SWIMMING UPSTREAM:
PRODUCT STEWARDSHIP AND THE PROMISE OF GREEN DESIGN[1]

DOCUMENT CONTEXT AND PURPOSE

This document is one of several exploratory papers developed for the Product Stewardship Stakeholder Process convened by Oregon's Department of Environmental Quality[2]. The focus and intent of this briefing paper is an exploration of product stewardship as an environmental management strategy for "greening" product design and production, and thereby reducing product life-cycle impacts. If successful, this document will provide a common language and expanded vocabulary for stakeholders involved in the DEQ process and for future discussions regarding product policy mechanisms and their ability to influence product design [3].

Product-oriented policies are increasingly being used by all levels of government to address concerns regarding material use and toxicity (as well as energy use and production impacts) throughout the life-cycle of the products we use. Oregon has laws on electronics, paint and beverages. If future laws and policy tools are to best balance the needs of all stakeholders, the literacy of all interested parties is essential.

ABSTRACT/ DOCUMENT SUMMARY

Product-oriented policies reflect an awareness of – and an attempt to address – the impacts products have at end of life, as well as throughout the product's life-cycle. Ideally, such product stewardship policies establish built-in mechanisms and incentives that minimize environmental impact at time of disposal, as well as during design, production, transport and other life-cycle stages. This is often achieved by building the costs of such impacts into the consumer-manufacturer transaction, rather than covering such costs through solid waste rates and taxes. Many mechanisms exist and are emerging that establish level regulatory playing fields, thus allowing industry to compete on improving their environmental footprint, rather than simply cost and performance. These mechanisms rely on different engines, ranging from leveraging purchasing power (EPEAT, Top Runner) to restricting materials (RoHS, food service packaging), to requiring manufacturer takeback (Paint, E-Waste). These approaches provide lessons and experience from which Oregon can draw when exploring continued product-oriented policies as a tool for decreasing waste and toxicity in the State. Several lessons and policy recommendations are suggested.

BROAD ISSUE BACKGROUND

1 Prepared on behalf of the 2010 Oregon Department of Environmental Quality Product Stewardship Stakeholder Group. Funded by Metro, Resource Conservation & Recycling Division. Prepared by David Stitzhal, MRP, Full Circle Environmental, Inc., stitzhal@fullcircleenvironmental.com, May, 2010

2 http://www.deq.state.or.us/lq/sw/prodstewardship/stakeholdergroup.htm

3 The definition of product stewardship -- and discussions of key policy elements that address "downstream" stages (such as convenience standards, disposal bans, etc.) -- are covered in other papers prepared for the Stakeholder process.

Commerce – the river in which products ebb and flow – is undergoing a transformation characterized fundamentally by an explosion of information. This explosion is jointly fueled by a growing demand for information (by customers, suppliers, manufactures, recyclers, consumers, solid waste officials, regulators and others) and by an increasingly sophisticated ability to provide information (through computing power, life-cycle assessment protocols, product tagging, scientific monitoring, greenhouse gas calculators, etc.). Together, the supply and demand of information allows, and fosters, a call for increasing product transparency. This transparency tries to address such questions as:

- Where is the product made,
- Who made it and under what conditions,
- What materials went into the product and how much recycled-content was utilized,
- What is the greenhouse gas footprint,
- How else does it impact the environment or public health, across the whole life cycle,
- What impacts does the product have on the user,
- Is the product recyclable, repairable or reusable,
- And many others[4].

Design issues have always been at the center of such questions, therefore design issues sit squarely at the heart of all product policy discussions. Even questions that appear to narrowly focus on end-of–life concerns about product disposal and recyclability quickly move the inquirer 'upstream' toward questions of design, and more broadly, toward questions of product-associated impacts throughout the product's life-cycle. It's hard, for example to talk about recycling rates for computers without stakeholders soon emerging to discuss whether the varied plastic components are comprised of the same resins, whether the metal and plastic components are easily separable, whether the materials used offer life-cycle environmental benefits compared to alternative materials, whether toxic components have been eliminated or minimized, whether stand-by and operational energy use have been minimized, etc. These are all systemic questions of design that impact all links in a product's life-cycle chain, from material extraction to end-of-life management.

UPSTREAM AND DOWNSTREAM:
ALL THE WORLD'S A STAGE

In product policy discussions it is important to differentiate between upstream and downstream life-cycle stages, as well as between upstream and downstream impacts. Upstream stages typically encompass design, manufacturing and marketing activities while downstream stages include recycling and waste handling. Upstream impacts are those associated with resource extraction, manufacturing and distribution. Downstream impacts are those associated with end-of-life transport and associated disposal and recycling activities.

These distinctions are particularly useful for clarifying that changes in practices in upstream *stages* can influence downstream *impacts* (e.g. design changes can reduce toxic burdens in recycling and disposal facilities), and similarly, changes in practices in downstream *stages* can influence upstream *impacts* (e.g. establishing an EOL recycling infrastructure results in materials being collected and sent to recycling markets, which (typically) reduces manufacturing-related impacts, when these recovered materials are used in the manufacture of new products).

PROVISOS FOR DISCUSSION

4 This document does not explore calls for transparency with regard to nutrition, labor organizing and other attributes associated with production and use.

Product policy is an emerging, expanding and maturing discussion. There are areas of agreement, areas of argument, areas of ambiguity. It is therefore important to remain open to differing perspectives, as well as to the outcomes of on-going program, policy and regulatory experiments that are churning out data yet to be analyzed and interpreted.

In order to keep the discussion more focused, the following points are provided as a backdrop to bear in mind. The intent is that, having given these important concepts voice, we need not get distracted by them during our more concentrated discussion on product stewardship mechanisms and implications for Oregon policy and programs..

- A growing number of products and product components are being addressed by product stewardship policies.
- Product stewardship embraces a wide range of tools and mechanisms, including take-back requirements, substance restrictions, individual as well as joint producer responsibility, recycled-content standards and more.
- Europe, Asia and Canada are rapidly developing product stewardship policies and programs with, among other goals, an aim to influence green product design, energy use and other life-cycle impacts.
- Product policies, specifically those addressing end-of-life material use and toxicity considerations, are in a time of growth and transition. The majority of even the most mature policies are less than twenty years old.
- Attempts to lessen the environmental impacts at one stage of a product's life-cycle may actually increase the impacts at other life-cycle stages, sometimes with an unintended net loss to the environment.
- No single policy or restriction can drive manufacturers to utilize green design for all future products.
- No single policy tool should be rejected out of hand because it doesn't single-handedly address all aspects of product design and disposal.

THE CONCEPT

Let's start simple. You are an electronics recycler and you receive a mainframe hulk with parts made from multiple plastic resins in a manner that is hard to disassemble, has components with toxic materials and the stand-by mode drains away 12 watts/hr. Who designed this thing, and did they ever think beyond the sales floor? It doesn't take long for your thoughts to flow upstream to the origin of the product's troubling features. And likely you arrive equally quickly at *prevention* as the best solution to eliminate the processing and toxicity challenges. The question is, How to achieve such prevention? Options include:

- Consumer demand – customers stop buying products that are difficult to recycle or have problematic features, and choose to replace their hardware less often[5].
- Market demand – stores stop carrying products about which consumers express concern.
- Competitive demand – competing companies capture market share by offering "greener" products.
- Internal company demand – management chooses to avoid liability exposure by making process and material changes that place them outside the regulatory envelope.
- Social demand – the press or advocacy groups spotlight the product and producer.

[5] For a broader discussion on issues of sustainable consumption, The Journal of Industrial Ecology (JIE) has recently published a special issue on Sustainable Consumption and Production (SCP). The papers of this issue are available for free at: http://www3.interscience.wiley.com/journal/123296535/issue .

- Regulation/ Legislation – enforceable guidelines establish explicit limits for material selection, toxicity, energy demand, etc.

> [O]nce the product is sold, problems generated by poor design often create no cost to the company that produces it (e.g. the product manufacturer bears no responsibility or costs associated with ease of dismantling or sorting). – Design for the Environment Best Practices: Lessons for British Columbia's Ministry of Environment; Prepared by Five Winds International; March, 2009.

This pallet of options relies on broad drivers, such as demand-side behavior (which often comes after a product has been put on market) and narrow drivers, such as prohibitions, bans and other command-and-control mechanisms that constrain the market and depend upon enforcement.

Product stewardship offers a finesse on these options by creating baseline regulations and by supporting infrastructure development, often within a specific product category. These regulations and infrastructure serve to organize the free-market in such a way – sometimes simply by increasing transparency and information flow -- that business behavior inherently recognizes, addresses and internalizes environmental impacts, and is rewarded for doing so.

The salient issue for product stewardship is this: how can product policy be expressed through a combination of regulatory and free market structures such that the production chain, starting with designers, inherently pushes toward and rewards reductions in life-cycle environmental impacts?

The sample mechanisms in the next section attempt to do just that – namely, use regulatory tools and market drivers to structurally embed incentives for product design that decrease life-cycle environmental impacts.

MECHANISMS

There are numerous policies and mechanisms currently in play that attempt to shape and harness market mechanisms to drive product life-cycle improvements. Rather than try to provide an exhaustive list, the sampling below offers several different types of product stewardship programs in an effort to spotlight different concepts, approaches, tools and mechanisms used to drive design change and to lower life-cycle environmental impacts. Some are more market driven, others are more regulatory, some mandatory, some regulatory. Also note that while many of these approaches are being implemented at a national level, even those may be scalable or able to be modified for state level implementation.

> **HP, Sony, Dell Push PVC, BFR Restrictions**
> An alliance of global companies including Acer, Dell, Hewlett-Packard and Sony Ericsson, and environmental organizations including the European Environmental Bureau (EEB), urged restrictions on PVC and brominated substances in electric and electronic equipment in the EU. -- Environmental Leader; May 24, 2010; http://www.environmentalleader.com/2010/05/24/hp-sony-dell-push-pvc-bfr-restrictions/

Restriction on Hazardous Substances (RoHS)

Highlighted Aspect: RoHS uses a regulatory approach to drive the restriction and phase-out of specific hazardous substances from selected products made or sold into the European Union.

Description: RoHS, also known as Directive 2002/95/EC, originated in the European Union and restricts the use of specific hazardous materials found in

electrical and electronic products. All applicable products in the EU market after July 1, 2006 must pass RoHS compliance.[6] The substances banned under RoHS are lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (CrVI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

Discussion: This policy tool was developed to work as a companion to WEEE (Waste Electrical and Electronic Equipment Directive) which focuses more on end-of-life take-back requirements. The idea is that rather than having one policy that attempts to simultaneously improve EOL product recovery and toxicity reduction, the two policies could work in tandem. Domestically, the California Air Resources Board (CARB) has implemented a RoHS-like approach in its prohibition of certain hazardous constituents from certain consumer products (e.g. methylene chloride, perc, and trichloroethane in brake, engine, and carburetor cleaners).

<u>Waste Electrical and Electronic Equipment Directive (WEEE)</u>

Highlighted Aspect: WEEE mandates collection, recycling and recovery targets for a broad range of electrical products, with the responsibility for such management falling on the product manufacturers.

Description: The WEEE Directive is the European Community directive 2002/96/EC on waste electrical and electronic equipment which, in tandem with the RoHS Directive, became European Law in February 2003. Manufacturers responsible for collection and recycling targets are required to establish an infrastructure such that "Users of electrical and electronic equipment from private households should have the possibility of returning WEEE at least free of charge".

Discussion: WEEE is not intended on its own to influence product design, but rather in tandem with the RoHS Directive. Collection and recycling requirements alone for some products may not be able to send design change signals upstream to producers. That being said, there is evidence that when manufacturers are responsible for taking back their own equipment specifically, there may be sufficient incentives to drive upstream design changes. (See discussion below re. individual producer

> [E]vidence from corporate environmental and sustainability reports….explicitly mention the influence of both the WEEE (Waste Electrical and Electronic Equipment) and the RoHS (Restriction of Hazardous Substances in EEE) Directives on product design. – p. 7, "Extended Producer Responsibility: An examination of its impact on innovation and greening products," Chris van Rossem, Naoko Tojo, Thomas Lindhqvist; International Institute for Industrial Environmental Economics

[6] For the complete directive, see Directive 2002/95/EC of the European Parliament.

responsibility.)

Top Runner

Highlighted Aspect: Japan's Top Runner Program is a combination of regulatory and market-driven measures; it uses existing, already on the market, high performing products and product attributes to set required benchmarks for that product.

Description: Japan's Top Runner program is a regulatory framework designed to stimulate the continuous improvement of the use-phase energy efficiency of products. The Top Runner Program sets energy efficiency targets for 11 products, namely, passenger vehicles, motor trucks, air conditioners, fluorescent lamps, television receivers, copying machines, computers, magnetic disc devices, video cassette recorders, refrigerators and freezers. These machines occupy about 70% of total residential power consumption and about 80% of total power consumption of office automation equipment.

The target values are set on the basis of whether a product has the highest energy efficiency of all the products of the same group currently in the market. This is a substantial change from the earlier energy-efficiency standard because the previous one was set based on average performance.

Under this law, all manufacturers and importers are obliged to achieve these challenging targets by a specified target year. If a certain manufacturer or importer can not comply with the target by the target year, a regulatory authority will issue recommendations to it, and if it fails to abide by the recommendation, its name will be made public or an administrative order will be issued.

Discussion: Top Runner's hallmark is its focus on the supply-side, not the demand-side, of product markets. The obligation of compliance with Top Runner regulations rests entirely with manufacturers and importers. If producers wish to remain in the marketplace, they must meet certain design requirements, and if they excel in this regard, they are rewarded distinctly by the government sector through preferential purchasing.

Electronic Product Environmental Assessment Tool (EPEAT)

Highlighted Aspect: EPEAT is a voluntary, market driver approach. It uses a tiered ranking and third-party certification system to qualify greener products, thereby making them easier to identify for purchase.

Description: "EPEAT is a system that helps purchasers evaluate, compare and select electronic products based on their environmental attributes. The system currently covers desktop and laptop computers, thin clients, workstations and computer monitors. Desktops, laptops and monitors that meet 23 required environmental performance criteria may be registered in EPEAT by their manufacturers in 40 countries worldwide. Registered products are rated Gold, Silver or Bronze depending on the percentage of 28 optional criteria they meet above the baseline criteria. EPEAT operates an ongoing

verification program to assure the credibility of the registry."[7]

Discussion: EPEAT has essentially established a "market mandate" for green products given its wide adoption by the leviathan federal purchasing system. This is a clear example of how procurement regulations, in this case a directive to purchase EPEAT certified products, can be a market driver. Manufacturers have quickly moved to redesign products to meet EPEAT standards.

Oregon E-Cycles Program

Highlighted Aspect: Oregon is one year into implementing a statewide program requiring manufacturers to finance and arrange for end-of-life management for computers, TVs and monitors.

Description: "Oregon E-Cycles is a free, easy and environmentally responsible recycling program for computers, monitors and TVs. The program is financed by electronics manufacturers and jointly implemented with the Oregon Department of Environmental Quality (DEQ). Anyone can bring seven or fewer computers (desktops and laptops), monitors and TVs at a time to participating Oregon E-Cycles collection sites for free recycling."[8] This program is coupled with a disposal ban that went into effect in the beginning of 2010.

> A principal reason for allocating responsibility to producers is their capacity to make changes *at source* to reduce the environmental impacts of their product throughout its life cycle. It is essentially the producers that decide the features of the products they manufacture at the design phase of products. Rational manufacturers, when made responsible for end-of-life management of their products financially and/or physically, would presumably try to find a way to minimise the costs associated with end-of life management by changing the design of their products. The establishment of such feedback loops from the downstream (end-of-life management) to the upstream (design of products) is the core of the EPR principle that distinguishes EPR from a mere take-back system. Assigning responsibility primarily to one actor would also avoid the situation where everyone's responsibility becomes no one's responsibility. – pg. v, "Extended Producer Responsibility: An examination of its impact on innovation and greening products," Chris van Rossem, Naoko Tojo, Thomas Lindhqvist; International Institute for Industrial Environmental Economics.

Discussion: Oregon was among the first states to select a specific product, or suite of products, and require manufacturer take-back . This program is also demonstrates the establishment of a third-party organization (a consortium of manufacturers) to fulfill financing and collection responsibilities.

[7] http://www.epeat.net/

[8] http://www.deq.state.or.us/lq/ecycle/index.htm

Oregon Paint Program[9]

Highlighted Aspect: The manufacturers of paint sold in Oregon, or a stewardship organization representing manufacturers, are required to set up and run a convenient, statewide system for the collection of post-consumer architectural paint.

Description: Manufacturers or the stewardship organization must:

- Identify the brands of paint sold by a manufacturer.
- Implement pilot program by July 1, 2010 as described in approved plan.
- Pay an "architectural paint stewardship assessment" for each container of paint sold in Oregon, such that the funds collected are enough to recover -- but not exceed -- the cost of running the paint stewardship pilot.
- Develop and implement strategies to reduce the amount of post-consumer paint that becomes waste, including contracting for the collection, transport, recycling, energy recovery, or sound disposal of leftover paint.
- Promote the reuse of leftover paint.
- "[U]ndertake the responsibility for the development and implementation of strategies to reduce the generation of post-consumer architectural paint"[10].

Discussion: As with many product stewardship program, a major driver for the paint product stewardship law was the desire to move the costs of managing end-of-life paint management from ratepayers and taxpayers, and rather to internalize it into the transaction costs between producers and consumers. Ideally this will ultimately result in incentives to drive behavior change toward more efficient purchasing and use of paint, thus resulting in less left-over paint.

Seattle Foodwaste Program

Highlighted Aspect: Seattle Public Utilities is moving incrementally to expand the compostable fraction of its waste stream by regulating movement away from non-compostable components, such as certain food service containers. This operational requirement is leading to design change through product substitution.

Description: "The City of Seattle is requiring all food service businesses to find packaging alternatives to throw-away food service containers, cups and other products in all food service businesses - restaurants, grocery stores, delis, coffee shops and institutional cafeterias. By July 1, 2010, all food service products designed for one-time-use must be replaced with one-time use products that are either compostable or recyclable. Phase one of the ordinance applied only to expanded polystyrene (EPS, sometimes called "Styrofoam"). The foam ban took effect January 1, 2009….Phase two of the ordinance applies to ALL throw-away food packaging and service ware. The ban on disposables

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[9] The following information is drawn from: http://www.deq.state.or.us/lq/pubs/docs/sw/PSIFactSheetOregonPaintLaw.pdf . Additional information may be found at: http://www.deq.state.or.us/lq/sw/prodstewardship/paint.htm .

[10] Language from statute. In this context, "reducing generation" refers to achieving waste prevention by avoiding over-purchasing by the consumer.

takes effect July 1, 2010."[11] "According to a study recently conducted … for Seattle Public Utilities, all disposable paper and plastic bags have significant negative energy, climate change, wastewater, litter and water quality impacts on Seattle's environment."[12]

Discussion: Changes in design and material choice for fast food packaging can have local impacts on solid waste management systems as well as have implications for the production life-cycle phase (see inset box above regarding life-cycle stages and impacts). Thus local requirements can drive manufacturing design changes in order to remain competitive in the market place.

Danish Packaging Law

Highlighted Aspect: The Danish packaging fee system utilizes life-cycle data on common packaging components to develop a fee structure whose goal is to steer upstream packaging choices to decrease overall life-cycle impacts, rather than to influence decisions that simply ease end-of-life processing and management alone.

Description: "In many countries, fees on plastics and composites can cost several times more per kilogram than other materials such as glass, paper, and metals. This is a reflection of the high cost of sorting plastics and composites, and the low market prices for the recovered materials. However, a few countries have assessed fees on a broader set of environmental criteria. For example, Denmark has set fees based on life-cycle analysis studies of common packaging materials."[13]
Thus in Denmark an aluminum package is assessed a high fee given its overall life-cycle environmental impact, compared to a similar package in Ontario, which would receive a credit, and in Japan, which would have no associated fee.

Discussion: Though it is challenging for varied parties to come to consensus on the life-cycle impacts of specific products, it is clear that a narrow focus on end-of-life impacts from specific products and packages may miss comparatively large impacts encountered during other life-cycle phases.

Empty Space Laws

Highlighted Aspect: Excess material use can be avoided by requiring limits on the amount and style of packaging permitted for given products.

Description: "Various regulations … attempt to prevent excessive packaging through specific requirements... Several countries have implemented regulations regarding empty space and the permissible number of layers in a packaging system. South Korea has strict limits on empty space, allowing no more than 10-35% of a single product to be headspace or concealed empty space, or 25-40% of a "set" product (e.g. a gift box containing several packaged products). Australia has limits on the maximum allowable empty space that

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[11] http://www.resourceventure.org/foodpluscompostables

[12] http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/spu02_014614.pdf

[13] International Packaging Regulations: Packaging Waste Reduction, An Introduction to What You need to Know. http://www.deq.state.or.us/lq/pubs/docs/sw/packaging/intlpkgregulations.pdf

depend on the category of product and ranges from 25-40%. There is a limit of 40% empty space in Japan for cosmetic products and proposed legislation in other countries such as Taiwan."[14]

Discussion: While such regulations are typically implemented on a national level, states are increasingly showing their ability to place constraints on packaging (such as those implemented on packaging toxicity by a number of states through the CONEG process[15]).[16]

EMERGING ISSUES AND CONSIDERATIONS

Reflecting upon these programs and approaches, a number of broad themes, issues and important details begin to emerge with implications for favorably impacting product design from an environmental perspective. A number of these are explored below.

To separate or not to separate

Rather than tackling toxicity reduction and material management under one policy, regulators have in some instances chosen to separate these topics. For example, in Europe, RoHS is focused upon toxicity reduction and materials substitution while the WEEE Directive focuses more squarely on end-of-life collection and processing. These approaches have different impacts when it comes to sending design signals upstream to new product manufacturers. They can also be explicitly designed to work in concert and support each other. [17]

DESIGN FOR RECYCLING

"[M]ore companies have been choosing product recovery instead of disposal as their primary retirement strategy…….Accordingly, engineering methods for maximizing recovery profit have come into increasing demand from industry." – *Cell Phone Designers Should Think Trash*; Futurity, University of Illinois Engineering News; March 16, 2010.

Individual versus collective responsibility

Product take-back programs can be designed and implemented in numerous ways. One major distinction concerns whether product manufacturers are required to specifically take back their own branded products individually, or whether they are permitted to work together collectively to establish a take-back infrastructure. There is evidence that when individual producer responsibility (IPR) is required, a more direct feedback loop to the manufacturer is

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[14] International Packaging Regulations: Packaging Waste Reduction, An Introduction to What You need to Know. http://www.deq.state.or.us/lq/pubs/docs/sw/packaging/intlpkgregulations.pdf

[15] The Toxics in Packaging Clearinghouse (TPCH) was established by the Coalition of Northeastern Governors (CONEG) in 1992 to assist states that adopted the CONEG-developed Model Toxics in Packaging Legislation. That legislation, adopted by 18 states as of 1998, requires reductions in the amount of four heavy metals (specifically, mercury, lead, cadmium, and hexavalent chromium) in packaging and packaging components sold or distributed in these states. The laws, which aim to phase out the use and presence of these four metals, require certificates of compliance and allow for certain exemptions (which must be approved by the individual states). http://www.coneg.org/programs/other.htm

[16] Though worthy of a much more thorough discussion, it is worth noting here that the famed German Green Dot program shows some evidence of having reduced the overall volume of packaging used in commerce as a direct result of the fee structure and take-back program requirements.

[17] In the US, state laws governing manufacturer take-back for electronics have been typically unable to broadly regulate toxicity components or export considerations based on recycling standards.

established which can incentivize product design changes that lower processing costs and other associated environmental impacts.

Timing is important

For some products, even IPR (see above) won't necessarily help establish an actionable feedback loop able to influence new product design. For example, manufacturers required to recover long-lived products, such as televisions, will likely have moved on to different designs and technologies for which the recycling and toxicity lessons from currently recovered products won't be relevant. At best such manufacturers can be required to safely recycle and manage such products, but expecting design changes based on such recovery may not be appropriate. For products with quicker design cycles and shorter life-cycles, expectations of design relevance may be more appropriate, at least for end of life management efficiencies (see box above).[18]

Long supply chain

Global production complicates the path design signals must travel to provide upstream information to designers and producers. Some stakeholders argue this challenge creates a situation in which little can be done to link end-of-life impacts to design and production activities. The countering viewpoint is that the challenge of global production makes it all the more important that the producer/ manufacturer/ brand owner be spotlighted as the principle actor in take-back activities and design changes given that they, more than any other actor in a product's life-cycle, have the ability to direct change.

Purchasing as a driver

Purchasing guidelines and regulations can drive design changes. Both the EPEAT and Top Runner approaches discussed above demonstrate that the market is the message. For example, with the advent of the US federal government turning toward a purchasing preference for upper tier EPEAT products, computer makers quickly responded by developing products that achieved notable environmental improvements in the production, use and disposal phases. Such drivers could also be achieved at the State level.

It's not just about design

Design is often conceived too narrowly to encompass only the material choice and recyclability of a product. While important, this limited perspective can lead to a constrained focus on end-of-life environmental issues such as recyclability and toxicity. Often a product's predominant life-cycle impacts occur during upstream life-cycle phases, such as extraction and production. For example, it is often useful to look at the production processes utilized in the manufacturing of a given product category. A product might be easily recyclable at end-of-life, but still require considerable toxic inputs during its creation.

[18] As a side note it is worth mentioning that upstream design changes can both constrain and open downstream recycling options and the resultant product life-cycle impacts. In other words, not all recycling is equal. Glass recycled to cullet has a lower life-cycle impact than glass recycled to aggregate. Likewise for e-waste recycled according to high environmental standards versus exported to unmonitored conditions. Upstream design choices can ease the entry of recovered materials into market channels that allow high-value "upcycling."

Ownership and tangible goods

Traditionally the purchase or exchange of tangible goods has characterized commerce. The recipient desires and acquires a physical item. This is, by definition, a material-focused transaction. New market tools, and policies that drive toward such tools, are being developed and supported which shift the frame from product-focused to process and service focused. These approaches can provide a powerful environmental driver.

An oft-quoted example involves Ford Motor Company switching from subcontracting to a vendor to paint their cars to purchasing from their vendor the unit of a painted car. By paying the vendor a per-painted-car price, the vendor is incentivized to maximize their profit by reducing their overall per car costs (while maintaining defined quality expectations). One easy way to do this is to identify opportunities for minimizing the amount of paint and wasted paint required per car. In another example, directory service companies can move toward on-line rather than yellow-page fulfillment of their information provision product. Pharmaceutical companies can offer coupons for drug samples, rather than liberally dispensing actual samples that often end-up expiring in clinic drawers. Finally, vehicle leasing arrangements can guarantee that the leasing company owner will end up with the end-of-life product, which could influence them to reconsider certain product and production attributes in a way that individual car owners cannot.

> [O]ur most important finding is that fee-upon-sale types of e-waste regulation (including ARF, collective EPR with current-sales-based cost allocation and RoHS) reduce the quantity of electronics produced and disposed by reducing the frequency of new product introduction. In contrast, in competitive product categories, fee-upon-disposal types of e-waste regulation (including individual EPR and collective EPR with disposal-based cost allocation) fail to reduce the frequency of new product introduction. -- Plambeck and Wang: *Effects of E-Waste Regulation on New Product Introduction;* Management Science 55(3), pp. 333–347, ©2009 INFORMS

Moving forward with incomplete information

In a policy world you often must take action without complete information. You will never have complete information from, or agreement about, an LCA or an environmental impact assessment, etc. And yet policy makers must make a decision. Thus thought should be put into what parameters allow the most equitable policy development given the absence of complete information. (This is particularly important when proposed policies may negatively impact different stakeholders differentially, perhaps one group more than others.)

> "…IPR (Individual Producer Responsibility) is a policy tool that relies on economic signals from treating end-of- life products (environmental 'cost' signals) getting through accurately to the producer, to drive design change. Therefore, there must be, as far as possible, an 'economic level playing field' or minimal distortion of these cost signals for the economic advantages of product design change to be reaped. (See footnote for "Lost in transposition…. Pg. ii)

More information is on its way

Balancing the prior statement regarding incomplete information is the fact that LCAs are becoming more sophisticated, more complete and perhaps even more agreed upon by varied stakeholders. This will support life-cycle decision-making on a scale not seen before.

Related to this, information disclosure tools such as product declarations, mandated reporting, "light of day" policy requirements and other tools are growing in maturity and use. Such requirements have been shown to incentivize manufacturers to make product changes, such as reducing toxicity.[19]

The incomplete promise of focusing on end-of-life

As alluded to above, a product's upstream footprint may be larger than its downstream footprint. Production and use phase impacts often outweigh disposal impacts, and thus offer preferable insertion points for design, material and process changes. Certainly requiring take-back, or at least recyclability will usually decrease a product's overall life-cycle impact, but this is not always the case, and even when it is, such a focus may divert attention away from more effective leverage points in the life-cycle. A frequently cited example outlines how even with a very high recycling rate for metal coffee cans, the life-cycle impacts of this packaging option are greater than using non-recyclable laminate brickpack packaging that is disposed of 100% of the time. Additionally, for many producers, downstream costs, even if internalized, are just a tiny fraction of upstream costs. So internalization of downstream costs is a lever, but for many producers a very weak one.

> In general, the more control the manufacturers have over the downstream infrastructure, the more likely it is that measures belonging to the higher ladder of resource efficiency will be taken. The study also revealed anxiety among manufacturers concerning the development of downstream infrastructure. The manufacturers feared that the current development does not enable the distinction of their products from products of similar types. It means that their upstream efforts may not be adequately rewarded. – p. vi; Extended Producer Responsibility as a Driver for Design Change - Utopia or Reality?" Tojo, Naoko; The International Institute for Industrial Environmental Economics; Doctoral dissertation, 2004.

Related to this is the phenomenon that many design improvements go unnoticed or unrecognized by government and other stakeholders that are focused too narrowly on end-of-life management activities. Source reduction activities are often not discussed, or at least remain unmeasured, in traditional solid waste circles. Industry is then left wondering how they can get "credit" for source reduction success, especially if it results in the decline of their gross recycling tonnages.

Expanding from a "waste management" focus to a "materials management" view

Product stewardship in the U.S. has historic roots in state and local waste programs, and early program and policy efforts have often emphasized end-of-life management, even as the definition of product stewardship addresses the full life cycle. Since the outset however, many waste programs have been undergoing a slow but steady transformation from addressing "waste management" to a broader focus on "materials management".[20] This shift is driven by a growing awareness of a number of factors,

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[19] Though not explored in this paper, labeling and information disclosure requirements are also being used to facilitate consumer scrutiny and decision-making. Examples include France's eco-label (http://www.marque-nf.com/pages.asp?ref=gp_reconnaitre_nf_nfenvironnement&Lang=English)and Japan's carbon label requirement for consumer goods (http://www.meti.go.jp/english/press/data/20090529_01.html).

[20] For example, one of the key findings of EPA 's "2020 Vision" is a need to shift from waste management to materials management. Specific recommendations from EPA are laid out in the document, "Sustainable Materials Management: The Road Ahead". Oregon's Integrated Resource &

including environmental and public health impacts beyond those seen at the time of disposal, the relationship between products and the environment, the limitations of focusing on just one element of the life cycle (in this case, disposal), and the benefits of taking a more holistic view of the entire life cycle. This shift can be seen in private sector activities as well.

Financial assurance as design insurance

Increasingly, product stewardship policies are incorporating so-called financial assurances, or guarantees for future waste. These take the form of a bond or other setting aside of funds by the manufacturer to cover the future costs associated with its end-of-life management. Ideally this approach builds in incentives for manufacturers to minimize those costs now, through design changes, so as to possibly save expenses later, or at least to have provided funding for such management (especially if the manufacturer has gone out of business and is no longer around to arrange for pay for recovery and disposal). As one analyst notes: "Financial guarantees for future costs are the way to ensure that producers take these costs into account when designing products and product systems. Financial guarantees should not only ensure that there are funds to pay for these end-of-life costs, but also provide flexibility and possibilities for competition in the market, thus allowing market forces to develop efficient solutions. Such efficient solutions must also secure an environmentally-responsible treatment of products and their components and materials. By internalizing these costs, avoiding subsidies for collection and other activities, and establishing a true financial guarantee system, a level playing-field will result, that rewards corporate responsibility and innovation in product design."[21]

RECOMMENDATIONS AND POLICY OPTIONS

Like the proverbial tail trying to wag the dog, local and state governments are close to and responsible for the waste end of products, and yet traditionally have been rather distant from being able to influence upstream aspects of the product life-cycle. This presents a challenge when city, county and state governments attempt to craft polices – especially solid waste policies -- at the local level that attempt to drive design changes and life-cycle improvements.

Clearly some of the mechanisms discussed above can be implemented effectively at the state level and local level.[22] Additional approaches and guidelines for state level options that facilitate Design-for-the-Environment (DfE) within industry were outlined in a 2009 report for British Columbia's Ministry of the Environment[23]. Recommendations from that

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Solid Waste Management Plan, adopted in 1994, and revisions to solid waste laws in 2001 signaled a somewhat similar shift. More recently, planning efforts by local governments including Metro, Portland and Eugene have all redirected – or are in the process of redirecting – some emphasis to "upstream" actions that address the larger life cycle impacts of materials, as opposed to concentrating primarily on the management of discards.

[21] "Lost in transposition: A study of the implementation of individual producer responsibility in the WEEE directive;" Van Rossem, Chris, Tojo, Naoko & Lindhqvist, Thomas; Report Commissioned by Greenpeace International, Friends of the Earth Europe and the European Environmental Bureau (EEB); September, 2006; pg. vi.

[22] A major driver for local governments to pursue measures that shift end-of-life management costs to producers is to bring financial relief to the local ratepayers who currently fund disposal and recycling activities through rather blunt financing mechanisms.

[23] "Design for Environment (DfE) Best Practices Lessons for British Columbia's Ministry of

report are provided below along with additional policy ideas and options intended to pave the way for policy setting that drives upstream design and other life-cycle improvements.

- Provide **a clear policy or statement of intent** to promote design changes that will improve environmental outcomes across the life cycle. Such statements can range in form and include:
    - components of solid waste plans
    - resolutions in support of product stewardship policies
    - legislative preambles
    - agency white papers

  Such language sets the stage for more concrete action by various public and private stakeholders. This approach also helps broaden awareness of and literacy in these concepts.

- Undertake **research that can inform future product stewardship policies**. For example, waste stream characterization studies undertaken by local governments typically focus on material sorts, establishing such categories as glass, aluminum, ferrous metal, paper, etc. Product policy development would benefit from sorts that also focus on product type, as well as on sorting by brand-owner.

  Other research might include exploration of life-cycle assessments for targeted products and materials. While LCAs may not provide definitive analyses on their own (due to technical as well as political constraints), they do play an important role in informing policy decisions. [24]

> Green design is likely to have its largest impact in the context of changing the overall systems in which products are manufactured, used, and disposed, rather than in changing the composition of products per se. – P. 59; *Green Products by Design: Choices for a Cleaner Environment;* September 1992; Office of Technology Assessment; OTA-E-541; NTIS order #PB93-101715

- Develop **policy approaches that focus on results** rather than on the means of achieving those results. A core strength of product stewardship is its reliance on establishing market mechanisms that then drive innovation internally. By focusing on the outcome of a program (for example, tons recovered or prevented, user convenience, energy demand, lifecycle greenhouse gas emissions), the market is left free to innovate how to accomplish those goals. Where possible, focus on actual environmental outcomes as opposed to attributes, proxies, or process outcomes.

- Develop policy recognizing that **recycling does not always provide the optimal solution** from a design perspective; room should be left for environmentally advantageous alternatives that are preferable to recycling from a life-cycle perspective.

Environment;" Prepared for British Columbia Ministry of Environment; Prepared by Five Winds International; March, 2009.

[24] For example, DEQ's life-cycle analysis of e-commerce shipping options was instrumental in demonstrating that: recycled-content and recyclability is not necessarily a good indicator of life-cycle benefits when comparing dissimilar materials; "mass matters," with lighter weight options almost always being preferable to heavier options, regardless of material use; shipping bags are generally preferable to boxes for non-breakable items.

- Provide **information that allows consumers to choose products or packaging** with better environmental performance over the life cycle. Such transparency can alone often drive manufacturer design changes. Just as localities are currently experimenting with local regulations that require restaurants to provide nutrition information, local and state governments should explore options for requiring that consumers be provided with coherent actionable environmental information or the products they buy.

- Involve **stakeholders representatives from the full product life cycle** (including suppliers, producers, retailers, consumers etc.) in the development and regular evaluation of stewardship programs that incorporate DfE as a policy objective;

- The best designed programs include established **baseline data, clear targets for collection, performance goals, reporting standards and clear goals for design improvements & other life-cycle improvements**.

> **Anticipating laws can drive change:**
> [A]nticipation of EPR law has been central for specific design changes for the products investigated. Tojo (2004) provides empirical evidence that EPR law does provide tangible incentives for environmentally-conscious design in the case of electrical and electronic equipment (EEE) and cars in Japan and Sweden. The analysis of her interviews in 2001 revealed that all manufacturers that were interviewed considered anticipated regulatory requirements posed by EPR law in their product development strategies. Upstream measures in design, both in terms of reduction of hazardous substances and enhancement of source reduction of material use, re-use and recycling, have been undertaken in both industry sectors in Sweden and Japan respectively. – p. v, "Extended Producer Responsibility: An examination of its impact on innovation and greening products," Chris van Rossem, Naoko Tojo, Thomas Lindhqvist; International Institute for Industrial Environmental Economics

- Develop **statewide priorities for product categories and articulate a clear step-by-step process for program development that includes design and life-cycle elements** (e.g. start with stakeholder engagement, authorize DEQ to establish minimum mandatory standards, etc.).

- Identify and **adopt leading existing standards.** This could take the form of purchasing standards like EPEAT or Top Runner, or energy standards such as Energy Star. (Note that Oregon DAS already directs use of EPEAT under Statewide Policy 107-009-0050.)

- Continue to **identify targeted products for product stewardship legislation**. Build on the State's experience with electronics and paint, and move on to additional electronic products, pharmaceuticals, mercury-containing devices, containers and packaging and other products that meet criteria such as environmental impact, human health impact, and/or are challenging for local government to manage. Continuing to build momentum for product stewardship policies provides opportunities to develop programs in a manner that encourages design and life-cycle innovation, for example by emphasizing individual producer responsibility policy elements.

- Prioritize policy instruments that foster **direct feedback to manufacturers**, such as individual producer responsibility rather than third-party organizations that pool responsibility. Other channels for providing manufacturer feedback can also be developed and institutionalized, at least in the government purchasing context. For example, a formal process can be established in which product specifiers and purchasing agents are expected to review products for environmental concerns and to

convey those findings directly to manufacturers and vendor agents.

> Among various other factors that influence the manufacturers' undertaking of upstream changes, literally all the manufacturers interviewed acknowledged influence from EPR legislation on their efforts to reduce product environmental impacts. Among the policy instruments, *material restrictions* and *reuse and recycling requirements* have directly driven the undertaking of upstream measures. It was found that *take-back requirements* not only facilitate the development of downstream infrastructure, but also the establishment of communication paths between downstream and upstream. – p. vii; Extended Producer Responsibility as a Driver for Design Change - Utopia or Reality?" Tojo, Naoko; The International Institute for Industrial Environmental Economics: Doctoral dissertation. 2004.

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