Policy Options to Reduce Consumer Waste to Zero: Comparing Product Stewardship and Extended Producer Responsibility for Refrigerator Waste

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ABSTRACT

Today, over consumption, pollution and resource depletion threaten sustainability. Waste management policies frequently fail to reduce consumption, prevent pollution, conserve resources and foster sustainable products – as seen in the context of managing end-of-life refrigerators and appliances containing ozone-depleting substances (ODSs). However, waste policies are changing to focus on lifecycle impacts of products from the cradle to the grave by extending responsibilities of stakeholders to post-consumer management. Product stewardship and extended producer responsibility are two policies in use, with radically different results when compared for one consumer product, refrigerators. North America has enacted product stewardship policies that fail to require producers to take physical or financial responsibility for recycling or for environmentally sound disposal, so that releases of ozone depleting substances routinely occur, which contribute to the expanding the ozone hole. Conversely, Europe's *Waste Electrical and Electronic Equipment* (WEEE) Directive requires extended producer responsibility, whereby producers collect and manage their own post-consumer waste products. WEEE has resulted in high recycling rates of greater than 85%, reduced emissions of ODSs and other toxins, greener production methods, such as replacing greenhouse gas refrigerants with environmentally friendly hydrocarbons and more reuse of refrigerators in EU compared to North America.

KEY WORDS
Extended producer responsibility, product stewardship, refrigerator, ozone-depleting substances, end-of-life, waste

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INTRODUCTION

Effective waste policies are badly needed as waste per capita continues to increase throughout North America and the world. Inefficient production processes, poor product design and societal over-consumption are blamed (Sinclair and Quinn 2006). In North America, municipal waste management subsidies have ultimately created a 'disposable society' (Seidel 2006). Municipalities are obligated to manage consumer waste streams with the costs levied through municipal taxes, rather than internalized into product pricing. Policymakers are now emphasizing lifecycle analysis, which examines cradle-to-grave impacts of products and processes. This analysis extends responsibilities to one or more stakeholders along the product chain to include post consumer management. Although "waste generation should be prevented in the first place; and final residuals should be treated in an efficient manner" (OECD 2001:93), realistically, life-cycle impacts are externalities, not required to be counteracted or paid for by the producer (BIAC 1998).

Responsibilities for end-of-life management must be assigned and clearly articulated when developing policy if waste from consumer products is to be reduced. Effective policies exploit all possible avenues for waste reduction (*i.e.,* source reduction, recycling, material substitution, etc.). Product and producer responsibility policies have emerged as two important approaches to minimize environmental impacts of products and realize zero waste. Extended producer responsibility (EPR) requires producers to pay the cost of recycling their post-consumer waste (Sachs 2006; Walls 2006). Conversely, product stewardship does not target producers specifically, relying upon other stakeholders, with costs paid by consumers, material handling by the vendor or municipality, and no required recycling targets (Schwartz and Gattuso 2002; Short 2004; Walls 2006). In 2006, the European Union (EU) adopted EPR to deal with the growing volume of refrigerators and electronics while North America has no sustainable electronics management plan (Sachs, 2006; Short, 2004). Thus, it is important to see whether EPR has any benefits over product stewardship to recommend policy for post-consumer refrigerator management in North America.

APPROACH

EPR and product stewardship policies were compared for effectiveness at achieving environmental goals, particularly towards refrigerators in Europe and North America. A literature review, interviews, a survey and tours of recycling and disposal facilities in the US, Canada and the EU were conducted to ascertain the impact of different policies for the management of post consumer waste refrigerators.

Fifty million refrigerators are sent for disposal each year in North America and Europe respectively, representing one percent of the total municipal solid waste stream.

Refrigerator waste management is an important case study as they contain ozone-depleting substances (ODS). Refrigerators contain chlorofluorocarbons (CFCs) in their insulating foam and cooling circuit, which are major contributors to ozone depletion. Releasing refrigerants into the atmosphere has created "ozone holes," which are severe depletions of the stratospheric ozone layer above the Arctic and Antarctic poles. The chlorine from CFC molecules bond with oxygen destroying 100,000+ ozone (O_3) molecules over its 40-120 year life span. Scientists report that the 2006 ozone hole was the largest to date (NASA 2006). The ozone layer is needed to protect life from the harmful impacts of solar radiation. With its thinning, increases in skin cancer, cataracts, and loss of species diversity have occurred over the last few decades (The Ozone Hole 2006). Additionally, each kilogram of CFC-12, one of the most commonly used CFCs, has the global warming potential of about 11,000 kilograms of carbon dioxide. Despite implementing the Montreal Protocol (the international agreement to protect the stratospheric ozone layer), Canada and the US have no comprehensive waste management policy for discarded refrigerators.

Although EPR and product stewardship are very different in practice, these terms are used interchangeably (Worrell and Appleby 2000:266). McKerlie, Knight, and Thorp (2006) found that policy makers confuse these terms, mistaking shared responsibilities for sole producer accountability. The US Environmental Protection Agency's (EPA) describes product stewardship as a system of shared responsibility extending beyond EPR (Hanish 2000). Similarly, Minnesota (2006) makes no distinction between extended product responsibility, shared responsibility, manufacturer responsibility, and EPR. As well, EPR is labelled product stewardship: British Columbia's 'full product stewardship approach,' is actually an EPR policy as producers assume full physical and financial responsibility, which includes consumer education, collection, recycling, etc. This mixing up of the two obliterates the important difference "between truly progressive EPR programs which aim to prevent rising levels of waste and pollution, versus shared product stewardship initiatives" which do not (McKerlie, Knight, and Thorp 2006:620).

COMPARING THE TWO POLICIES

There are many product/producer responsibility strategies as Diagram 1 shows the continuum from low producer responsibility for product stewardship to ultimate producer responsibility for EPR.

Diagram 1: Continuum of Producer Responsibility for Different Strategies.

<------------------------------ Decreasing Producer Responsibility <------------------------

Product Stewardship	Shared Responsibility	Shared Producer Responsibility	Producer Responsibility	Extended Producer Responsibility

---------------------------------> Increasing Producer Responsibility ----------------------→

Modified from: (Business and Industry Advisory Committee to the OECD 1998)

Extended Producer Responsibility

EPR is defined as "the producers' responsibility, physical and/or financial, for a product [which] is extended to the post-consumer stage of a product's life cycle, to provide incentives to producers to incorporate environmental considerations in the design of their products" (OECD 2001:18). Physical responsibility refers to the direct or indirect handling of a product, including take-back by producer for recycling (Toffel 2002). Financial responsibility has the producer pay for any end-of-life recycling and disposal costs. This relieves municipalities of the financial burden of waste management and encourages producers to reduce resources, utilize recycled materials, and undertake product design changes to reduce waste (OECD 2001 *in* Walls, 2003). The producer is in the best position to assume waste management responsibilities, holding the most product-related knowledge and controlling the production and design process.

EPR includes product recycling, regulation, and redesign as solutions for sustainability. Policy instruments can include product fees, such as advance recycling fees (ARFs), product take-back mandates, virgin material taxes, pay-as-you-throw, waste collection charges, and landfill bans (Sachs 2006). Consumer education programs, that encourage product recycling over disposal, help producers effectively recover their products from consumers.

EPR policies have three characteristics: 1) a focus on end-of-life waste management to encourage environmental redesign, 2) a shift of physical and/or financial responsibilities from taxpayer/consumer to producer, and 3) an explicit target for waste reduction (e.g., WEEE 75—80% recycling of refrigerators). Mandated programs "force producers to get involved in managing material streams" (McKerlie, Knight, and Thorp 2006:625). Effective EPR programs require government regulations mandating producer responsibility for the physical and financial take-back of their products with limited government involvement. An open market with diverse competition for waste management is considered to be more effective than state-run programs, which suppress competition (Sheehan and Spiegelman 2005a). Mandated programs prohibit 'free riders,' who abuse take-back programs by using the established infrastructure for collecting their products without providing an ARF to fund that system.

When lifecycle environmental costs are required to be paid by the producer, implementing green production processes makes economic sense. Design for Environment (DfE) has producers considering "at the development phase of a products life cycle, the environmental impacts through enhancing the product design…[which] includes resource consumption, both in material and energy terms and pollution prevention" (Dantes 2005:1). Environmental considerations in product design include: waste minimization, reuse or recyclability, material conservation, pollution reduction, lower toxicity and "eco-design" (Schwartz and Gattuso, 2002; Walls, 2006).

EU's Waste Electrical and Electronic Equipment (WEEE) Directive
The WEEE Directive is EPR legislation that regulates the collection, recovery, reuse, and recycling of electrical and electronic equipment destined for disposal. The onus of post-consumer product disposal is solely the producers and requires all products on the market be designed for disassembly and recovery. Consumers of WEEE products must have the opportunity to return waste items, without charge, to collection facilities with the producer responsible for product recovery (M. Baker Recycling 2006).

Prior to WEEE, several member states within the EU (Belgium, the Netherlands, Sweden, Norway, and Switzerland) adopted national regulations and management schemes for e-wastes (Sachs 2006; Savage et al 2006). Programs operated at a recycling rate of approximately 80-90% with 97% achieved by Switzerland. The Norwegian, Belgian, and Dutch models had visible ARFs on the sale of white goods (i.e. all refrigerators in Belgium had a flat fee of 20 euros per unit) while the Netherlands charged costs related to the cost/ease of recycling specific products. Industry supports ARFs to illustrate the costs of recycling historical waste for periods of eight-ten years – as white goods constitute the largest category of historical waste. As pre-2005 orphaned products (after August 13, 2005 producers deal only with their own products) become a smaller part of total waste collected, producers have greater incentive for ecodesign, to reduce costs associated with recycling/reuse and individual collection, for a market price advantage (Savage, 2006).

Drawbacks to EPR
The majority of producers saw few commercial opportunities in implementing WEEE, only 'a burden and a challenge, nothing positive' (Savage et al 2006:25). The 20 euro ARF applied to the sale of refrigerators in Belgium does little to drive DfE changes, by not rewarding manufacturers/consumers of environmentally friendly refrigerators. The lack of linkage between fee levels for recycling and actual costs (as a result of cross subsidy or high administrative costs) has led some producers to show that "a cost-effective recycling solution is not necessarily related to environmental benefit" (Savage, 2006:30). Many producers are disappointed at the missing incentives in the Directive for better environmental performance, as they will be charged for their products on, e.g. a weight basis, independently from the attributes of their products in the same category. Although all nations allow individual and collective producer compliance, criteria usually encourages producers to join a single national collective system to reduce the burden of monitoring and approvals on government. Some producers argue that waste management requirements of EPR are unfair as producers are not experienced waste managers. Furthermore, product related environmental footprints are not always reduced by the producer acting alone, without other actors, such as retailers, consumers, and municipal waste management organizations "pitch[ing] in for the most workable and cost-effective solution" (US EPA 2001 *in* Toffel 2002:5).

Product Stewardship
Product stewardship is "an environmental management strategy that means whoever designs, produces, sells, or uses a product takes responsibility for minimizing the products environmental impact through all stages of the products lifecycle" (NWPSC 2001 *in* Toffel 2002:5). This multi-stakeholder approach advocates participation from all

actors along the product chain including the producer, manufacturer, importer, distributor, retailer, consumer, and recycler (Sheehan and Spiegelman 2005a). Ideally, responsibility is divided up as follows: producers ensure that collection and recycling infrastructure is in place, consumers pay levies and deliver the product to collection points, retailers participate in collection of waste, and governments establish standards and ensure free riders do not take advantage of the system (Thorpe, Kruszewska, and McPherson 2004).

However, allocating responsibilities among many stakeholders often leads to confusion over who is primarily responsible for end-of-life management (OECD 2001; Thorp, Kruszewska, and McPherson 2004). As well, the role of producer is limited, typically, having no financial or physical responsibility. Shared responsibility approaches fail to internalize environmental impact costs, providing no feedback to the producer regarding lifecycle management costs of their products. Although product stewardship programs increase recycling rates they fail to reduce consumption or prevent pollution. This legislation neglects to *prevent* waste, as it provides no incentive for DfE and does not impose hazardous wastes restrictions (i.e. RoHS) or recycled content targets. Overall, product stewardship programs are a "step in the wrong direction because they will not lead to better and safer product design nor will they lead to the phase out of hazardous chemicals in the product" (Thrope, Kruszewska, and McPherson 2004:21).

Policy makers in North America are reluctant to require EPR. The US has rarely mandated strict guidelines for product manufacturing towards processes or types of materials used. The lack of green product development, compared to the EU, is explained by the "stronger conception of individual and property rights in the United States, the legacy of the western frontier and the relative abundance of open space in the United States, and a greater mistrust of government in the United States" (Sachs 2006:86). Also US manufacturers lobbied for product stewardship over mandated EPR (Thorpe, Kruszewska, and McPherson 2004). Industry pressure led to the Presidents Council on Sustainable Development abandoning EPR for voluntary, shared responsibilities (Sheehan and Spiegelman 2005a).

Comparing the Two Policy Approaches for Effective in Refrigerator Management

Table 1 compares the two policy approaches -- EPR in the EU to product stewardship in North America for refrigerator management.

Table 1: Comparison Between Different Refrigerator Waste Approaches in the European Union and Canada

Environmental, and funding considerations of policies	EPR in WEEE Directive – EU	Product Stewardship -- North America
Targets to encourage full recycling/reuse	Minimum 75-80% per unit.	No target requirements set.
Recycling rates	Recycling rates exceeded 80% reaching 97% in Switzerland.	Unknown (much less than 75%)
Best Available Technology (BAT) for recycling	Required. MeWa/SEG advanced technology reduces ODS emissions.	Not required. Automotive shredding releases ODS and other toxic materials.
Adequate funding for collection and recycling	Yes -- producer pays	Generally, municipalities do not provide enough funding for BAT.
ODS in refrigerant recovered	Yes (Average 99% recovery rate under MeWa/SEG technology)	Yes with an estimated 10% non-compliance found in Canada from Survey of 45 landfills
Adequate infrastructure in place for recycling	Yes (inclusive refrigerator recycling facilities)	Generally limited to scrap metal recycling and refrigerant recovery.
ODS in insulating foam recovered	Yes.	No facility in Canada to recover ODS in foam results in its release. Manual disassembly techniques reduce emissions.
Monitoring and regulation of ODS	Yes – 0.05 grams per hour, strict regulation.	Yes, however, rarely enforced.
Monitoring and regulation of mercury switches and PCB	Recovered prior to recycling	No
Free of Charge Take-back for consumer paid by producer	Yes	No. Costs $35-115 to consumer for pick-up and decommissioning results in illegal refrigerant venting or unit disposal.
Collection systems	Yes.	Usually municipal solid waste
Regulation prohibiting toxic materials	Yes – RoHS	No
Incentives for DfE	Yes	No
Promotion of reuse	Yes	No – discourage reuse due to older models using 2x electricity.
Incentives for repair/remanufacture	Yes	No
Landfill ban	Yes	Limited – Depends on jurisdiction

North American and EU approaches to refrigerator management show the striking differences between product stewardship and EPR on: recovery/recycling/reuse targets, emissions of ODS, and environmental design feedback. The EU has much higher recycling rates for all refrigerator components whereas North America, recycling is limited to metals and refrigerant collection. In the EU, WEEE stipulates that 75-80% of all component parts from refrigerators must be recycled or reused (Official Journal of the EU 2003, M. Baker 2006, Walls 2006). For example, the Dutch *Management of White and Brown Goods Decree* (1998) set recycling targets at 75% and actually achieved 85.5% between the years 2000-2001 (Walls 2006). By producers being required to fund recycling and collection infrastructure, implementation of best available treatment technology is possible (Sachs, 2006). For refrigerators that means properly extracting, containing, and treating any ODS or greenhouse gases contained in a cooling circuit or insulating foam (Official Journal of the EU 2003). For example, the UK has a number of refrigerator recycling factories to service the many municipal collection centres throughout the country. Specialized treatment systems have been installed for collection of refrigerant, shredding and separating component materials, treating insulating foams for CFCs, and recovering compressor oils. Recovery rates for ODS are strictly regulated and emissions from recycling factories are limited to less than five grams per hour (with actual emissions of less than one gram per hour) (Sims Group 2004). Exceeding limits trigger alarms and requires an environmental officer to visit and apply warnings or fines (Pers. Comm. Reeves & Holyoak, 2006). In contrast, only a few local governments in North America run appliance collection programs due in part to limited funding (Pers. Comm Art Eggleton 2006), with plastics and untreated ODS insulating foams typically being landfilled. In EU, one recycler uses treated ODS foams as oil and chemical binders called ÖKO-Pur (SEG 2007), although much still goes to landfill after treatment (Pers. Comm Holyoak, Reeves, and Dunham 2006). In the EU, mercury switches are collected by hand prior to recycling to prevent contamination but in North America, they are often shredded with the refrigerator causing widespread contamination of a highly toxic compound.

In the EU, the ban on hazardous substances (RoHS) and the internalization of waste management costs has resulted in ecodesign. WEEE requires that new electrical and electronic equipment contain no hazardous materials (Macauley, Palmer and Shih, 2003), requiring hydroflourocarbon (HFC) replacement by hydrocarbons as a refrigerant. Electrolux, the world's largest appliance manufacturer, has actively reduced the toxic impacts of their refrigerators through DfE. In Europe, R134a (an HFC with a high global warming potential [GWP] of 1,300) has been successfully switched to cyclopentane as an auxiliary blowing agent and isobutane has replaced R134a as the refrigerant (Wilt 1997). Conversely, in North America the municipality or consumer, and not the producer, pays for disposal, recycling and decommissioning. As a result, end-of-life costs remain externalities, providing no incentive to prevent pollution by switching to hydrocarbons or require environmental waste management.

In North America, most ODS, oils and other toxic compounds in refrigerators are released. Automotive shredders separate component parts — potentially releasing compressor oils (containing residual ODS) and ODS within insulating foams (35% ODS immediately released, with remainder off-gassing over time in landfill). Best available technology is not required and rarely used, but some recycling facilities in the U.S. recover ODS foam manually, which results in only minimal loss during rip-down (Dunham 2006). Seventy-five percent of ODS is contained within the foam, which is typically landfilled untreated, resulting in its release with only 25% of ODS refrigerant recovered. However, this refrigerant isn't always recovered: approximately 10% of the time, the consumer avoids the end-of-life decommissioning costs, which amount to $35-$155, by releasing it. Thus, 75% to 100% of the ODS is typically released in North America. Enforcement of ODS regulations are rarely imposed and those in contravention are rarely disciplined (Friends of the Earth 2001).

Finally, reuse of refrigerators is favoured in the EU more than North America as embodied energy and recycling costs are considered (Sachs, 2006). Many EU recyclers partner with social and community organizations to refurbish older low-cost appliances for lower income families (Sims Recycling Solutions 2004). Conversely, in North America, a few utility driven recycling and collection programs focus on removing older appliances, which require twice the energy of an equivalent newer appliance. Incentive is given to the resident, either as cash or a rebate on their utility bill. Although this reduces consumption of electricity for the refrigerator, it increases consumption of new refrigerators.

CONCLUSION

Wastage has risen over the past few decades due, in part, to ineffective policies that have failed to account for lifecycle environmental impacts of consumer products. Although EPR and product stewardship policies both share a similar foundation in extending responsibilities for waste management but differ radically in their effectiveness. The blurring of the lines between each approach has confused policy makers -- this confusion has to be removed in order to arrive at truly progressive polices that prevent rising levels of waste and pollution.

To achieve high recycling rates, reduce ODS and other toxic emissions, encourage environmental design and provide adequate funding — EPR is clearly superior. EPR provides best available technologies for ODS recovery (in both the cooling circuit and insulating foam), treatment of toxic and hazardous substances (mercury switches) and has markets for recovered materials such as steel, aluminium, copper, plastic, glass and emerging ones for insulating foams. Mandatory EPR programs that target specific recovery and recycling rates are effective in reducing waste and driving DfE changes for consumer products, such as switching from HFCs to hydrocarbons as refrigerant. In contrast, product stewardship externalizes end-of-life costs and provides no incentive to prevent the generation of waste during the design stage and no regulation to reduce emissions or increase recycling rates. EPR has rarely been applied in North America, despite the lacklustre performance of product stewardship at reducing waste and preventing pollution, which has the municipality or consumer taking back the products and paying end-of-life costs. However, British Columbia's full product stewardship program, provides a North American EPR model in which industry must take physical and financial responsibility for their products.

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