of EPR/PS according to interview respondents is the fact that it transfers the financial burden of waste from municipalities to product producers and consumers. Also, by applying recycling fees at the point of purchase the program will effectively produce a fund designated to manage ELM's. Waste and stewardship planning respondents note that this feature will work against the problem of illegal dumping, and create a level playing field and sustainable business model for all mattress producers in BC.

Respondents identified many potential barriers associated with EPR/PS policy for mattresses. These barriers are predominantly concerned with establishing convenience; logistics, collection and storage mechanisms of the program; servicing remote areas; tracking mattresses coming into the system from other jurisdictions; managing health and safety; and creating a program that takes advantage of economies of scale. Solutions to these barriers will be the responsibility of the product manufacturers or the EPR/PS managing agency, however various interview responses provided best practice options to effectively approach the situation.

Implementation of the BC mattress EPR/PS program is where many of the various challenges/barriers become reality. Through discussions with EPR/PS professionals who have been at the forefront of program implementation it has become evident that no

program is perfect. Recycling mattresses will require a well planned distribution network. Program planners must know where units are being retrieved, where and how they are going to get them recycled, and where the end markets are for recycled materials. The fact that the recycling model has worked in Metro Vancouver and other jurisdictions across North America is helpful in determining various provincial program elements. Information about program costs, logistics, labor requirements, recycling facility requirements, what synergies have worked, and the collection of ELM's in Metro Vancouver will be useful as the BC MoE moves forward on mattress EPR policy. A BC program will however incorporate servicing rural communities and therefore region specific logistical infrastructure and higher overall program costs will be required (R. Driedger, personal communication, January 17, 2012; BCMoE Representative, personal communication, August 22, 2013; M. Hennessey, personal communication, August 28, 2013).

Further to program implementation, the majority of EPR/PS professionals agreed that you just have to "go for it" (R. Driedger, personal communication, January 17, 2012) and "implement like crazy" (M. Hennessey, personal communication, August 28, 2013), continuously improving the system over time. Once planners have forecasted estimated annual ELM's and regional distributions, considered program costs, have a recycling process and markets for end products, and have addressed all other logistical concerns, then it is time to initiate the program and refine it over time. EPR/PS organizations or their management agencies should prepare and predict outcomes as much as possible in the lead-up to the program start date, however, it is not until the implementation phase

commences that the real problems and inefficiencies are realized. After the program is implemented managers will be able to identify problems and make changes in order to increase accessibility and convenience, lower program costs, source out new and diverse markets for materials, which all help to stabilize the system and encourage the highest possible recovery rates (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013; B. McDonald, personal communication, September 3, 2013).

Collection from rural and remote areas is going to be one of the biggest challenges for mattress EPR/PS planners, specifically since mattresses are so large, hazardous and lightweight relative to their size (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013; BCMoE Representative, personal communication, August 22, 2013). Under the BC recycling regulation all BC residents pay the same fees for stewardship services, and therefore residents of rural and remote areas are effectively receiving services that are subsidized by individuals living in urban regions, where the logistical networks can take advantage of economies of scale (R. Driedger, personal communication, January 17, 2012). This fact means that determining the provincial recycling fee will require careful consideration of increased logistical costs associated with collection from rural and remote areas.

All respondents referred to reverse logistics as a collection mechanism that will be instrumental in achieving desired recovery rates for ELM's at the lowest cost. This service is already provided by many mattress retailers who drop-off new products. Sleep Country Canada has already made recycling used mattresses a part of their business plan

across Canada, and all mattresses they receive will travel backwards through the distribution chain, ending up at a recycling facility or in the company's charitable mattress donation program (S. Will, personal communication, September 6, 2013). Reverse logistics has been important for recovering EoL products such as post consumer tires, where consumers leave their old worn out tires with retailers to be recycled when buying new ones (M. Hennessey, personal communication, August 28, 2013).

Reverse logistics is not deemed the only collection mechanism for mattresses. Interview respondents with experience in EPR/PS programming all described the need for a combination of collection programs. Return to depot, return to municipal waste management centers, municipal curbside pickup services, special one-day collection events, and junk removal companies must all be considered for the mattress EPR/PS program, and the application of various different methods will be largely dependent on geographical and demographic influences (BCMoE Representative, personal communication, August 22, 2013; M. Kosmac, personal communication, Feb 20, 2012; R. Driedger, personal communication, January 17, 2012; B. McDonald, personal communication, September 3, 2013). Reverse logistics was a popular response to interview questions about appropriate collection mechanisms because this process takes advantage of existing infrastructure, thereby reducing program costs significantly.

The importance of cost effective collection, storage, and distribution of ELM's is a primary concern for program planners, and this process will need to be tracked and documented in order to effectively refine/improve and audit the overall system. All of the EPR/PS program managers interviewed in this study made it clear that tracking

mattresses from eco-fee to the end market of used materials, and clearly documenting this information, is an essential element of any stewardship program. By tracking the product from development to the product materials end market program managers can identify where system inefficiencies and problems occur, where the recycled materials are ending up, and accurate program documentation will streamline the external audit process, which is a mandatory component of the program (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013; J. Illingworth, personal communication, Jan 17, 2013).

Interviews also provided insights about the best course of action with regards to engaging stakeholders in the mattress EPR/PS discussion. Once the BC recycling regulation is amended to include mattresses, manufacturers will be responsible for comprehensive outreach and education programs. These programs are meant to create awareness about the shift to provincially mandated EPR/PS as well as collection sites, costs and program attributes. According to stewardship program directors and waste planners interviewed in this study, BC has started to consolidate EPR/PS communications through the Recycling Council of British Columbia (RCBC). Brock McDonald is the Chief Executive Officer of the RCBC, a NFP operating as a public hub for product stewardship. He explains that the RCBC and partner organizations have designed various programs and services, such as the BC Recyclepedia, a recycling phone app, and a social media presence, to make recycling EoL products as easy as possible for BC residents. Regarding mattresses McDonald expects that, as seen with other products, once the policy is in place, a communications strategy will likely take the form of a media blitz,

with elements of radio, newspaper, public signage, and television advertisements (B. McDonald, personal communication, September 3, 2013). Getting the word out will mean that less people react negatively to new fees and the process of getting ELM's to recycling sites will be streamlined. No matter how much consultation is conducted, there will always be people who are surprised by stewardship policy (R. Driedger, personal communication, January 17, 2012).

Another important theme that was echoed throughout various interviews is the importance of consolidating resources between the mattress stewardship organization, other organizations, private business and government bodies. A major consumer complaint about EPR/PS programs in general is the fact that they require dropping off products at different facilities all over the city or region. This effectively deters people from properly disposing of various EoL products, as it requires too much time and resources (R. Driedger, personal communication, January 17, 2012; B. McDonald, personal communication, September 3, 2013). By partnering with other organizations, such as the case with Encorp beverage container recycling accepting EoL electronics (Encorp, 2013), stewardship organizations are making it less expensive and more convenient for consumers to make sustainable choices regarding waste management. It was identified that collection and storage of mattresses is a challenge given their size, structure and the concerns of/about biohazards and bedbugs. Nonetheless, program planners must seek to form synergies with any organizations that are willing to act as collection centers for ELM's. Mattress manufacturers and retailers will likely act as collection centers for ELM's. Other organizations may take part in collection given some

financial incentive, or purely based on the fact that, by doing so, the organization is bringing customers to its establishment.

Collaboration is becoming more prevalent amongst EPR/PS organizations, especially with regards to communications and program management. As explained earlier, RCBC has become the educational voice of EPR/PS in the province and organizations like Product Care are starting to manage multiple product categories in BC. These organizations have the expertise, resources and program networks to make efficient use of stewardship dollars (B. McDonald, personal communication, September 3, 2013) and ELM stewardship planners will realize overall program efficiency through harmonization with other programs and the associated scientific and technical expertise these programs have gained over time (R. Driedger, personal communication, January 17, 2012).

Since this industry is relatively new to BC, there was overall agreement that operators of recycling facilities should take a very cautious stance on worker health and safety. As mentioned previously, the mattress dismantling process creates dust, increases worker exposure to bedbugs and biohazard substances, and since bed units are typically stacked high for storage, there is the concern of injury associated with falling mattresses. The owner of PMR Inc. notes that this is a top concern within his organization. Scaldaferri operates under the most stringent organizational health and safety rules, however workers do not always abide by company rules due to the discomfort or inconvenience. One challenge acknowledged by Scaldaferri is the fact that there is a lack of health related research about mattress recycling, specifically with regards to worker

exposure to broken down and degraded polymers and inorganic materials that become airborne particulate matter (dust). This concern will require attention as province-wide mattress recycling is implemented. However, until health and safety research is conducted for this industry, mattress recyclers must provide employees with regulated safety equipment and have systems in place to manage health concerns (F. Scaldaferri, personal communication, April 23, 2013; R. Driedger, personal communication, January 17, 2012).

At PMR Inc. health and safety rules state that respirators, steel toes, and high-visibility vests are mandatory during mattress disassembly. Furthermore, employees are encouraged to remove coveralls, boots, respirators, gloves and headwear and leave these items at work in an attempt to combat the spread of bedbugs. Additionally, protective eyewear and hard hats are mandatory for specific tasks, and mattresses are only to be stacked ten high so that storage instability is minimized (F. Scaldaferri, personal communication, April 23, 2013). There are other system policies that drive the health and safety regulation for stewardship programs in BC, and through collaboration with other recycling organizations and assessment of best practices, the health and safety of workers will be acknowledged and documented in the mattress stewardship plan.

Overall, the ten interviews conducted for this study provided experienced accounts of the Metro Vancouver recycling bylaw, EPR/PS program implementation and management in BC and Canada, and the voluntary stewardship model that has been championed across Canada by the mattress retailer Sleep Country. In combination with the literature review and Metro Vancouver case study, interview responses outline

attributes of a province wide mattress stewardship program that will help to ensure maximum public participation and will be environmentally sound as well as cost effective.

CHAPTER 5 DISCUSSION

Issues associated with implementing stewardship programs for ELM's are very complex and require careful consideration to ensure maximum participation from residents in the areas where the stewardship program is proposed. During the process of EPR implementation, multiple dimensions of environment, economics, society and politics come into play, and the differences within these realms create challenges in achieving a balanced and equitable overall system (Gui et al., 2013, p. 273). Metro Vancouver waste planners and partner mattress recyclers anticipate that roughly 180,000 mattresses will become obsolete in 2013 (Metro Vancouver Representative, personal communication, February 23, 2012; F. Scaldaferri, personal communication, April 23, 2013), and this number is growing as the regional population increases. The literature review has revealed that EPR/PS is commonly held as the best management practice for ELM's in North America, and the Metro Vancouver case study has shown that a mandated program can work well to divert beds from the waste stream in an urban environment, this given a recycling fee of $10-$15.

Features of mattress stewardship programs vary across North America. To date, the majority of programs have been voluntary, regional government responses to growing pressures on traditional waste management systems. In Canada, Sleep Country has become the first and only mattress retailer to institute a comprehensive mattress recycling program to deal with ELM's that they pick up from customers. The literature review also uncovered that in the USA, state governments are in the process of enacting legislation mandating mattress stewardship (ISPA, 2012). BC is likely to initiate province-wide

mattress stewardship in 2017, which, as explained in the literature review, is the date set for phase 2 of the Canada-Wide Action Plan for Extended Producer Responsibility (CCME, 2009; BCMoE Representative, personal communication, August 22, 2013).

Moving forward on EPR/PS for mattresses in BC will require an in-depth analysis of various challenges that have been identified in this research. For instance, a province-wide system must maximize consumer convenience through adequate collection, distribution and overall program logistics and infrastructure. Stakeholder engagement will be very important to make the program known, and help streamline program uptake. Engagement and logistics will require information sharing and consolidation of resources amongst stewardship organizations, producers, and policy planners, and these synergies will drive the overall success of the program as well as reduce overall costs. Additionally, since this industry is relatively new, health and safety concerns must be given attention through research, information sharing and precautionary business operations.

Producer Managed EPR/PS for Mattresses in BC

As discussed in the literature review and interview response sections of this paper, province-wide EPR/PS program implementation and management will be the responsibility of mattress producers. Producers will either setup a NFP organization responsible for program management, or will designate an agency to take on the responsibly of stewardship plan development, implementation and program management on the producer's behalf (MWLAP, 2004). In the past, the process of EPR program development in BC typically begins to unfold as the MoE reveals its target policy implementation date and begins facilitation of the producer engagement process, where

stakeholders negotiate the stewardship plan details (BCMoE Representative, personal communication, August 22, 2013). Interview responses by stewardship planners/directors indicated that: the sooner the stewardship group formation and subsequent forecasting/planning process occurs, the more streamlined and cost-efficient the program will likely be. Rather than reactively responding to policy changes, industries that embrace stewardship and voluntarily plan for EPR implementation will create a level playing field amongst manufacturers and reduce recycling costs through economies of scale, improve consumer perspectives of the industry, create economic activity, and minimize their environmental footprint (R. Driedger, personal communication, January 17, 2012; BCMoE Representative, personal communication, August 22, 2013; M. Hennessey, personal communication, August 28, 2013).

Further to program implementation and management, producers will be responsible for the application of efficient consumer education campaigns to achieve diffusion of mattress EPR awareness and collection convenience (BCMoE Representative, personal communication, August 22, 2013; R. Driedger, personal communication, January 17, 2012). As explained by EPR professionals in the interview results, BC has started to consolidate EPR/PS education and outreach through the RCBC in an effort to make efficient use of resources (R. Driedger, personal communication, January 17, 2012), and as the implementation date for mattress EPR draws near, the program would likely benefit from a media blitz, utilizing some combination of the following outreach streams: online social networking, newspaper advertisements, public

signage, radio and/or television advertisements (B. McDonald, personal communication, September 3, 2013).

In order to operate a successful program that maximizes collection of ELM's in an environmentally sound and cost-effective manner, the producer led stewardship program must also maintain audit level assurance on recovery rates, logistics of the system, system financing, and end markets for reusable materials (R. Driedger, personal communication, January 17, 2012). Properly tracking these elements of the system is imperative as EPR/PS programs are required to obtain a yearly third party audit, which helps regulators determine how the system is working to reach the goals set out in the stewardship plan (BCMoE Representative, personal communication, August 22, 2013; R. Driedger, personal communication, January 17, 2012).

Determining Program Costs and Regional Service

During the stakeholder consultation and planning phase for mattress EPR program development, managers must determine program costs and regional service levels. Through interviews, EPR/PS professionals and government waste policy planners have made it clear that no program is perfect, and that once a program is implemented planners must constantly optimize and refine various attributes, generally in the early stages/years of program development. (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013; BCMoE Representative, personal communication, August 22, 2013; F. Scaldaferri, personal communication, April 23, 2013).

One method of ensuring the financial success of a stewardship program is to charge an inflated recycling fee at the point of purchase (for example an eco-fee of $10 when your estimated per-unit recycling costs are $8). Operating with a surplus reserve fund of one year's operating budget will mean that the program has a safety net for unpredicted costs and liability issues. Also, stewardship programs often notice problems when recycling service providers hold diversion remittances for long periods of time, thus causing financial imbalance in the overall system. Remittances are the proof of service (e.g. the recycling of some number of mattresses), which allow stakeholders in the EPR/PS program to collect revenue generated by the eco-fee. The BC Used Oil Management Association (BCUOMA) finds hundreds of thousands of dollars in unclaimed remittances yearly, which shows how challenging it can be to track eco-fees for products (R. Driedger, personal communication, January 17, 2012). Once financial stability is achieved, stewardship program planners can start to refine fees to better reflect program costs. The Metro Vancouver program, which initially operated on a $20 per-unit charge at landfills and transfer stations, dropped the per-unit price to $15 in 2012 to better reflect the true cost of program management (F. Scaldaferri, personal communication, April 23, 2013).

In terms of regional service levels for ELM stewardship in BC, the major challenge will be in servicing rural and remote areas. Despite there still being challenges in servicing MFD's in Metro Vancouver, the system has proven to recover and divert the large majority of ELM's in the region. As explained in the introduction, collecting mattresses from remote areas is challenging, given their size, relative weight and the fact

that they don't compact well (Metro Vancouver Representative, personal communication, February 23, 2012). Essentially, trucking companies are shipping air over large distances, and the low material value (relative to its size) within a mattress makes it challenging economically (R. Driedger, personal communication, January 17, 2012; F. Scaldaferri, personal communication, April 23, 2013). Program funding that reflects service to rural and remote areas will allow for the development of proper logistical infrastructure to collect and recycle ELM's. ELM's in rural BC are currently taken to landfills and transfer stations or returned to retailers during delivery of new products, and under a province-wide stewardship program these collection sites will likely continue to recover units. However, funding will be generated through a user/polluter pays framework rather than from municipal tax dollars (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013; BCMoE Representative, personal communication, August 22, 2013).

Collection Mechanisms

Development of an effective mattress product stewardship program for BC will be met with a number of challenges, not the least of which is the unbalanced distribution of the provincial population. The majority of BC's population lives in Metro Vancouver and the interior BC and in these areas permanent recycling depots and curbside collection make economic sense. This is exemplified through the success of the Metro Vancouver case study, where a combination of return to retailer, return to recycling depot, municipal large item pickup services, and the many waste removal companies all contribute to collection of ELM's (F. Scaldaferri, personal communication, April 23, 2013; Metro

Vancouver Representative, personal communication, February 23, 2012). However, for residents in the more remote and less populated areas of BC, it doesn't make economic sense to provide the collection and recycling services (R. Driedger, personal communication, January 17, 2012). The implementation of an ELM EPR program collection will need to be sufficiently flexible to take into account differences population distribution and density, access to recycling facilities, distances to end-markets for recycled materials, as well as the wholesale and retail distribution systems for mattresses. The EPR program should also conform with regulations and established practices that are particular to all BC regional and/or municipal governments (CCME, 2009, p.22).

Similar to various stewardship programs in BC, reverse logistics through producer take-back will be the most cost effective method of collection for a BC mattress recycling program. Sleep Country has been recycling ELM's from their eastern Canada customers since 2006, and across Canada since 2010. Every mattress distribution center now has a mattress recycling trailer, making the process of getting ELM's from customers to recyclers as convenient and streamlined as possible (S. Will, personal communication, September 6, 2013). Provincial collection will, however, be region specific and may require a combination of various mechanisms mentioned previously. There is no one-size-fits-all collection program for stewardship programs, and so planners must share knowledge and look to what has worked for collection of similar items. Collection planners must also consider a multitude of other factors including, but not limited to the cost of transport, plan recovery rate, optimum recycling center locations, and

education/outreach, all while offering a free and convenient service to product consumers (R. Driedger, personal communication, January 17, 2012).

Return to municipal transfer station/landfill/recycler, and reverse logistics/return to producer are the main collection systems for mattresses in Metro Vancouver (F. Scaldaferri, personal communication, April 23, 2013). Planners of a provincial mattress stewardship program would also benefit greatly by maximizing synergistic relationships with retailers, thrift stores, and other organizations that have the capacity to act as satellite collection centers for ELM units. Thrift stores already face the problem of illegal mattress dumping at their facilities (F. Scaldaferri, personal communication, April 23, 2013) and depending on the remittances structure or supply chain funding, thrift stores and other partnering collection organizations may benefit from financial incentives and/or increased traffic to their establishments. As a minimum, EPR/PS for mattresses should establish funds that could be used for collection of ELM's dumped illegally (F. Scaldaferri, personal communication, April 23, 2013).

Mattress EPR/PS – Considerations and Challenges for Program Development in British Columbia

To date, the costs and problems associated with landfilling mattresses in BC has been the responsibility of municipal and regional governments. EPR/PS for mattresses in BC will support the "polluter pay" principle, shifting the burden of ELM management from governments onto producers and consumers responsible for the waste (CCME, 2009, p. 2). This EoL management solution is currently in development in three USA states (ISPA, 2012), and many jurisdictions in Canada are establishing capacity to divert

and recycle mattresses voluntarily. The Metro Vancouver mattress tipping-fee bylaw exemplifies how an urban/peripheral-urban recycling program can function to divert beds from landfills.

The BCMoE will develop enabling legislation for a mattress product stewardship program, and because EPR laws make producers responsible for their products at EoL, this legislation will encourage product design for environment (DfE) initiatives that are meant to reduce the use of hazardous materials and increase the reuse and recycling of product materials thereby increasing the life cycle environmental performance of their products (CCME, 2009, p. 10).

In BC and most of Canada, EPR programs are widely accepted as the best way to address designated end-of-life (EoL) products such as: beverage containers, tires, paint, used oil, and hazardous wastes (BCMoE, 2013) To assist in the transition of ELM responsibility from governments/tax payers to the product producers and consumers, and to facilitate the development of a level playing field between mattress industry stakeholders, the Canadian Council of Ministers of the Environment (CCME) has established the following set of principles for product stewardship, which can easily be amended to apply specifically to mattresses and align with the findings of this report.

1. Responsibilities associated with management of ELM's are primarily the responsibility of mattresses producers, where "producer(s)" means the manufacturer, brand-owner or first importer of mattresses into BC.

2. Costs of program management are not borne by general taxpayers.

3. Environmental and human health impacts are minimized throughout the product life-cycle, from design to EoL management.

4. Management of ELM waste is environmentally sound and consistent with the 4**R** waste management hierarchy:

    a. **R**educe and redesign products for improved reusability or recyclability
    b. **R**euse
    c. **R**ecycle
    d. **R**ecovery, of materials and/or energy from the ELM waste stream

5. Consumers have convenient or reasonable access to collection systems without charge.

6. Education and awareness programs ensure that consumers, retailers and other stakeholders have sufficient information on program design and knowledge of their roles.

7. Program design and implementation strive to be equitable and consistent for all consumers, particularly between those living in adjacent jurisdictions and between those who live in rural and remote communities and dense urban centers.

8. Programs include residential, commercial, historic and orphan ELM's.

9. Programs report on performance, specify objectives and targets, and provide transparent financial management.

10. ELM's are managed in the most economically and logistically feasible manner, while striving to maximize local and economic and social benefits.

11. An ELM recycling program must be in compliance with environmental and occupational health and safety requirements and best management practices.

12. Governments are responsible for setting the scope for the mattress stewardship program, establishing performance targets and ensuring that a level playing field exists between producers and importers. (CCME, 2009, p. 9)

These adapted principles will guide the development of ELM product stewardship legislation between different BC jurisdictions and industry stakeholders. The principles will optimize program attributes to ensure maximum public participation, environmental performance and cost effectiveness of the overall program.

Some challenges that are likely to confront program planners include issues surrounding the efficient collection from multi-family dwellings, where recycling services are not as robust as those offered to single-family residents. At the opposite end of this spectrum is the problem of collecting mattresses from remote and rural communities in BC.

Research Limitations

Mattress recycling is not an entirely new waste management practice in North America, however the implementation of government mandated mattress product stewardship has only recently gained traction in the US, and at the regional level in Metro Vancouver (2011). Therefore, a lack of history and relevant data regarding the implementation of a province-wide EPR/PS program means there are many unanswered questions regarding program viability. This lack of knowledge and industry/academic information translates into a relatively generalized research thesis, with a limited number of directly experienced individuals to interview. Furthermore, mattress manufacturers were not included in this study. The International Sleep Products Association (ISPA) represents the large majority of bed manufacturers in North America, and since this thesis makes recommendations about program EPR/PS development in BC, ISPA remarks were deemed adequate representations of where the industry stands today. When moving

forward on the development of program funding, logistics and overall management, a comprehensive dialogue must take place amongst planners, operators, producers and regulators. At this point, more specific information related to sales trends, market volumes and life cycle of mattresses could be explored in more detail; a component not incorporated into this thesis due to ISPA data accessibility constraints.

Finally, there is a lack of information related to the recycling process for textiles and mattresses specifically. This research acknowledges health concerns related to the dismantling process and the materials that workers are being exposed to, yet there is a need for a more scientific analysis of the hazards that workers face in this new recycling industry.

CHAPTER 6 RECOMMENDATIONS

Having recently enacted provincial stewardship legislation for packaging and printed paper, which will be implemented on May 19th, 2014 (Multi Materials British Columbia, 2013), BC continues to demonstrate global leadership in its management of end-of-life products, containers and packaging. Producer responsibility for mattresses in BC, whether mandated by the province, or establish voluntarily by the sleep products industry itself, will be another significant milestone in the province's leadership journey towards zero waste. Mattresses would be the first furniture item to be managed under EPR/PS laws in BC, setting the stage for sustainable end-of-life management of various furniture items, including couches, loveseats and other upholstered furniture.

Implementing a government mandated EPR/PS program for mattresses in British Columbia is considered the next step in managing ELM's in the province. There are however significant challenges associated with establishing provincial mattress stewardship laws, such as collection, storage and processing units from rural and remote communities; providing free and convenient collection services to multi-family dwellings; providing education and outreach programs that ensure program uptake; the health related concerns associated with biohazards on mattresses, the spread of bedbugs, and the hazardous dismantling process which exposes recycling workers to various airborne particles. Fortunately, BC has a great deal of expertise in EPR/PS program implementation as well as program management and improvement. It is recommended that planners draw on the experiential knowledge base that has been developed since 1970, when BC became the first jurisdiction in North America to develop a deposit-

refund system for soft drinks and beer containers (RCBC, 2011). BC can also take advantage of the fact that BC residents are not apprehensive about recycling and product stewardship as a responsible waste management strategy (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013), and so public backlash and interference should not be an issue of concern.

Those involved in development of a mattress stewardship program for BC will soon be able to look to other jurisdictions for recommendations and strategies from which to draw and share expertise. Various States in America are beginning to enact legislation to mandate mattress stewardship, and so it will be important for BC planners to follow this process closely, to better understand opportunities, barriers, administrative requirements, costs and recycling market data relating to mattress stewardship. Relevant and important features of the US mattress stewardship program will be the stakeholder engagement process, program development, management and funding negotiations, as well as more specific features like collection and distribution mechanisms, remittance structure, geographical optimization of processing facilities, administrative requirements and consumer education/outreach. In addition to the US programs that are currently in development, various voluntary programs have been established across North America, which provide valuable information regarding best operating practices and regional pricing structures. The Metro Vancouver mattress recycling initiative outlined in this paper currently diverts roughly two thirds of the province's mattress waste from landfills, and therefore various program attributes can be scaled to incorporate the remaining less densely populated geographical regions of BC. For instance, the three mattress recycling

businesses operating in Vancouver are successfully operating with a $10-$15 per-unit recycling fee (based on volume). Scaling this fee up to account for province-wide mattress stewardship will mean consideration of increased logistical costs as well as the additional costs associated with managing the program, establishing a reserve fund, funding an outreach program, collecting historical waste and program reporting/auditing. Additional costs will also depend on where recycling facilities are situated and whether or not rural and remote communities will be incorporated in the initial stages of the program. Further research will be required to determine an appropriate provincial recycling fee for mattresses. It should again be noted that during the start-up phase of a mattress stewardship program, a slightly overstated eco-fee would work to the benefit of the overall program, ensuring maximized collection and recycling of mattresses across the province without concerns of funding restraints.

For mattress stewardship legislation in British Columbia it is recommended that a program be developed that is non-prescriptive and flexible and allows different jurisdictions to adapt various program elements to meet their own particular regional needs. For example, the City of Surrey is dense with single-family homes. This means that a large-item pickup service can be delivered to residents at a reasonable cost (economies of scale). Alternatively we can look at a more rural BC community like Smithers, where we would expect to see collection services limited to local transfer stations/landfill. Program flexibility also means that the remittance structure of a provincial program should change over different geographical regions. Collecting mattresses from the more rural and remote areas of the province will cost more than in

dense urban centers, and so funding through remittances for mattress collection should reflect this difference in cost.

Similar to other policy driven stewardship initiatives in BC, constructing the legislative parameters and timeline should be an inclusive process, incorporating mattress producers (manufacturers, retailers, first importers), provincial government policy officials/regulators, local governments, logistical service providers, recyclers, and any other parties who will be affected by the change in management practice. This consultation process should focus on the 'how' elements of developing provincial policy; specifically, how mattress industry stakeholders in BC could effectively implement a province wide mattress stewardship policy that ensures maximum public participation and is environmentally sound as well as cost effective. Following the amendment of the BC Recycling Regulation to include mattresses, the stewardship group or managing agency will be expected to produce a stewardship plan. During this time the stewardship group and the province should work with local governments to establish collection mechanisms and opportunities across the province. From this point, the stewardship program should be implemented in two phases. Full program implementation, where facilities and collection mechanisms are established in each region of BC, should be achieved within three years of the program start date. The first phase of the program should be initiated in highly populated areas of the province, such as Metro Vancouver, the Okanagan, Prince George, and Vancouver Island. By managing ELM's in more densely populated regions, program managers will be able to streamline collection efforts and identify and respond to any problems or opportunities within the system. The second

phase of the program, which involves the more rural and remote BC communities, should be implemented as expertise is gained and collection and financial resources become stable.

Taking advantage of existing collection and logistical infrastructure such as landfills, transfer stations, mattress retail and manufacturing outlets, municipal large pick-up services, and waste haulers/disposal companies will work to minimize program costs. Furthermore, developing reverse logistics networks, an approach employed by Sleep Country to recover ELM's, will be paramount in maximizing ELM collection rates at the lowest possible cost. It is also recommended that program planners look to new inclusive approaches to ELM collection, such as special community recycling events/days, collection partnerships with local businesses and NFP's, and pickup services for multi-family dwellings. These types of services will directly assist low-income and less mobile residents who want to make the sustainable choice when disposing of an ELM.

Given that British Columbia has expertise in product stewardship and implementation and management, it is in a good position to move forward on a provincial mattress recycling initiative. Consolidation of stewardship planning resources and knowledge, specifically through collection partnerships and the Recycling Council of British Columbia, which manages outreach campaigns, has been an effective means to both increasing consumer convenience and overall program efficiency as well as maximizing public awareness and education around provincial stewardship programs. It is recommended that mattress program planners seek out potential synergistic relationships with other provincial stewardship groups, private businesses, and other

organizations, as this will help to increase consumer drop-off/storage convenience and general program awareness. For example, this could mean having thrift stores take part in the program; acting as satellite drop-off locations for ELM's. Thrift stores already see the problem of mattress dumping on their property and it is a huge financial burden for these organizations to have to pay to remove ELM's (B. McDonald, personal communication, September 3, 2013). This type of partnership could result in a win-win situation, where businesses and NFP's may witness increased foot traffic to their establishments by taking part in the collection of ELM's.

The education and outreach component of stewardship planning is very important as it works to minimize public misunderstanding, backlash and political interference, which has been a problem for various provinces, such as Ontario, where stewardship programs became a political issue and couldn't get the proper support from councilors and residents (R. Driedger, personal communication, January 17, 2012; M. Hennessey, personal communication, August 28, 2013). Getting all stakeholders on board with the program will mean trying to align the program with their personal values. Demonstrating the undisputable facts about mattresses in the traditional waste stream will be very important, as will showing the public that roughly 95% of a mattress' components can be salvaged and put to new uses. The education and outreach component of a mattress stewardship program is arguably one of the most important considerations, as this is what lets people know why and how the province will help consumers to make responsible choices.

Producers should be responsible for the mattress stewardship program in the province and in order to ensure there are sufficient funds to initiate and sustain the program, manufacturers should collect advance disposal fees from consumers at the point of purchase. At this stage it is uncertain what the fees will be, and planners should inflate the per unit eco-fee slightly above estimated costs to account for historical waste (waste that is present in society prior to product stewardship development), collection and transport from rural areas, an initial educational blitz, building up a reserve fund of one year's operating expense, and additional unknown costs. Once the program is running efficiently and the system becomes more predictable, then eco-fees might be reduced to better reflect actual program costs.

Industry should be responsible for monitoring and tracking all elements of the program, from eco-fee to the end markets of disassembled materials. This will allow program managers to identify where system inefficiencies and problems occur, where the recycled materials are ending up, which individuals/corporations are trying to cheat the system, where and how. Maintaining accurate program documentation will also streamline the external audit process, which is a mandatory component of stewardship programs in BC. Documentation must be provided by the mattress stewardship organization or managing agency to provincial regulators who will ensure that regulatory requirements set out in the stewardship plan are being met. A good tracking/monitoring system will help managers refine the program once the implementation stage is complete.

Conclusion

This thesis examines how mattress industry stakeholders in BC could effectively implement a province wide mattress stewardship policy that will ensure maximum public participation and will be environmentally sound as well as cost effective. Findings from the literature review, case study of Metro Vancouver's mattress recycling program, and exploratory interviews confirm that recycling ELM's is the most sustainable waste/resource management practice, shifting the burden of waste from governments to those responsible for the product. Landfilling mattresses creates a number of problems for society and the environment, whereas recycling mattresses has a number of social and environmental benefits, such as the associated job creation and the carbon emissions reductions associated with salvaging and reusing materials.

In summary, findings from this paper suggest that the development of a provincial stewardship program for mattresses should include advance disposal fees to create a fund for program management. The program must plan for convenient and free access to collection services, taking advantage of reverse logistics networks, a collection technique utilized in Sleep Country's national ELM recycling program. Planners must also seek out potential partnerships and region specific collection programs that work to maximize user convenience. Partnerships may include aligning collection services with existing stewardship programs, such as with Encorp (beverage containers and electronics), or it may mean that planners need to seek out synergies with other organizations, like thrift stores and private businesses. Program planners should also look to special collection events/days and other initiatives that help to combat the challenge of collecting

mattresses from multi-family dwellings and remote communities. It is also recommended that the provincial program have two phases. Phase one would include collection and recycling mattresses in the more dense, populated regions of the province, such as Metro Vancouver, the Okanagan, Prince George, and Vancouver Island. Phase two would be implemented as the program develops and becomes financially and operationally stable.

BC is a leader in stewardship program development and so engaging various local experts in the process of mattress stewardship will only benefit the planning process. There is a need for research into the program pricing and remittance structure, and given the various voluntary mattress recycling initiatives identified in the literature review combined with advanced forecasting practices and the experiential knowledge base in BC, a suitable eco-fee will have to be developed. Furthermore, it is suggested that the eco-fee be inflated initially to account for unknown expenses and ensure that an inclusive education and outreach strategy be developed. Education and outreach to maximize public awareness will also been an important component of the mattress stewardship programs as it will reduce consumer agitation and promote program benefits, letting people know why the program is in place.

Product stewardship for mattresses offers an ecological, political, social, and economic opportunity for governments. Development of provincial programs will work to reduce material being landfilled, reduce the demand for raw/virgin materials and subsequent carbon emissions, create jobs, create economic activity, and provide an inspiring alternative waste management success story, which will promote new ideas and

encourage a new generation of eco-entrepreneurs who will guide the global zero-waste effort into the future.

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