Revenue sources to fund recycling, reuse, and waste reduction programs

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Prepared for

Washington State Department of Ecology

June 30, 2011

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1. Introduction and Overview

Solid waste management is a process that encompasses the entire life-cycle of materials that have the potential for some kind of costly disposal. The amount, characteristics, and destination of potential solid waste can be affected at every point in the life-cycle of materials; from the production of products, through wholesale and retail marketing, consumer purchase, use, and ultimate disposal, recycling, or reuse. The stages of the waste life-cycle can be defined in terms of human decision points. People and firms make decisions about what to produce or purchase, how much to produce or purchase, and how to dispose of it. These decisions are made in the context of market prices, a physical environment, and a legal and regulatory setting surrounding solid waste.

The design of the public policy framework within which decision makers operate in part determines the effectiveness of policy to achieve waste management outcomes. Mandated and enforced regulatory requirements can directly restrict or modify consumption and disposal decisions. Price instruments such as fees and taxes can change consumption and disposal decisions indirectly by altering incentives that govern behavior which change relative costs and benefits. The effectiveness of specific regulatory and price instruments depends on the specific structure of these instruments vis-à-vis the objectives for their use.

The objectives of this document are to

1. Summarize a set of cost or fee related policy instruments for solid waste management.
2. Characterize the relative effectiveness of these instruments in relation to a set of important policy criteria.

To proceed, working definitions of materials in the waste life-cycle are important. We use the term **waste** to represent any materials that have been dispossessed by a consumer (including firms) at any point during the material's lifecycle either for free or at a cost.[1] All or part of this waste may be **recycled**, **reused**, or **disposed**. **Recycling** represents the process of transforming waste into a useable material or product. **Reuse** of goods can entail reuse of the same good by another entity (perhaps after refurbishment). **Disposal** is used in this document to mean dispossession of materials without the intent of further use, and generally means burying, burning, or simply dumping. More generally, disposed goods are those goods left over after all uses are

[1] If one is receiving payment for dispossession, this is equivalent to a sale of a good just as with the sale of any other valuable good, and so the material is not considered here to be waste. This distinction can become blurry if goods are sold for recycling or refurbishment, but this definition of waste allows us to avoid these definitional complications for our purposes.

exhausted in a practical/economic sense. Generating energy from disposed materials can be thought of as generating a valuable good from waste. As such, it might be considered recycling. However, we will generally treat it separately so as to minimize confusion.

Regulatory rules as well as public fee and subsidy programs can be implemented at various stages of the lifecycle of material. The amount of waste produced and purchased can be affected by public policy if the policy instruments are either imposed on upstream materials producers and/or consumers, or if instruments applied at waste dispossession decision points also affect consumer incentives to alter their material purchases. The share of waste going toward recycling, reuse or disposal can be affected by policy instruments that alter the incentives for diversion toward these three downstream fates.

To satisfy the first of the two objectives of this report, we develop a summary of various categories of regulatory and price-based programs at important materials life-cycle decision points. The summaries are based on a review of existing programs in the US, Canada, Europe, and New Zealand, and these existing programs are used as examples for the various instrument types summarized. To satisfy the second objective of this report, we provide an analysis of each instrument in relation to a set of important public policy characteristics. These characteristics are:

1. *Incentive for waste reduction*: Policy instruments that increase the relative costs of waste production upstream in the production process will tend to decrease the amount of waste produced. Mandates that limit the amount of waste production or taxes that increase the cost of production may result in less waste to manage.

   The United States Environmental Protection Agency defines "source reduction" as: "the strategy behind reducing and reusing waste. By designing, manufacturing, purchasing, or using materials in ways that reduce the amount or the toxicity of trash created, less waste is generated and fewer natural resources are used. Reuse is often part of the waste prevention strategy, stopping waste at the source due to preventing or delaying a material's entry in the waste collection and disposal system." (US Environmental Protection Agency 2011).

2. *Incentive for recycling and reuse*: Policy instruments that decrease the relative cost of recycling and reuse or mandate recycling requirements will tend to direct waste toward recycling and reuse and away from landfill or other dumping. The cost of recycling to disposers includes both the monetary price paid for recycling services and a potential time cost, such as the time cost incurred in sorting household recyclables. Increases in recycling opportunities can lower the time cost. Costs to recycling firms themselves are similar in that if the variable costs of recycling are reduced, recycling services can be feasibly provided at lower cost.

3. *Revenue generation effectiveness*: Some policy instruments provide public revenue that may be spent to support waste reduction or for directing waste toward recycling and reuse. Publicly imposed fees can raise revenue, but mandates and regulatory restrictions alone do not. For fees and taxes, revenue generation effectiveness is a measure of how much revenue could feasibly be raised from a given instrument. Revenue generation capacity or effectiveness depends on the magnitude of the market for goods and services upon which fees or taxes are imposed, and on the market characteristics of the goods and services, such as the changes in the amount purchased and therefore taxed when prices change due to the tax.
4. *Revenue sustainability*: Some revenue-generating instruments are affected substantially by a waste reduction policy trajectory. For the purposes of this report, an instrument is sustainable if decreases in the level of waste generated or sent to the landfill do not decrease the level of revenue raised from the instrument. Revenue is unsustainable if revenues decrease as waste production or disposal decreases. For example, revenues from landfill tipping fees will decline as solid waste is redirected away from landfills, and so revenues from tipping fees are unsustainable for present purposes.
5. *Administrative costs and complexity:* Some policy instruments are simply more costly and/or difficult to implement, monitor, and enforce. This characteristic relates to the cost effectiveness of implementation. Cost effectiveness may be in relation to revenue generation, but more broadly it relates the implementation costs to the effectiveness of a program for reducing waste through reduction and redirection of potential waste.

Most or all policy suites applicable to solid waste entail both regulatory components and fiscal components. Mandates for recycling and reuse impose requirements on the private sector and require public revenues and financing for enforcement and administrative costs. Taxes and publicly mandated fees may additionally raise funds to cover the operating expenses of a recycling program. One pressing public policy problems is how to fund recycling and reuse programs.

Revenue generation instruments will receive the most substantial attention, because of the concern that revenue generating instruments as commonly used today would become increasingly ineffective for substantial redirection of end-of-life products away from disposal and toward recycling and reuse. No single one-dimensional policy instrument is capable of effectively directing both upstream production/consumption decisions *and* disposal decisions. As such, a suite of policy instruments is often called for, especially in an attempt to address multiple competing policy objectives. We examine a set of policy suites that appear promising from the perspective of economic incentive structures.

Throughout the document a **fee** is defined as any charge imposed by a private or government entity. A **tax** is a fee (a subset of fees as defined here) charged by the

government, which may or may not be attached to or reflect a particular services rendered or goods provided. Two characteristics of these revenue instruments are important determinants of the impact of fees, and are defined as follows for the purposes of this document:

- **Targeted** versus **General** fees: Targeted fees pertain to more specific or narrow categories of waste, whereas general fees pertain to broader and less specific categories of waste.
- **Variable** versus **Flat** fees: Variable fees are charged to a decision maker per a defined unit of a product or waste category. Flat fees are charged without regard to the amount produced.

Targeted fees tend to affect the *quality characteristics* of the overall waste stream more than general fees. A highly targeted fee, for example a fee imposed at the sale of one kind of television, will tend to reduce the demand for that kind of television (much like a price increase will according to the "law of demand"). However, it may have the ancillary effect of increasing demand for another kind of television that is not taxed as consumers substitute one for the other due to a price difference. A general fee that is imposed on a large class of goods or materials will not provide such a substitution incentive within the class of goods to which the fee is attached, but it may lower the aggregate amount of this class of goods purchased and consumed.

Variable fees tend to affect the *quantity of waste* generated or diverted at least as much or more than flat fees do. This follows from the basic economic idea that firms base price on their variable costs (to be more precise, their marginal costs). Fixed (flat) costs that do not vary with output do not affect a firm's output. However, just like a higher fixed cost of production (like a fixed rent or loan payment on production equipment), a large enough flat fee can in principle affect the number of firms who produce the good with the flat fee, or even the number of firms in the industry. So, while a flat fee can affect the quantity of waste produced, a variable fee is likely to have a stronger effect in many circumstances, especially in short and intermediate time periods. A *targeted variable* fee provides the strongest incentives to reduce or redirect the targeted waste type. For example, a variable fee based on the amount of a specific heavy metal such as mercury included as a component of a complex product such as a cell phone is both highly targeted and variable, and will in principle provide incentives for reducing mercury use, perhaps through substitution away from mercury and toward other alternative materials. However, this type of fee also may require a heavier regulatory measurement and enforcement burden, because it requires measurement per unit and measurement of more categories of waste. It therefore can be more costly.

In contrast, a *general flat* fee charged to cell phone producers or importers per month (not dependent on production levels) are easier to implement from a regulatory perspective, but provides little incentive for the producer to reduce their use of mercury

in their cell phones. In reality, these two dimensions of fee structure are not strictly dichotomous, but are defined to varying degrees. Nonetheless, they are useful for characterizing the incentive effects of fee structure.

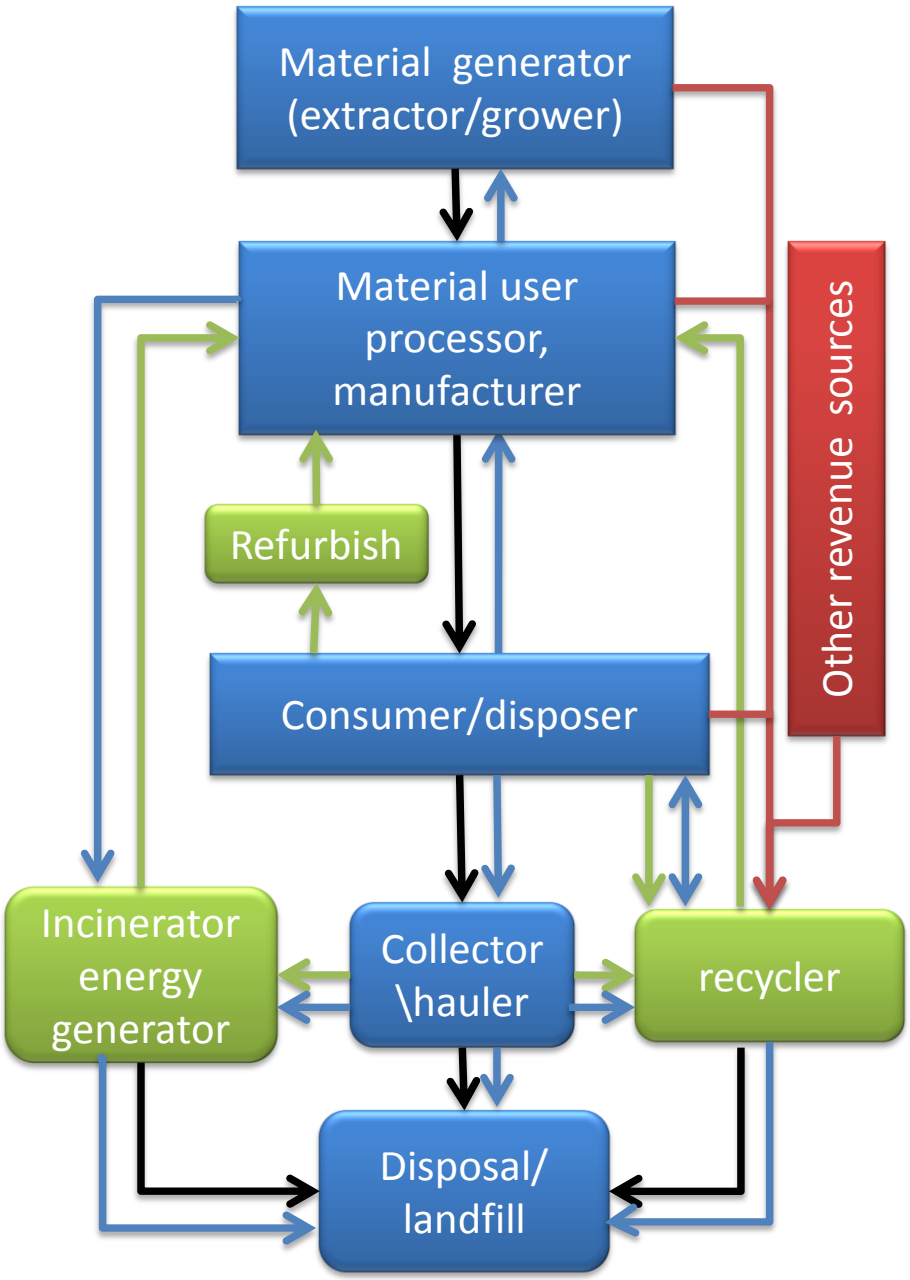
A fee will incentivize only one aspect of waste management. A per-unit fee charged to a producer may incentivize a producer to produce less potential waste (e.g. use less packaging by volume) and for a consumer to buy products associated with less waste to the extent that the fee is passed on to the consumer. However, it does not augment the consumer's incentive to recycle rather than dispose of waste in a landfill.

It should be noted that a policy which provides an incentive to reduce disposal may not provide sustainable revenue. A per-unit tipping fee may provide an incentive to reduce landfill use as well as provide revenue for subsidizing recycling (a "double dividend" so to speak). As landfill use declines (with help from the tipping fee incentive), revenues from tipping fees decline, which means the budget for recycling subsidization declines. Thus, per-unit tipping fees do not provide a sustainable revenue source to the extent that solid waste streams shift increasingly and substantially away from landfills toward recycling.

We focus on the general decision points in the waste stream in order to discuss how policies impact these decision makers. The flowchart in Figure 1 identifies the key categories of decision makers in the waste management system, as well as the key financial flows. Blue boxes are typical market participants for material goods. Black arrows indicate the direction of material flows toward waste generation, and blue arrows represent typical market payment flows for these goods. Green boxes represent entities specializing in waste-to-energy, recycling and reuse, and green arrows represent material flows toward recycling and reuse. Red arrows represent fees potentially paid to government entities (as opposed to other market participants), and the red box represents potential revenue sources from outside the waste stream that can be used to fund recycling/reuse programs. This flowchart is not indicative of the current waste management finance system in Washington State. Rather it illustrates the different scenarios discussed in this paper.

These categories of decision makers and flows are only meant to be representative of general points in the waste stream. For example, the *Recycler* represents both recyclables processing facilities and composting facilities. Some entities may be represented by more than one box. Material generators are different from producers only in that they represent the origin of physical materials that may enter the waste stream, but material generators are also often processors. Landfills may also have incineration and/or energy generation capacity. Landfills and/or waste collectors and haulers may be government or quasi-government entities, but are not distinguished as such in figure 1.

Figure 1: Typical material and financial in the waste management system. Black lines represent downstream material flows, green lines represent recycling, and reuse activity, including energy generation. Blue lines represent market payment flows (subject to waste management regulations and requirements), and red lines represent government-imposed fees. For clarity, some flows may not be represented.

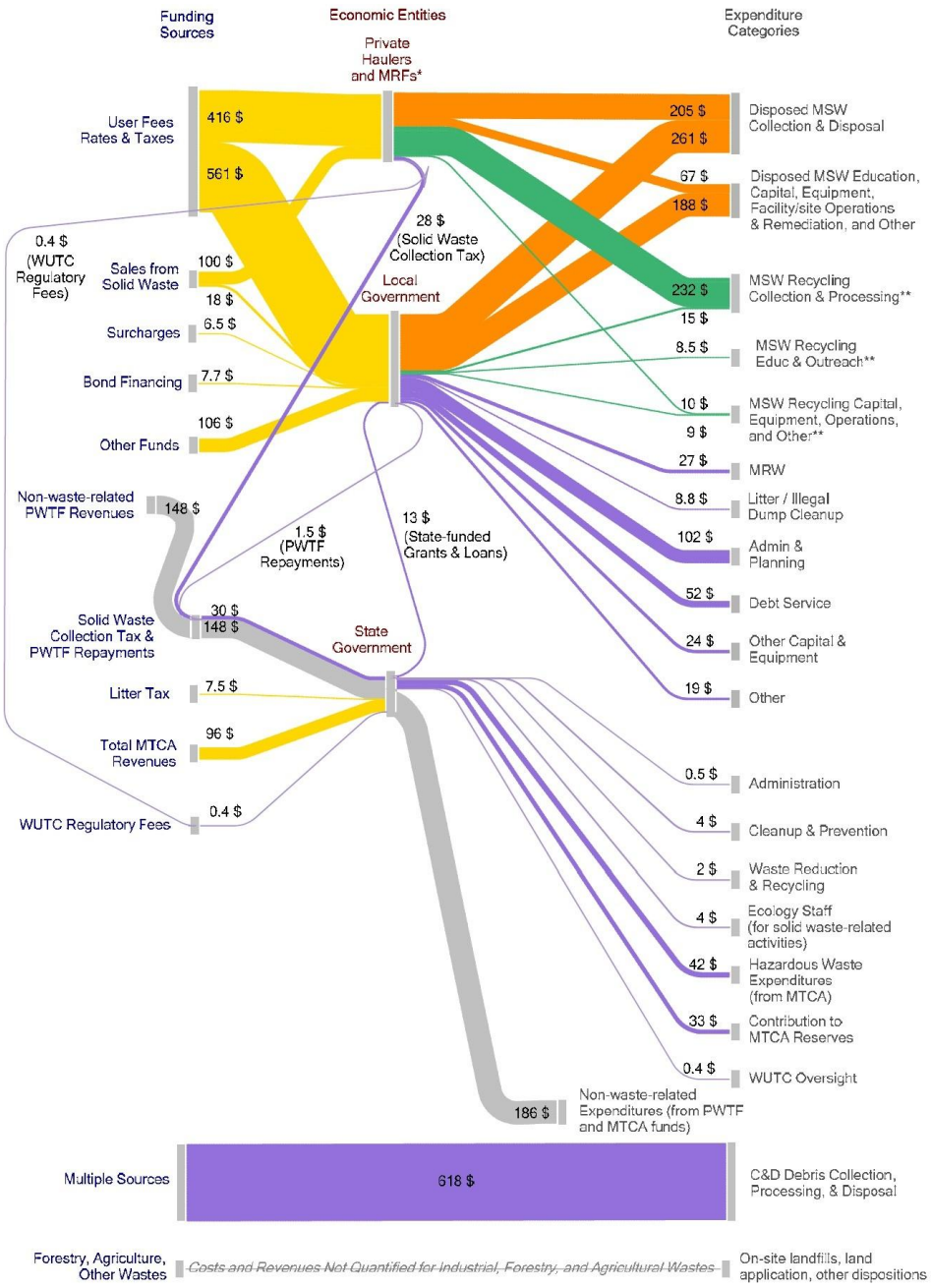


Government revenues may be used for expenditures in the solid waste system. Traditionally much of the funds used for recycling, reuse and waste reduction programs have been collected from landfill tipping fees. This document discusses additional instruments to raise revenue that do not rely on landfill tipping fees. This document also discusses instruments that pass the responsibility of funding recycling on to non-governmental stakeholders; an example of such an instrument is an Extended Producer Responsibility program. Revised Code of Washington 70.95.090 describes some of the recycling, reuse and waste reduction programs requiring funding in the state. Each county's solid waste management plan needs to include a waste reduction and recycling element (Washington State Legislature 1969a with revisions). Source separation strategies requiring funding include: providing curbside recyclables collection for urban areas, providing recyclables drop-off boxes for rural areas, providing educational programs to promote waste reduction and recycling, and potential provision of yard waste collection programs. Recycling strategies, such as researching markets for recyclables and waste generation trends, also require funding.

Figure 2 provides a perspective of the relative scale of cost flows in Washington State. User fees and waste related taxes are the largest source of revenues, and the largest expenditure categories are solid waste disposal and recycling costs.

User fees and waste related fees may be charged by a firm for services rendered (e.g. landfill costs, recycling costs), which likely will include not only the direct costs of service provision but also regulatory compliance costs. Alternatively, fees or taxes may be charged by a government entity, and the revenues may be used either to cover regulatory administrative costs including the costs of education, monitoring, enforcement, and fee collection. One of the key factors determining the relative efficacy of one policy over another is the cost effectiveness of the policy --- that is, how costly in terms of both compliance costs and administrative costs is it to reach a policy goal under one policy regime relative to another. These distinctions will be addressed where applicable to assess the relative efficacy of policy approaches.

Figure 2: Estimated Monetary Flows in Washington's Solid Waste System in 2005 (Figure in millions of dollars). Source: Cascadia Consulting Group and Industrial Economics Incorporated (2007, 5).



Dollar amounts are shown in millions. The labeled gray bars represent major entities or activities involved in Washington's solid waste system and the colored bands represent flows of money between these entities and activities. The width of each flow is proportional to the dollar amounts represented. More specifically, yellow flows depict revenues entering the system. Orange flows represent final expenditures on disposed MSW. Green flows represent final expenditures on MSW recycling, composting, and waste reduction. Violet flows represent final expenditures on other categories or pass-throughs (e.g., grants to local governments or solid waste collection taxes paid by haulers). "Recycling" includes composting and waste reduction.

* In this diagram, all commercial recycling (e.g., by businesses) is represented as passing through haulers or MRFs, thus no flow runs directly from "User Fees, Rates, & Taxes" to "MSW Recycling Collection and Processing." In addition, it was not possible to separate local government expenditures on disposed MSW that pass through haulers from direct expenditures on disposal. Consequently, local governments are depicted as responsible for a larger portion of disposed MSW expenditures that may be the case.
** Recycling in this report also refers to composting and waste reduction.

2. Producers of goods and packaging

This section summarizes each revenue option targeted at the producer of waste. Producers have some control over at least three characteristics of their products: the material content of their product, the durability of their product, and their packaging. Products that are more likely to be recycled, more durable, and are accompanied by less packaging will tend to contribute less to the amount of waste disposed. Revenue-generating policies focused on the amount of waste produced may provide incentives to reduce waste generation and generate revenue that may or may not result in sustainable funds.

a) Producer mandates with a revenue generating component

i. Extended Producer Responsibility

Traditional, downstream waste instruments collect funds from the disposer at the time of product disposal. For some types of hazardous products, including electronic waste, the unintended consequences of charging for disposal may be great. For example, because the costs of recycling a television are high, some states (not Washington) charge a fee at the time of disposal for their recycling, which increases illegal dumping of hazardous products. Recognizing this incentive problem, many state governments have subsidized the collection of hazardous waste, which places the financial burden of proper disposal on tax payers. Globally, within the last 20 years there has been a move towards holding producers responsible for end-of-life management of the products that they produce.

Product Stewardship can be defined as, "....an environmental management strategy that means whoever designs, produces, sells, or uses a product takes responsibility for minimizing the product's environmental impact throughout all stages of the products' life cycle (Northwest Product Stewardship Council 2011). The US Environmental Protection Agency has a similar definition stating, "...product stewardship calls on those in the product life cycle—manufacturers, retailers, users, and disposers—to share responsibility for reducing the environmental impacts of products (US Environmental Protection Agency 2010). In this document the term Extended Producer Responsibility (EPR) refers to an aspect of the broader term Product Stewardship.

Under an Extended Producer Responsibility (EPR) program, producers of a covered product must either physically accept delivery of or finance collection and recycling /safe disposal of their products. In addition, producers are also often charged fees to cover the government's administrative costs associated with organizing and enforcing

the program (this is true for E-Cycle Washington, described below).[2] EPR has been applied to product packaging, paints, televisions, computer monitors, laptops, batteries, cell phones, and auto tires, among other products.

Some sources may refer to an EPR program as a Producer Pays program, since it is the producer that must directly pay the costs of recycling. However, the costs of recycling may be partly passed onto consumers through higher product prices. While the costs may be passed onto consumers, only those consumers who purchase the products will pay, as compared to recycling programs funded by tax revenues in which all taxpayers must pay.

An EPR program as often applied is an example of a relatively targeted instrument, particularly when it holds producers responsible for funding the recycling or disposal of the specific products (sometimes very specific categories) they make. Producers may be required to participate in an EPR program based on the type of products they manufacture and sell. An EPR program may mandate that producers provide recycling opportunities. In some cases, such as in the Standard Plan of Washington State's E-Cycle Washington program, the government may run a program that producers can use to meet their mandate to provide recycling opportunities. E-Cycle Washington also gives producers the possibility to opt out of the government operated Standard Plan if they can introduce an acceptable Independent Plan of their own. Any revenue generating portions of EPR programs, such as funds collected to cover government administrative and enforcement costs, often require producers to pay variable fees.

Examples of Extended Producer Responsibility

Several examples of EPR are provided here to illustrate the specificity and breadth of application to date.

Product Stewardship in Washington State: E-Cycle Washington: The E-Cycle Washington program covers four products: computers, monitors, laptops and televisions. Manufacturers of these products are responsible for funding collection and recycling programs for these products. Each manufacturer must also pay an administrative fee used to cover the government's costs associated with implementing, monitoring, and enforcing the program. Administrative fees are based on each manufacturer's market share within the state. Based on a tier system, manufacturers with larger market shares pay greater administrative fees. In 2011 for manufacturers whose sales made up 5% or more of total sales of all covered products the administrative fee was $43,721. Fees are collected by the Department of Ecology and total collections

[2] Administrative fees could be separated and listed under "Producer fees based on product type," but because they are used entirely to implement a regulatory mandate (in this case EPR), they are included only here (and later as applicable for other regulatory mandates).

are expected to be $357,000 in 2011 (Washington State Department of Ecology 2011a). In addition to administrative costs, manufacturers must also pay for the collection and recycling programs. Manufacturers may opt out of the Standard Plan and form their own Independent Plan to collect and recycle covered products (Washington State Department of Ecology 2011b). The Washington Materials Management & Financing Authority coordinates collection for manufacturers participating in the Standard Plan and charges them a share of the costs (Washington Materials Management & Financing Authority 2008). As of 2010 there were no Independent Plans and all manufacturers participated in the Standard Plan (Northwest Product Stewardship Council 2010, 5).

For manufacturers using the Standard Plan, responsibilities are distributed through a system that is a combination of Return Share and Market Share. In 2010 the Standard Plan financed the collection and recycling program costs such that 45% of these costs were based on return share and 55% on market share.[3] The return share of a manufacturer is calculated as the proportion of total end-of-life products collected for processing that the specific manufacturer's brand(s) make up. The brand name of all returned end-of-life products are not recorded, instead the State Department of Ecology randomly samples a portion of them. In 2010 over 14,900 televisions, computers and computer monitors submitted for recycling were sampled. Each manufacturer's responsibility for financing the recycling of returned products is partly based on their Return Share. For example in 2010, Sony brands constituted approximately 8% of the weight of all sampled returned products. Thus, of the total cost of collection and recycling programs to be paid by return shares, Sony was responsible for about 8% of these costs. Some of the products submitted for recycling have unidentifiable brand names or were produced by companies that have gone out of business. The costs of recycling these products are divided proportionally among the manufactures paying based on return shares (Washington State Department of Ecology 2011c).

Product Stewardship in Oregon: Oregon E-Cycles: In Oregon, disposers can bring up to seven desktop or laptop computers, monitors and televisions to collection sites free of charge. The processing and recycling of these covered electronics in Oregon is funded by their manufacturers. Manufacturers may join the State Contractor Program in order to fulfill their requirement to fund processing and recycling of covered electronics, which requires that they pay a yearly per pound recycling fee to the Oregon Department of Environmental Quality based on their share of total processed electronics. Manufacturers must also pay a yearly registration fee to cover the administrative costs of the Oregon E-Cycles program (Oregon Department of Environmental Quality 2011b). Qualifying manufacturers have the option to instead pursue setting up an Independent Program (Oregon Department of Environmental Quality 2011a). A statewide ban on the disposal of computers, monitors, or televisions in

[3] Source: E-Cycle Program Manager, personal communication with Janine Bogar, WA Dept. Ecology.

landfills is in effect statewide in Oregon (Northwest Product Stewardship Council 2010, v).

Product Stewardship in Maine: Maine Revised Statute Title 38, Section 1610 establishes the law requiring producers to cover the costs of collecting and recycling covered electronics. Covered electronics are: computer central processing units, desktop printers, video game consoles, cathode ray tubes and devices, flat panel displays and video display devices. Consolidation facilities provide the service of collecting end-of-life electronics from the consumer and then transport them to recycling facilities. The electronics will be dismantled or recycled at the recycling facility. Consolidation facilities record the brand name of each collected computer monitor and desktop printer. Producers of monitors and printers pay for the recycling of each product of their brand name collected. Televisions and video game console producers pay a share of the total cost of recycling televisions and video game consoles based on how large a share of the national market their sales make up. Television and video game console producers whose market shares are lower than 1/10th of 1% do not pay the cost of recycling as these costs are paid by the producers with larger market shares (Maine State Legislature 2009). Maine also has legislation mandating that producers fund product stewardship plans for paint, unused pharmaceuticals, and medical sharps. Maine has a product stewardship framework law to assist in forming new product stewardship plans. Legislation proposed for the 2011 legislature includes mandating stewardship plans for car mercury switches or headlamps containing mercury, and florescent lamps (Maine Department of Environmental Protection 2011, 33, 52-84).

Product Stewardship in Germany: Packaging Ordinance: The world's first Extended Producer Responsibility program was instituted in Germany in 1991. The "Green Dot" system was created to deal with packaging waste and continues today (Fleckinger and Glachant 2010, 57). Producers selling products in Germany are required to accept returns of their packaging free of charge. The federal government's Packaging Ordinance specifies that certain categories of packaging should be reused or recycled as much as possible. The Ordinance calls for the opportunity for the consumer to be able to return the packaging at or very near the retailer where the product was purchased (Federal Ministry for the Environment 2009, 5-7). In order to comply with the Act, producers pay a third party company to collect and recycle their packaging (Nakajima and Vanderburg 2006, 511). Austria, Sweden, France, and other countries have similar programs (Tojo and Lindhqvist 2001, 9). Germany has extended its product stewardship programs to cover end-of-life vehicles and electronics as well (Nakajima and Vanderburg 2006, 510).

Product Stewardship in New Zealand: New Zealand's Waste Minimization Act of 2008 is designed to increase opportunities to reuse or recycle products, reduce source waste generation, and reduce environmental effects of disposal. In several cases producers have set up voluntary product stewardship schemes, such as some producers

of cell phones, tires, chemical containers, and paint. The Minister of the Environment may declare priority products, for which setting up stewardship schemes is mandatory. As of 2011 no priority products have been declared. Producers using voluntary product stewardship schemes may apply to have their scheme accredited by the Minister of the Environment. A product stewardship scheme may set up infrastructure to recover and handle end-of-life products. This may include producers contracting out to third party recyclers to collect their product (New Zealand Ministry for the Environment 2009).

Product Stewardship in Ontario: Electronic Stewardship: Producers and importers (collectively known as Stewards) of designated electronic equipment for use in Ontario, Canada must pay monthly fees to cover the net costs of managing the designated electronic equipment at the end of its life. The Stewards submit a monthly report detailing the quantity of designated electronics that they supply for use in Ontario. Designated electronics include many common household electronics including computers, computer monitors, computer keyboards, radios, video players, telephones, and cell phones, among others (Ontario Electronic Stewardship 2011a). Monthly fees are based on the quantity of each type of electronic devise supplied for use each month. Fees vary among the type of product reflecting their cost to manage at the end of their life. For example, the fee for computer keyboards is much lower than the fee for computer monitors (Ontario Electronic Stewardship 2011b). However the fees for each electronic devise category and size are identical for each Steward, thus there may be little reward for producers who make electronics with fewer toxic materials.

Product Stewardship in British Columbia: Fee targeted at thermostat producers: Manufactures and distributors that sell or import thermostats into British Columbia, Canada fund the thermostat collection program. The program began in 2006 in order to collect the hazardous mercury in thermostats. Each participating company pays a flat fee to cover fixed costs of planning the program and variable fees based on the number of thermostats returned (Clean Air Foundation 2010, 14). The program is managed by the manufacturers and distributers but this type of revenue option could also be used by government run programs.

Product Stewardship in Denmark: Fees to cover the operating costs of a beverage container deposit and refund system: Producers and importers of beverage containers in Denmark pay for the operating costs of the beverage container deposit and refund system. The fees are adjusted annually with the goal of the not-for-profit company that runs the program avoiding an operating profit or loss. The fees are charged based on the sales volumes of producers and importers. Logistics fees are charged to producers in order to cover administrative costs. Collection fees are charged to producers in order to cover the cost of collecting and counting the beverage containers (Dansk Retursystem 2011a). Collected containers are sorted then sold to companies that will process them into recycled materials (Dansk Retursystem 2011b).

Effectiveness of Extended Producer Responsibility

- **Incentives for waste reduction:** In an Extended Producer Responsibility program the producer pays for (at least some of) the costs of handling each product at the end of its life. A portion of these costs may be passed on to the consumer through higher product prices, which may result in fewer sales and perhaps lower prices received by the producer. Compared to an instrument where producers do not take the cost of disposal into their decision process an Extended Producer Responsibility program incentivizes waste reduction.
- **Incentives to promote recycling and reuse:**
  When producers are held responsible for recycling or disposing of the products they produce, they may have stronger incentives to design and manufacture their products to facilitate recycling and handling at the end of product life. Frequently in an EPR program producers are mandated to recycle their products. An EPR program may provide disposers with cost free options to submit their end-of-life products for recycling, but this is not sufficient to guarantee that all products will be recycled, because bringing used items to a drop-off point entails transportation and time costs to the consumer. Potentially, further increases in recycling rates could be obtained with a deposit refund system. Return rates might also be affected by bans on input use or bans on sending certain products to the landfill.
- **Revenue generation effectiveness:** An Extended Producer Responsibility program is a regulatory instrument that imposes the direct costs of recycling and disposal on producers, so revenue generation needs and effectiveness are both generally low. Funds to cover the government's costs of enforcing the program are still necessary and may be raised via taxes on regulated producers or from another source.
- **Revenue sustainability:** Producers are held responsible for recycling and disposal regardless of what the costs of recycling and disposal are. Producers must provide funds regardless of the proportion of end-of-life products sent to the landfill vs. those that are recycled, thus the revenue instrument is able to provide sustainable funds, even if return rates increase. If the producer cannot effectively pass on the costs of the program to consumers and if recycling or properly disposing their products at the end of their life is too costly to remain in business then the producer may choose to not sell into the state or country.
- **Administrative costs and complexity:** Administrative costs are likely to be much higher for an EPR program than downstream landfill tipping fees. The programs tend to be highly targeted to specific product types and/or product characteristics. Although this focused targeting provides a clear responsibility for producers of specific products, application to very broad categories of potential waste would be costly and difficult to implement. Based on applications to date, it

appears that Extended Producer Responsibility programs will likely be most useful in relatively narrow niche waste categories. However, broader (less targeted) applications exist and are likely to be feasible in some additional general cases as well.[4]

b) Revenue generating instruments

Producers may be charged a fee based on the type of product they sell, or the characteristics of the product they sell. An instrument focused at a particular type of product is relatively less targeted than an instrument aimed at a product's characteristics. This becomes important if specific characteristics of a good are of particular concern. For example, a fee per mercury-containing thermostat will charge the same for a thermostat containing a small quantity of mercury as it would for a thermostat containing a large quantity of mercury. But a fee on the amount of mercury in a thermostat would charge more for those with higher levels of mercury. This distinction is important because in the first case, producers are not incentivized to reduce the amount of mercury in their products.

ii. Producer fees based on product type

A producer fee based on product type is a targeted instrument, but relatively less targeted than fees based on product characteristics. Producers may pay per product they sell, or by another form of a variable fee. One strength of a fee based on product type as opposed to product characteristics is that there is no attempt to measure the characteristics of each product, so the administrative costs of doing so are avoided. The weakness of this approach is that producers will have less incentive to change the characteristics of their products. In general, fees on product type rather than characteristics will be more cost effective if the substances of interest (e.g. mercury) are constrained by production or consumption to vary little.

Examples of Producer Fees Based on Product Type

Litter tax: In 1992, Washington imposed a litter tax that the manufacturers, wholesalers and retailers of all products which were deemed likely to end up as litter must pay. The tax is equal to the value of products multiplied by fifteen thousandths of one percent (Washington State Legislature 1986a).

Levy on aggregates: In 2002 the United Kingdom introduced an environmental tax on aggregates including sand, gravel and crushed rock used in construction to

[4] Indeed, this idea is being formally pursued. According to New York Product Stewardship Council (2011), "Framework EPR is an alternative to the current piecemeal approach of laws that address individual problem products like fluorescent lamps and batteries. The framework approach establishes consistent principles, clearly defined roles for all parties, and a transparent process for adding new product types. British Columbia and several other Canadian provinces have adopted the framework approach."

encourage the use of recycled materials. The producer of aggregate is responsible for paying the levy per weight of commercially exploited aggregate. A portion of the revenue from the levy goes to a Sustainability Fund which benefits local areas affected by quarrying. Denmark, France, and Sweden have similar taxes on aggregates (HM Revenue and Customs 2011).

Effectiveness of Producer Fees Based on Product Type

- **Incentives for waste reduction:** A targeted variable fee on producers based on type of product will increase the cost of production in each unit of the target product produced and purchased. Presumably, producers will pass some fraction (perhaps most) of these fees onto consumers through higher prices. When making their purchasing decision consumers may therefore consider this increased cost of the product, and potentially even the cost of its disposal. In contrast, a general and/or flat fee imposed on producers may not be as effectively integrated into the market price of a product in relation to its embodied potential waste.[5] Therefore consumers may not face the full cost of disposal and thus will not have as much incentive to avoid the product with more waste.
- **Incentives to promote recycling and reuse:** When fees are only charged on certain types of products, producers may have a disincentive to produce that type of product. Producers may change the mix of products they produce in order to avoid paying fees. The revenue instrument may be designed to charge greater fees for products that are difficult to recycle or reuse. Such a design would incentivize producers to produce the types of products that can easily be recycled or reused. A fee based on product type provides incentives for the producer to adjust the quantity of a given product type produced. However, there is no incentive to change the characteristics of a given product type. For example when all televisions are charged a fixed fee regardless of their lead content, producers may have an incentive to produce fewer televisions, but they will not have an incentive to produce televisions that contain less lead.
- A producer fee does not provide an incentive to recycle at the time of disposal.
- A tax on virgin materials (produced by material extractors or growers as in Figure 1) would raise their price relative to recycled materials. When virgin materials and recycled materials are substitutes in production the rise in the relative price of virgin materials, due to the tax, gives producers an incentive to substitute recycled materials for virgin materials.

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[5] As discussed in the introduction, fundamental economic methods suggest that individual firms in a competitive market setting tend to pass on all or part of an increase in variable costs to consumers, but this is not generally the case for fixed (flat) costs. Prices may however be affected to the extent that firms alter their behavior to avoid the fixed cost, or to the extent that the fixed cost leads to changes in the number of firms in a market.

- **Revenue generation effectiveness:** Fees and taxes on producers based on the type of product they produce is an example of an upstream revenue instrument. Funding for eventual downstream disposal costs may be raised, in advance, at the point of sale.
- **Revenue sustainability:** A fee on waste production will in principle decrease the amount of the potential waste produced, so revenues may decline as a result of this market adjustment. However, all else constant, waste disposal volume will tend to decline, which will in turn decrease expenditures on disposal, making possible revenue declines of less consequence. Further, holding potential waste production constant, revenues from an upstream instrument such as this will not decline as waste is redirected from landfills to recycling or reuse. Thus, producer fees provide relatively sustainable sources of revenue for supporting recycling and reuse programs.
- **Administrative costs and complexity:** Administrative costs for taxes and fees on producers are expected to be comparatively high for general waste management concerns. Taxing producers a portion of the value of the products they produce requires measuring the value of these products. If only producers of certain types of products are taxed it may be costly to determine which producers are making the types of products that are subject to the tax.
- A litter tax, which charges manufacturers of products likely to be littered, already exists in Washington. Further revenue could potentially be raised by introducing additional instruments which charge the producers of other types of products.

iii. Producer fees based on product characteristics

A fee on producers based on product characteristics is a relatively targeted, variable instrument when it is applied to specific product characteristics. A fee on producers based on product characteristics may incentivize producers to change the characteristics embodied in their products. For example, if producers are charged a tax rate based on the content of hazardous materials, recyclable materials, durability, or packaging used in their products they may change these characteristics. For instance, in California beverage container producers are charged a processing fee based on the recycling rates of the materials they use. The processing fee rates for materials that have high recycling rates by consumers are lower than the rates for materials that are rarely recycled. Producers have an incentive to produce their beverage containers using materials that are frequently recycled in order to pay lower processing fee rates. This is an example of "design for the environment." Calcott and Walls (2000) describe "design for the environment" as a producer's decision to manufacture products that may present fewer environmental costs.

Examples of Producer Fees Based on Product Characteristics

Tax for using hazardous materials: In 1988 Washington passed the Model Toxics Control Act. The act imposes a tax of 0.7% on the first instate processor of hazardous materials. The tax revenue funds the investigation and cleanup of hazardous waste sites, among other activities (Washington State Department of Ecology 2007, 5). Producers only pay taxes on the hazardous materials they process so they can lower their tax burden by processing fewer hazardous materials. Producers have an incentive to produce the same product but with fewer hazardous materials.

Processing Fee: Certified recycling centers in California process and resell the recycled materials they receive; the price they receive is the market scrap value price. In 2011 the cost to process each material exceeded its market scrap value. To cover this difference the CA Department of Resources Recycling and Recovery pays the recycling centers a processing payment. Beverage producers pay processing fees to the Department to cover a percent of the processing payment. Producers pay processing fees equal to 65% of the processing payment if they choose to use materials with a recycling rate less than 30%. If producers use materials that are more commonly recycled, they can pay processing fees at a lower percent of the processing payment. For example since the recycling rate of glass was greater than or equal to 75%, producers making beverage containers out of glass only have to pay processing fees equal to 10% of the processing payment in 2011.Vinyl plastic had a recycling rate of lower than 30%, thus beverage container producers using vinyl plastic must pay processing fees equal to 65% of the processing payment in 2011 (Cal Recycle 2010a; California Law 2005).

Ontario Blue Box program Stewards: The Blue Box program in Ontario, Canada provides access to curbside collection using "blue boxes" to residents living in the province. Half of the funding of the program is provided by Stewards. Stewards are producers or importers of recyclable materials used in Ontario with gross revenue exceeding $2 million in any year since 2002. Stewards pay a tax per kilogram of glass, metal, paper, plastic, or textiles that they sell or distribute (Stewardship Ontario 2011). Covering half of the costs of residential recycling programs amounts to a summed payment from all Stewards of about $48 million per year (New York State Dept of Environmental Conservation 2010, 84).

Packaging Tax: The packaging for soap, detergents, perfume, margarine and select other products are taxed in Denmark. Most of the taxes are weight based so products that use less packaging pay lower taxes. Producers can also lower their tax liability by using less new materials and more reusable packaging. Local council governments are allowed to set the rate of the taxes so that the revenues cover the costs of managing the waste from the taxed products generated by households and industry (Eionet 2006). There is also a tax on disposable tableware. Consumers pay the taxes at the point of sale (Economic Instruments 2008).

Effectiveness of Producer Fees Based on Product Characteristics

- **Incentives for waste reduction:** A fee based on the characteristics of a product gives producers an incentive to change these characteristics in order to pay lower fees.
- A fee based on the amount of packaging accompanying a product may encourage less product packaging. Producers could be incentivized to use less or lighter weight packaging, reducing the amount of waste generated.
- A tax rate based on a product's durability will incentivize producers to make products that last longer. There are two ways that products with increased durability can lead to reductions in waste generation. First, the products last longer so their users will not have to replace them as frequently. Second, when long-lasting products are replaced by their original user they may be sent to the reuse market rather to disposal. A complication in the incentives for producers occurs because the reuse market could compete with their new sales.
- **Incentives to promote recycling and reuse:** A tax rate based on a product's content of recyclable materials or design for recyclability will incentivize producers to make products that are more easily recycled.
- **Revenue generation effectiveness:** Upstream revenue instruments that charge fees at the time of purchase rather than at the time of disposal can be effective at generating revenue. In Ontario, Canada a program has been successfully implemented providing millions of dollars worth of funding for recycling programs each year.
- **Revenue sustainability:** Fees on producers based on product characteristics can be implemented to encourage "design for the environment". The method to incentivize producers to consider waste costs in their production methods is to charge higher fees to producers that do not consider the environment in their production. Thus as producers begin to consider these costs they will pay lower fees. Less fees paid by producers implies fewer revenues collected by the government. Fees based on product characteristics may not be sustainable.
- **Administrative costs and complexity:** Measuring each product's characteristics so that a tax can be imposed based on these characteristics may be difficult, especially if product characteristics often change.

3. Purchasers of goods and packaging

This section summarizes revenue options targeted at the purchaser at the point of sale of goods that will eventually be recycled, reused, or disposed. These are often similar in nature to producer fees, and may have many of the same effects.

iv. Advance disposal, recycling or recovery fees

Advanced disposal, recycling, or recovery fees are paid by the consumer of a product at the point of sale. An advance disposal, recycling, or recovery fee is a targeted instrument because it is attached to a specific type or characteristic of potential waste. It is a variable fee because it is paid per unit of a product purchased. The advance disposal fee may be used to cover all or some cost of managing a product at the end of its life.

Examples of Advance Disposal, Recycling or Recovery Fees

Container recycling fee: In British Columbia, Canada Encorp Pacific, a not-for-profit company, runs a deposit and refund program for beverage containers. Encorp Pacific receives revenue from a non-redeemable container recycling fee charged per beverage container purchased. The container recycling fee for plastic containers ranges from 3-6 cents with higher fees for larger containers. The costs to recycle glass exceed the costs to recycle plastic and thus the container recycling fees are higher for glass at 12 cents per container (Encorp Pacific 2011).

Advance disposal fees for electronics and appliances: In Belgium whenever a new household appliance is purchased an advance disposal fee (termed an "all-in" contribution, presumably meaning that all costs to society are accounted for) is charged. The contribution is used to fund all aspects of end-of-life management for appliances, including: transportation, treatment/processing, and administrative costs. The materials of the appliances may be recycled. The system is run by Recupel a not-for-profit organization started by manufacturers with the help of Belgian regional governments (Recupel 2011).

Advance disposal fee for batteries: Whenever a purchaser in Belgium bought batteries they were required to contribute 0.125 euro per battery to the BEBAT battery collection program to be used to finance end-of-life management programs for batteries. The BEBAT program pays for media campaigns and collects batteries from more than 20,000 collection points including grocery stores and schools (Hogg 50-53). Companies may choose to join the BEBAT program so that they are exempt from environmental-taxes on batteries (BEBAT 2011).

Advanced Recovery Fee for electronics: In California when consumers buy electronics with a screen such as: computer monitors, laptops, portable DVD players with LCD screens, televisions, or a cathode ray tube, they must pay an Advanced Recovery Fee at the point of sale (Californians Against Waste 2010). The fee in 2011 is

$6, $8, or $10 depending on the size of the screen. The fees are collected by the State Board of Equalization from the retailers. The Board of Equalization deposits the fees in the Electronic Waste Recovery and Recycling Account which is used to reimburse collectors and recyclers of the electronics (Cal Recycle 2010b).

Effectiveness of Advance Disposal, Recycling or Recovery Fees

- **Incentives for waste reduction:** With an advanced disposal fee, purchasers pay a disposal fee per unit of a product. General application of advance disposal fees may potentially reduce the consumption/production of waste. When deciding whether or not to buy a product, purchasers take into account the product's price plus the advance disposal fee. This additional cost may lead to fewer purchases of these products and therefore less waste. However, consumers may simply substitute away from the target product toward one with no fee attached, thereby mitigating waste reduction.
- **Incentives to promote recycling and reuse:** Advance disposal fees alone provide no additional incentive to recycle or reuse rather than dispose of waste once the product reaches the end of its useful life. We use the term advance disposal fees broadly to also represent the cost of recycling collected upfront or participation in specific disposal programs such as the safe disposal of batteries. This type of advance disposal fee may be combined with variable pricing for waste disposal at the time of disposal in order to incentivize the disposer to recycle.
- **Revenue Generation Effectiveness:** Advance disposal fees in principle shift end-of-life costs in the waste system to upfront costs. To the extent that they are applied to broad categories of goods (a general rather than targeted instrument), they may provide a potential foundation for substantial revenue generation.
- **Revenue Sustainability:** In principle, revenues may decline as waste generation decreases, though the capacity to increase advance disposal fees at the margin depends on the characteristics of demand. However, to the extent that an advance disposal fee reduces potential waste, revenue needs would decline as well. Revenues from highly targeted advance disposal fees may decline to the extent that low-waste alternatives are developed and substituted in the long run.
- **Administrative costs and complexity:** At the point of sale, advanced disposal fees are charged much like a sales tax, and may entail low additional administrative costs. When different products are charged different advanced disposal fees there may be an administrative cost to keep track of each.

v. Generalized ADFs

Other fees paid by purchasers differ from an advance disposal fee because fees do not have to be used to fund the disposal of a specific product. In an "Other fees paid by purchasers" instrument funds may be raised in any quantity, whereas an advance

disposal fee typically raises just enough funds to cover the costs of disposal of a specific product. Additionally, an advance disposal fee makes a clear link that fees are being raised to cover the costs of disposal for a product. The link may be less clear in an "other fees paid by purchasers" instrument where fees are used to manage waste and support recycling or reuse. We call these "Generalized ADFs. Each of the examples below discuss variable taxes or fees, but "other fees paid by purchasers" could also be a fixed rate. As well, the degrees of targeting by such an instrument may vary.

Examples of Generalized ADFs

Sales Tax: Delaware County is the only county in New York that uses a portion of sales tax revenues to fund waste management (One cent out of every eight cents collected in sales tax is dedicated to the county's solid waste management complex). The funds have allowed increased investment in composting, helping make mixed-waste compost a product that can be marketed and sold (New York State Dept of Environmental Conservation 2010, 89). This instrument is very broad in that it applies to all product types that are subject to New York State's sales tax.

Tax on California Redemption Value: In California's beverage container deposit and refund system a redemption value is paid by the purchaser at the point of sale. A separate refund value can be received for returned containers. For taxable beverages sold in California their redemption value is also taxed (California Board of Equalization 2009, 2). The taxes charged on redemption values are not returned as part of the refund value.

Core charge for vehicle battery: In Washington, purchasers are charged at least a $5 core charge for each vehicle battery that they buy. The core charge can be avoided if the purchaser returns an equivalent size battery at the time of purchase. Retailers of vehicle batteries must post a sign stating that it is illegal to put a vehicle battery in the garbage. Collected batteries may be sent to a smelter who extracts the lead in the batteries (Washington State Legislature 1989).

Tire retailer fee: In Washington purchasers are charged a $1 point-of-sale fee for each new tire purchased. Retailers collect the fee and submit it to the state's Waste Tire Removal Account. The Account provides funding for cleaning up tire piles in the state and preventing accumulation of tire piles in the future. Balances in the account may also be transferred to provide funding for highway maintenance (Washington State Legislature 2009). The fee only applies to motorized vehicles and not bicycles or wheelbarrows. Retreaded vehicle tires are also exempt from the fee (Washington State Department of Ecology 2011e).

Fee for waste tires: In 2009, Colorado collected a waste tire fee of $1.50 per tire at the point of sale. After July 1, 2011, 39.66% of the fee will go to the waste tire clean-up fund, 8% to the waste tire fire prevention fund, and 6.7% to the waste tire market development fund (State of Colorado 2011, 2).

Effectiveness of Other Generalized ADFs

- **Incentives for waste reduction:** The effective price of a product will be its cost plus any fees that must be paid at the time of purchase. When fees raise the effective price of a product, purchasers may buy less of the product.
- A tax on packaging will make products with heavy packaging relatively more expensive than products with light packaging. The relatively lower price of products with light packaging provides an incentive for purchasers to buy them over products with heavy packaging. Purchasers may also have an incentive to buy less packaging overall.
- A packaging tax may send upstream signals to producers. If purchasers are buying fewer products with heavy packaging, producers will have incentives to make products with lighter packaging that purchasers desire to buy.
- **Incentives to promote recycling and reuse:** The effectiveness of Generalized ADFs as incentive instruments compared to ADFs in the previous section depends on the extent to which the revenues are used to provide direct incentives for recycling and reuse. This incentive will be weaker if revenues from the fees do not go wholly towards funding the disposal of a specific product. There may be some incentive for reuse if fees are only charged on new products, since purchasers can avoid paying the fees by buying used products.
- **Revenue Generation Effectiveness:** It is predicted that if a packaging tax as in Denmark were instituted in Ireland 60-80 million Euro per year could be raised in revenues (Fischer and Stenbaek Hansen 2010, 22). Using this technique, we were able to perform a similar analysis in MS Excel using data from Washington State. The data source used was the 2009 Washington Statewide Waste Characterization Study (Washington State Department of Ecology 2010a). The finding is that Washington could have raised over $116,000,000 in tax revenue in 2009 if a packaging tax as in Denmark were instituted (email correspondence with Christian Fischer, Chief Consultant for European Topic Centre on Sustainable Consumption and Production).
- In British Columbia in 2007 revenue from unclaimed bottle deposit refunds was $17-18 million (Gardner Pinfold Consulting 2008, 21)
- **Revenue Sustainability:** If Generalized ADFs are based on taxes on product characteristics or product type, this instrument will provide fewer funds as product characteristics are changed by firms in response to the tax. However, this process reduces the types of waste targeted, and therefore lowers the costs of the waste management system for those types of waste. For example, the revenues from a tax on product packaging will fall when products are made with less packaging, but additionally the non-fixed costs to handle waste with less packaging will also have fallen.

Administrative costs and complexity: A sales tax is likely to have low additional administrative costs. Determining which products to tax may be a costly process.

vi. Other revenue from purchasers

The "Other revenue from purchasers" category of instruments includes revenue from purchasers that is not directly collected as a tax or a fee. Unclaimed bottle deposits are a prime example. Other revenues from purchasers are raised by targeting a specific type of product and may be paid by the purchaser as a per-unit, variable fee.

Examples of Other Revenues from Purchasers

Unclaimed bottle deposits – British Columbia: Whenever a beverage container is purchased in British Columbia the purchaser must pay a deposit. The deposit will be refunded when containers are returned for recycling. However not all containers are returned. The unclaimed deposits are retained as revenues. In 2007 the revenue from unclaimed deposits totaled greater than $17 million (Gardner Pinfold Consulting 2008, 21).

Unclaimed bottle deposits – New York: In New York a 5 cent deposit is paid on all beverage cans, and bottles (including water bottles) at the time of purchase. For unclaimed deposits 80% of the revenues go to the state general fund (New York State Dept of Environmental Conservation 2010, 87).

Unclaimed bottle deposits - Denmark: The beverage container deposit and refund system in Denmark is run by the not-for-profit company Dansk Retursystem A/S. At the point of purchase consumers pay a deposit for each covered beverage container they purchase. Supermarkets that sell beverages may refund the deposits for returned containers. Unclaimed deposits are spent on improvements to the deposit and return system, or on community projects. In 2008, DKK 3 million (about 400,000 Euros) were spent on projects (Dansk Retursystem 2011c).

Effectiveness of Other Revenues from Purchasers

- **Incentives for waste reduction:** In a deposit-refund system the purchaser of a bottled product pays a deposit at the time of sale. The deposit may reduce the quantity of the bottled product purchased to the extent that it increases the cost of the product. The choice of the government to keep revenue from unclaimed bottle deposits is not expected to have any strong incentives for waste reduction in itself, unless these unclaimed deposits are used to fund waste reduction programs.
- **Incentives to promote recycling and reuse:** Revenue from unredeemed deposits may be used to pay for the recycling of returned beverage containers. The refund acts as an incentive for purchasers to submit their products for recycling

instead of sending them to the landfill or illegally dumping them. The deposit is used to pay for the refund, while deposit revenue will be left over for every bottle not returned for a refund. Oregon producers are allowed to keep unclaimed bottle deposits, whereas producers do not keep unclaimed deposits under British Columbia, Canada's beverage container deposit and refund system. In British Columbia the revenues from unclaimed bottle deposits are retained by the not-for-profit company that runs the program, Encorp Pacific (Gardner Pinfold Consulting 2008, 21). Allowing producers to keep deposits from unreturned containers might be counterproductive to the objective of increasing recycling rates because it weakens producer incentives to facilitate recycling of their products. Some cost leakage could occur if purchasers who buy their container out of state then return their container in states with a bottle bill to claim a refund. This would be less of a problem for Washington State because neighboring states of British Columbia and Oregon also require paying a deposit on beverage containers.

- **Revenue Generation Effectiveness:** Because other revenue from purchasers describes revenue not directly collected as a tax or a fee, it is not anticipated that this type of instrument can raise a great deal of revenue. A report by Gardner Pinfold Consulting (2008) found that British Columbia raised $17 million from unclaimed bottle deposits in 2007. Such an instrument faces many constraints. To raise additional revenues in a tax or fee instrument the tax rate can be increased, but the method to raise additional revenue in an unclaimed bottle deposit instrument is not as clear. If the deposit rate were increased, for example, by doubling the deposit paid per beverage container in New York from 5 cents to 10 cents, greater revenues would be raised from each unclaimed deposit. However, the number of unclaimed deposits might fall because the increased deposit rate would provide consumers with a greater incentive to claim their deposit. Thus, the effects on total revenue are indeterminate since fewer unclaimed deposits would decrease total revenue while higher deposit rates would increase total revenue.
- **Revenue Sustainability:** Funds from unclaimed deposit refunds from a beverage container deposit and refund system may not be stable on the path towards Beyond Waste because as recycling rates increase there are fewer funds from unclaimed deposits.
- **Administrative costs and complexity:** Administrative costs of a beverage container deposit and refund scheme are very high. This may be the main argument used against their implementation.
- British Columbia's beverage container deposit and refund scheme could be used as an example, if Washington desired to implement a deposit and refund scheme.

4. Waste disposers

This section summarizes each revenue option from solid waste disposal targeted at the disposer. The disposer is the entity who has used a product and now must decide what to do with the product. Disposers potentially choose among three options, send the products to the landfill or incinerator, submit them for recycling, composting, or reuse by others, or illegally dump them. Potential revenue options are grouped by these three end-of-life management options.

a) Fees for landfill disposal

Disposers sending their end-of-life products to the landfill may choose to self haul their waste by bringing it to the landfill themselves or they may subscribe to have all or a portion of their waste transported to the landfill by a solid waste collector. It is common for waste to be brought to a transfer station before it is transported to a landfill as its final destination. Tipping fees may be collected at the transfer station. Tipping fees represent the per-ton charge paid for waste brought to the transfer station or a landfill itself. A disposer who self-hauls waste may directly pay the tipping fee. For disposers subscribing to waste collection services their solid waste collector may pay the tipping fees. The tipping fees are an operating expense for the solid waste collector and may be passed onto the disposers subscribing to their services. The way in which these fees are passed on will affect the incentives of the disposer. Solid waste collectors may charge each disposer a flat rate regardless of how much waste they dispose or a variable rate per unit of waste they dispose. Many of the households in Washington State are charged a variable rate based on the number of garbage cans they subscribe to for waste collection services. This subsection will first discuss flat fees and then variable fees, for waste-to-landfill handling services.

vii. Flat fee for waste-to-landfill handling services

A flat rate for waste collection is a general, fixed instrument. The instrument is general to the extent that it does not differentiate among different waste characteristics. The instrument is fixed because the fee charged for waste disposal does not vary by the amount of waste disposed. The fee is generally a fixed yearly rate per household or business. Yearly flat fees may be collected as a component of property taxes. The flat rate fee may cover the cost of dropping your own waste off at the landfill or may be used to finance collection and hauling of waste in some locations. In many locations waste will be brought to a transfer station before it is brought to a landfill as its final destination.

A strength of flat fees over variable fees charged per unit of waste disposed by consumers (including businesses) is that revenues need not diminish if the waste stream

shifts away from disposal to recycling or reuse. However, the disposer pays no additional cost for sending more products to the landfill so there is not as much of an incentive to send less to the landfill as in a variable fee per unit instrument.

Examples of Flat Fees for Waste-to-Landfill Handling Services

Flat rate as a part of property taxes: In Auckland, New Zealand nearly all waste management activities are paid for through property taxes. The proposed annual tax amount per household in 2007-2008 was $199. The portion of tax revenue that covers waste collection services is used to fund landfill operation and some of the cost of landfill development. Litter control and the cleaning up of illegal dump sites are not covered by the tax revenue (Auckland Council 2011a).

Property taxes: In 2008, Boulder County, Colorado raised its general funds budget though a property tax levy. Funding from the general funds budget, along with user fees, was found in 1999, the year of the most recent "Solid Waste" section of the Boulder County Comprehensive Plan, to provide the bulk of the solid waste management budget (Boulder County, Colorado 2010, 29). Owners of high value homes pay more than owners of low value homes since the levy is a percentage tax.

Property taxes: In Kootenai County, Idaho, home of Coeur d'Alene, residents pay a Solid Waste Fee each year that is included in their property tax statement. (Kootenai County, Idaho 2011b). Residents of cities in the county may be required to pay additional fees for solid waste and recycling services. All solid waste and recycling services provided by the county are funded through the property taxes (Idaho Department of Environmental Quality 2003, 29). The county provides services covering self-hauled waste and does not cover the costs of waste collection services (Coeur d'Alene Garbage Service 2004).

Solid Waste Collection tax: Disposers who subscribe to "solid waste" collection services in Washington must pay a 3.6% collection tax on top of the cost of waste collection services. The definition of solid waste does not include materials intended to be recycled. The tax is paid by the disposer and collected by the provider of waste collection services. The waste collection provider then pays the tax to the state where it is deposited in the public works assistance account, which is used to fund public works projects of local governments. If disposers self-haul solid waste to a transfer station or landfill, they still pay the 3.6% collection tax in addition to the tipping fee (Washington State Legislature 1986b).

Effectiveness of Flat Fees for Waste-to-Landfill Handling Services

- **Incentives for waste reduction:** With a flat fee for waste disposal instrument the disposer does not pay by the level of waste he or she generates. There is no incentive to reduce the amount waste generated in order to pay less.

- **Incentives to promote recycling and reuse:** When additional waste disposal is free disposers have very little incentive to take the effort to recycle.
- **Revenue Generation Effectiveness:** Flat fee rates can be set so that the revenue raised covers the total cost of waste handling services. Rates may be adjusted so that revenue covers part of the cost or exceeds the cost. If set so that flat fee revenue exceeds the cost of waste collection the surplus may be used to fund recycling and reuse programs.
- **Revenue Sustainability:** A flat rate for waste handling services can be set at a premium above the cost of service in order to raise additional revenue to fund recycling and reuse programs. A decline in the level of waste (moving towards beyond waste) would require an increase in the premium.
- **Administrative costs and complexity:** Since the weight or volume of waste does not need to be calculated in a flat rate fee instrument the costs of measurement are avoided.

viii. Variable fees for waste-to-landfill handling services

A variable rate fee for waste handling services may be a general or targeted, variable instrument. The instrument is variable as it charges each disposer based on the amount of waste they send to the landfill. This section also includes different fees based on type of waste as a revenue instrument. Fees based on type of waste are a relatively more targeted instrument. Waste haulers transport the waste to a landfill or transfer station. Landfill operators may charge waste haulers by the ton for the waste they haul, known as a landfill tipping fee. A variable rate policy instrument may also be called pay-as-you-throw. There are four common units by which variable rate fees are charged: by weight, by volume, by number of bags, and by type of waste.

Examples of Variable Fees for Waste-to-Landfill-Handling Services

Specific Recycling Fee per ton brought to the landfill: Lane County, Oregon operates its own landfills, and allows competing landfills in the county. Recycling and waste reduction programs in Lane County received funding from tipping fees charged per ton of waste brought to landfills operated by Lane County. Therefore these programs had less funding when waste was brought to competing landfills. Lane County's solution was to charge a separate system benefit fee whose revenue is used for recycling and waste reduction programs. The new system benefit fee is charged per ton of waste no matter which landfill waste is brought to by the hauler. The fee is charged on waste but the revenues are used to fund recycling programs (Lane County, Oregon 2011). Specifically the waste hauler pays the fee but the charge is likely passed onto the disposer.

Charge by weight of waste: Some cities in Demark charge for waste collection services based on the weight of waste that each household disposes. Garbage trucks in

the small town of Tinglev, Denmark have a scale to measure the weight of each household's waste. Special garbage cans with electronic I.D. tags are used to record the weight of each household's waste (Anderson and Dengsoe 2002, 5).

Charge by weight of waste: The charge for household waste collection in the small town of Lokeren in Belgium is based partly on the weight of each disposer's waste. Residents also pay a fixed annual waste fee which was 80 Euros in 2007. Garbage collection trucks in Lokeren are equipped with scales that weigh each household's waste bin. Each garbage truck is able to record and keep track of the weight of each household's waste using an identifying microchip under each household's waste bin. Of 40,000 households which were asked if they would like to buy a lock to prevent illegal dumping in their bin, only 300 chose to purchase a lock (Andrew 2010).

Potential charge by weight of waste: In 2000 the city of Vancouver, Washington conducted a study concluding that switching from its system of charging for waste collection by volume of waste to a system that charges by weight may not provide large benefits in excess of costs. The benefit of the charge by weight system is that disposers are charged specifically by the level of waste they dispose providing incentive to lower charges by disposing less. Disposers can potentially put less in the garbage can by separating out yard waste and recycling from garbage or through source reduction (by switching to consuming products that generate less waste or by consuming less overall). Illegal dumping is also another option to avoid disposal charges. However in Vancouver the benefits from providing this incentive may be low because volume based charges already provide incentive to reduce the level of waste disposed. Weight is a more precise measure of the level of waste disposed than incremental charges based on the volume of garbage cans but the study finds the benefits from a more precise measure may be small. Costs may be high because scales would have to be installed on the city's garbage collection trucks. Costs may also be high because data on the weight of each household's waste needs to be collected. Additionally there may be problems when data cannot be collected due to breakdowns in the collection equipment. (Skumatz 2002, 3).

Tax per ton: All waste delivered to be incinerated or landfilled in Demark is taxed per ton. At an exchange rate of 5.15 Danish Krones per US dollar, the tax rate was roughly $72 per ton in 2000 (Anderson and Dengsoe 2002, 1), which is apparently among the highest in the world. The Ministry of Taxation or the state government collects the tax revenue. In 2003 about 130 million Euro in revenue was collected. Landfilled waste is taxed at a higher rate than waste brought to the incinerator, and recycled materials are not subject to the tax at all. The tax provides an incentive to recycle or incinerate waste. Incineration can recover some energy (Eionet 2006). Andersen and Dengsoe (2002) find that Denmark's tax on landfilled or incinerated waste likely reduced the levels of waste disposed. They hypothesize that producers began to reuse materials more often instead of dispose them. They further hypothesize that companies in very waste-intensive industries may have the strongest incentives to change their behavior in order

to generate less waste, thus the landfill tax may not have as strong a waste reducing effect for companies in non-waste intensive industries (Anderson and Dengsoe 2002, 1).

Tax per ton: The Kentucky Pride Fund was established in 2002. An environmental remediation fee of $1.75 per ton is charged on waste disposed at Kentucky landfills. Part of the collected funds are used to fund recycling grants for which city and county governments, solid waste districts, schools and school districts and other political subdivisions of Kentucky may apply (Kentucky Division of Waste Management 2007).

Excise tax: There is an excise tax on waste collection services in Whatcom County, Washington. Households and businesses pay the tax. The tax rate can be no higher than $8.50 per ton unless all cities and towns in Whatcom County unanimously decide to increase the rate (Whatcom County Public Works 2008, 106). The tax may be levied under the authority of Revised Code of Washington 36.58.140 (Washington State Legislator 1982).

Tax per ton: In order to raise the cost of landfilling in comparison to recycling the German government charges taxes on tipping fees. Uses of the tax revenues include funding education programs and R&D into clean technology. Some tax revenue may also be used to fund grants for recycling projects (Barlaz 2002, 42:47). The taxes are believed to be passed onto the disposer. The tax raises the relative cost of landfilling and may incentivize disposers to use end-of-life management options other than landfilling.

Charge by volume of waste: Seattle customers are charged $26.40 monthly per 32 gallon can for curbside collection (Seattle Public Utilities 2011a). By contract, the city of Seattle sets the rates that will be charged to customers (Seattle Public Utilities 2008, 7).

Charge by number of bags of waste: In 2008 the town of Bath, Maine charged $1.25 per bag. Many local retailers sold the special bags that must be used for curbside collection (Maine State Planning Office 2010, 4).

Different charges by type of waste: In Seattle residents may also subscribe for monthly collection of their food and yard waste. Fees are volume based and for a 32 gallon can, fees are less than a quarter of the charge for the same size garbage can (Seattle Public Utilities 2011a).

Different charges by type of waste: In the Regional District of Kootenay Boundary, British Columbia, Canada tipping fees vary by type of waste. The charge for waste containing Asbestos ranges from $90-$150 per ton. The charge for scrap metal is $10 per ton (Regional District of Kootenay Boundary 2011). High tipping fees for Asbestos waste may help offset the high costs of processing Asbestos waste.

Effectiveness of Variable Fees for Waste-to-Landfill-Handling Services

- **Incentives for waste reduction:** The disposer pays by the level of waste he or she generates so there is an incentive to reduce the amount waste generated in order to pay less.
- The costs of additional disposal will also affect the incentives of the disposer to generate waste. In a charge by volume of waste instrument the cost to a household to use a second garbage can per week may cost the same, more, or less than the first garbage can. In Seattle the charge for the first garbage can is the same as the charge for each additional garbage can (Seattle Public Utilities 2011a). In Moscow, ID the cost of an additional second or third garbage can gets progressively lower (Latah County, ID 2011). Progressively higher costs for additional garbage cans may encourage conservation.
- If waste haulers make a profit per unit of waste transported they may try to avoid declines in the level of waste disposed. When waste haulers are free to set prices in some cases they may not want to charge a greater fee for a second garbage can than for the first garbage can, because this makes disposers less likely to use a second garbage can.
- Volume based rates provided an incentive to compact garbage to fill the smallest possible space.
- Charges based on the volume of garbage cans are incremental. For disposers with a 32 gallon garbage can there is an incentive to generate less than 32 gallons of waste but there is little incentive to generate 30 gallons instead of 31 gallons, for example.
- Many locations including Seattle require all residents to subscribe to at least a minimum level of waste collection. In Seattle the smallest volume garbage can collection subscription is 12 gallons. This means disposers who landfill less than 12 gallons of waste (perhaps by practicing source reduction or composting) still have to pay for a 12 gallon garbage can, despite that it is not fully utilized.
- In their study of a pricing by the garbage bag initiative in Virginia, Fullerton and Kinnaman (1996, 981) find that under certain assumptions requiring each household to pay for the collection service of at least one bag per week may reduce illegal dumping substantially.
- **Incentives to promote recycling and reuse:** Under a system of free recycling but variable fees for sending waste to the landfill, disposers have an incentive to avoid paying the variable fee by recycling. If it takes time to sort recyclables, disposers will be more willing to incur the time cost when they can avoid variable fees for sending waste to the landfill by doing so.
- Under a variable fee for waste handling services instrument there is a potential for illegal dumping. In 2009 the Maine State Planning Office conducted a survey of 57 Maine Pay-as-You-Throw programs. Of the programs surveyed, 13 of them identified illegal trash dumping as a concern or problem (Maine State Planning Office 2010,

18). The data used in Fullerton and Kinnaman's (1996, 982) analysis provides evidence that households might have increased illegal dumping when households in Virginia were charged per bag they disposed.

- Charges by different types of waste can give incentives for disposers to sort their waste. For example in the Regional District of Kootenay Boundary, British Columbia, Canada the tipping fee for scrap metal is lower than the tipping fee for unsorted waste. Disposers may sort out their scrap metal in order to pay the lower tipping fee. The landfill may be able to more easily resell the scrap metal once it has been sorted.
- An incentive problem exists when waste disposal is charged a variable rate but recycling is provided for free. Disposers have an incentive to put waste in the recycle bin in order to avoid paying the variable rate. Seattle, WA's solution to this incentive problem is stating that recycling will not be collected if it includes garbage (Seattle Public Utilities 2011b).
- **Revenue Generation Effectiveness:** Variable rates can provide significant revenue, but as the amount of waste decreases, the rates will have to increase.
- **Revenue Sustainability:** Variable rates for waste handling services are not a stable source of funds. As the level of waste sent to the landfill declines revenue from variable rates will shrink, unless the rates increase.
- **Administrative costs and complexity:** In order to implement a variable charge for waste disposal the level of waste disposed must be measured. Because measurement is costly, the administrative costs of an instrument charging variable rates for waste disposal are expected to exceed the costs of a flat rate for waste disposal. As discussed in (Skumatz 2002) related to Vancouver, WA costs may differ based on which unit variable fees are based on. Because an instrument charging by weight would require scales to be installed on a city's garbage collection trucks, its costs may exceed the costs of volume based rates based on the size of each household's garbage can.

b) Fees for recycling or composting

Gertman (2010) identifies charging for all services as a possible solution to continued funding when the level of waste disposed of declines. For example if customers are charged for collection of traditional garbage as well as recyclables and yard waste, then reductions in traditional garbage won't eliminate the collection of funds it will merely cause a shift towards more funds being raised from the collection of recyclables and yard waste.

Charging variable fees for all services may have strong waste reduction benefits. When all forms of end-of-life management are charged variable fees, disposers may have an incentive to practice source reduction in order to avoid the variable fees. Source reduction may include generating less waste to begin with. However, variable fees may

also give disposers an incentive to illegally dump in order to avoid paying for waste handling services. The incentive to illegally dump may be mitigated through the use of a "Fines for illegally dumping" instrument.

ix. Flat fees for recycling or composting

A flat fee for recycling or composting is a general, fixed instrument. The instrument is relatively more general because it does not differentiate among the waste characteristics of end-of-life products submitted for recycling or composting. Any end-of-life product submitted for recycling is just considered as "recyclables." A flat fee for recycling or composting is targeted to some extent because it differentiates products that are recycled vs. landfilled. Targeting based on the end-of-life management option chosen by the disposer may incentivize disposers to separate recyclables from general waste. The instrument is fixed because it charges a flat rate to each disposer regardless of how much they recycle.

Examples of Flat Fees for Recycling or Composting

Flat recycling fee: Tomkins County in New York charges its residents a Solid Waste Fee. Part of the Solid Waste fee goes specifically to recycling and reuse programs. Property owners are required to pay the yearly fee which was $54 per house in 2008. Businesses pay per square foot (Tomkins County 2006).

Flat recycling fee: Auckland, New Zealand uses property taxes to pay for much of its recycling services. The tax rate in 2010 was $164.44 (Auckland Council 2011b). About 40% of the revenue goes to recyclables collection, hazardous waste disposal, and other waste minimization activities such as: education about composting (Auckland Council 2011a). Properties with apartment buildings can opt-out of part of the tax if their waste is collected through a third party. The properties may not opt-out of the recyclables collection, hazardous waste disposal, and the other waste minimization activities portion of the tax amounting to $51.56 (Auckland Council 2011c).

Recycling and Yard Waste Collection Contracts Administrative Fees: Clark County, Washington charges a fee to each household subscribing to recycling and/or yard waste collection services. The fee revenue is used to cover Clark County's administrative costs related to granting recycling and yard waste collection contracts. The recycling collection service providers collect the fees monthly from each household as part of their collection subscription charges and then submit them to Clark County. Because collection subscription charges are already high for rural customers they are exempt from the fee (Clark County, Washington 2008, 5).

Effectiveness of Flat Fees for Recycling or Composting

- **Incentives for waste reduction:** The fees can provide an incentive to not participate in the recycling program. However, since the disposer does not pay by the level of recyclable waste he or she generates there is no incentive to reduce the amount of recyclable waste generated in order to pay less if recycling occurs.
- **Incentives to promote recycling and reuse:** Any price charged per unit for recycling would reduce the incentive to recycle compared to the case where recycling is provided for free. A flat fee for recycling avoids this problem because it is not charged based on the level of recycling. The flat fee that disposers must pay is unaffected by how much they recycle. Thus the disincentive to recycle caused by per unit recycling fees is avoided.
- In Washington there is a history of the cost of recycling being hidden in the cost of waste collection. Disposers may be accustomed to receiving recycling and waste reduction services at no extra visible cost. The vast majority of cities in Washington choose to "hide" the costs of recycling from disposers by avoiding listing it as a separate line item on monthly bills. Counties are regulated by the Washington Utility and Transportation Commission and must show disposers the cost of recycling services explicitly. Washington Administrative Code 480-70-396 specifies that all services billed to the disposer must be shown as separate line items on their monthly bill. Information included on the monthly bill may for example include: size of garbage can, fees for yard waste service, fees for recycling service, and adjustments for the sale of collected recyclables (Washington State Legislature 2001a). Cities and towns are not subject to the same regulations (Washington State Legislature 2001b).
- **Revenue Generation Effectiveness:** Similar to variable fees for recycling or composting, flat fees help could generate revenue even as landfill disposal declines. The flat fee would need to be adjusted periodically to account for waste being diverted from disposal to recycling or composting.
- **Revenue Sustainability:** A flat fee for recycling or composting is relatively stable. Decreases in the amount of waste sent to the landfill will not affect the level of revenue raised from this instrument. Additionally, decreases in the quantity of end-of-life products submitted for recycling will not decrease the level of revenue generated from this instrument. However the stability of this revenue instrument is dependent upon disposers not having the option to opt-out of the flat fee.
- **Administrative costs and complexity:** Charging fees for waste collection and fees for recycling may increase administrative costs compared to an instrument that only charges for waste collection. However, the additional administrative costs of charging a flat fee would be lower than charging a variable fee.

x. Variable fee for recycling or composting

A variable rate for recycling or composting is a relatively targeted, variable instrument. The instrument is targeted to the extent that different rates are charged for waste that is recycled or sent to a composting facility or landfilled. The instrument is general in that among all waste that is recycled each type of waste is charged the same rate. The instrument is variable because each disposer is charged based on how much they recycle or send to a composting facility. Variable fees for recycling have not seen widespread use. This is perhaps because disposers will be more likely to recycle when the cost of additional recycling is free, than when there is a charge for recycling. The possible disincentives to recycle must be carefully addressed when implementing an instrument that charges for recycling.

Examples of Variable Fees for Recycling or Composting

Proposed variable charge for recycling services: The revised 2005 Solid Waste Management Plan of the Regional District of Kootenay Boundary, British Columbia, Canada recommends the use of Composting Collection and Processing Fees per ton and Recycling Collection and Processing Fees per ton (Regional District of Kootenay Boundary 2005, 32). The Regional District does not currently use recycling fees to the extent recommended by the Plan. To a limited degree the Regional District charges per ton tipping fees on some recyclable material brought to disposal sites, for example, clean soil is charged a rate of $10 per ton for disposal (Regional District of Kootenay Boundary 2011).

Variable charge for organic waste disposal: The Butte Mill Road solid waste facility in Boulder County, Colorado charges contractors and non-residents a per ton tipping fee for disposed organic waste. The tipping fee for organic waste is half that of the tipping fee for waste that will be sent to the landfill. Boulder County residents do not have to pay tipping fees for organic waste. A 2010 feasibility evaluation report for organic waste management in Boulder County estimated that if all disposers who use the Butte Mill Road solid waste facility were charged tipping fees for their organic waste drop off, revenues of $355,850 per year could be raised (Tetra Tech, Inc. 2010, 44).

Recycling fees collected from commercial businesses: In 2005 it is estimated that the cost of providing recycling programs for commercial businesses in Washington was approximately $200 million. These costs included collecting and processing the recyclables. Approximately $100 million of the cost is believed to have been covered by recycling fees paid by the businesses covered (Cascadia Consulting Group 2007, 27).

Effectiveness of Variable Fees for Recycling or Composting

- **Incentives for waste reduction:** If disposers are charged variable rates for both waste disposal and recycling, disposers may be incentivized to reduce the level of waste they generate in order to pay lower costs for disposal. However, the costs of disposal could also be avoided through illegal dumping, thus there may be an incentive to illegally dump. Incentives to reuse products may be greater when recycling is charged a variable rate.
- **Incentives to promote recycling and reuse:** If the disposer is charged for both landfilling waste or recycling waste they may be more likely to recycle if recycling services are provided at a lower cost than landfilling. The issue is complicated because the opposite is also true; if fees to the disposer for landfilling are lower than recycling, consumers may choose to send end-of-life products to the landfill. The actual physical expense of recycling paid by the recycling facility may exceed the actual expense of landfilling paid by the landfill owner. In such a case recycling may require a subsidy in order to maintain the incentive to recycle.
- When organic waste is charged lower tipping fees than waste sent to the landfill disposers will have an incentive to separate out their organic waste and dispose of it at an organic waste or composting drop-off facility.
- A flat rate for waste disposal combined with a variable rate fee for recycling may provide a perverse incentive. This is because with a flat rate for waste disposal households would not pay any extra for throwing away more, so households have an incentive to put their recyclables in the garbage can in order to avoid paying their variable rate fee.
- **Revenue Generation Effectiveness:** A report prepared for the Regional District of Kootenay Boundary in British Columbia, Canada explores the way total revenue could be maintained as tipping fees from waste decline due to declines in the level of waste sent to the landfill (moving towards Beyond Waste). The report by Gallant and Wellwood (2005) discusses using fees for recycling or composting to generate revenue. Declines in total fee-based revenue due to declines in landfill tipping fee revenue could be lessened through increases in revenue from fees for recycling or composting.
- **Revenue Sustainability:** This funding policy is stable since it does not decline as the amount of waste disposal declines. Revenue raised from this instrument will increase as landfilling is substituted for recycling or composting. However as less waste is generated overall, moving towards Beyond Waste, there may be also be reductions in the total level recycled or composted. Revenue raised from this instrument will decrease if fewer end-of-life products are recycled or composted.
- **Administrative costs and complexity**: Charging fees for waste collection and fees for recycling may increase administrative costs compared to an instrument that only charges for waste collection. Charging per unit of recycling requires a

measurement of the number of units recycled. A downstream revenue instrument such as tipping fees for recycling may have lower administrative costs than an upstream revenue instrument. Historically revenue options for raising funds from end-of-life products sent to the landfill have been mainly downstream instruments. This might be because of their low administrative costs.

c) Fines for illegal dumping

The likelihood that disposers will illegally dump their waste may be influenced by at least three factors. First, when the costs of legal disposal are high, there may be an incentive to illegally dump in order to avoid paying the high fees. Second, weak enforcement of illegal dumping laws is expected to lead to more frequent occurrences of illegal dumping than if illegal dumping laws were enforced strongly. Third, it is expected that there will be more illegal dumping if the fines for getting caught are relatively low. Illegal disposal may include littering, burning waste, or putting non-recyclable waste in recycling bins. Some jurisdictions have laws stating that recyclables may not be put in waste collection and waste may not be put in recyclables collection bins. The main use of fines may be to provide an incentive against illegal dumping. It is unlikely that the fines will raise large quantities of revenue, in fact the costs of enforcement likely exceed the collected revenues.

xi. Fines for illegal dumping

A fine for illegally dumping is a relatively general, variable instrument. The instrument is relatively general because typically the fine for illegally dumping is the same regardless of the characteristics of the waste dumped. In theory the fine could be targeted at specific waste characteristics, for by example, issuing greater fines for more toxic dumped waste. The instrument is variable based on the quantity of waste illegally dumped. In Washington the fine varies in increments, charging a small fine for a small volume of waste and a large fine for a large volume of waste.

Examples of Fines for Illegal Dumping

Fines for illegally dumping: In Washington State it is a gross misdemeanor to litter an amount one cubic yard or more. Revised Code of Washington 70.95.240 specifies that any person caught dumping an amount equal to one cubic yard or more shall also pay a litter clean up restitution payment to the legal owner of the property they dumped upon. A person littering less than a cubic yard but more than a cubic foot may be charged with a misdemeanor (Washington State Legislator 1969d). Washington State also has laws specifically designed to discourage littering. As of 2008, the fine for littering less than a cubic foot was $50. The fine for littering on a highway can be higher at $87 plus traffic infraction fines. In 2008 the Washington State Patrol issued 3,916 litter related violations. 1,236 of these citations resulted in an actual ticket, the rest were a verbal or written warning (Washington State Department of Ecology 2011d).

Effectiveness of Fines for Illegal Dumping

- **Incentives for waste reduction:** Disposer will have increased incentive to avoid dumping illegally when they must pay fines if caught. The greater the fine or the higher the probability of getting caught, the greater a disposers incentive to avoid attempting to illegally dump. Fines for illegally dumping may be increased in conjunction with introducing unit pricing for landfilling or recycling. The increased incentive to illegally dump caused by unit pricing can be offset by the incentive to avoid illegally dumping caused by fines.
- **Incentives to promote recycling and reuse:** End-of-life products intended to be landfilled, recycled, or composted may all be illegally dumped. Fines for illegal dumping in principle provide incentives to utilize landfill, recycle or compost instead, though perhaps weakly.
- **Revenue Generation Effectiveness:** Fines from illegal dumping are unlikely to provide large revenue streams.
- **Revenue Sustainability:** Fines for illegal dumping should not be used as a main revenue source. Fines for illegal dumping are however important because they provide a disincentive for illegal dumping.
- **Administrative costs and complexity:** Enforcement costs for administering fines are high because of the difficultly to identify and punish those participating in illegal dumping. Fines for illegal dumping already exist in Washington. Fines may in principle be used to offset any policies implemented that increase the incentive to illegally dump. This offsetting could be achieved by increasing the fine and/or punishment for getting caught illegally dumping or by increasing the enforcement of laws against illegal dumping.

5. Solid waste collectors

In Washington, city governments may provide waste and recyclables collection services or a private hauling company may provide these collection services. Cities oversee the activities of private collection companies in incorporated areas and the Washington Utilities and Transportation Commission oversees collection companies in unincorporated areas (Washington State Department of Ecology 2004b, 13). Solid waste collectors are in a unique position to direct waste from landfill toward recycling, and as such are often the focus of recycling programs via either mandated recycling requirements, or through paying taxes to support recycling.

xii. Mandated Provision of Recycling Opportunities

Governments may mandate the provision of recycling opportunities. They may either directly provide services or contract with solid waste collectors to provide recycling opportunities. These mandates vary in the type of recycling opportunities that

must be provided, and to which stakeholders. They may specify that the solid waste collector must provide recycling opportunities in order to receive payment for a full suite of waste management services from the jurisdiction. These mandates impose compliance costs on waste management services, and these costs are passed on to consumers in various ways, sometimes as direct user variable fees for recycling, but often as flat fees as a part of their total waste collection bill (as a visible line item or not).

Examples of Mandated Provision of Recycling Opportunities

Mandated provision of household collection of recyclables: Revised Code of Washington 70.95.090 specifies that each city comprehensive solid waste management plan related to urban areas should include programs for the collection of recyclable materials from households (Washington State Legislature 1969a, with subsequent revisions for recycling).

Mandated waste reduction responsibilities: Revised Code of Washington 70.95.010 says, "It is the responsibility of county and city governments to assume primary responsibility for solid waste management and to develop and implement aggressive and effective waste reduction and source separation strategies" (Washington State Legislature 1969e).

Solid waste in the city of Seattle, WA is collected by either Waste Management, Inc. or Cleanscapes Inc. Waste Management, Inc. is contracted to provide collection services for Northwest and South Seattle until March 31, 2019 (Seattle Public Utilities (SPU) 2008, 1). The city sets waste collection requirements to be provided and the rates that will be charged to customers. The city pays all transfer fees (tipping fees paid to privately or government owned transfer stations) (SPU,7). It is Waste Management, Inc.'s responsibility to provide all labor and equipment necessary for the contracted waste collection (SPU, 8).[6] Waste Management, Inc. must collect recyclables from households and commercial establishments (SPU, 17). Households may subscribe to a compostables collection service. Waste Management must collect compostables from subscribing households (SPU, 16). Waste Management, Inc. can earn a bonus of up to $75,000 per year for decreased tons of garbage collected or decreased tons of recycling and compost collected compared to levels in the baseline year 2009-2010. The bonus acts as an incentive for Waste Management, Inc. to encourage reductions in the generation of total waste and recyclables (SPU, 60).

[6] The city pays Waste Management, Inc. predetermined monthly sums for its collection and transportation services of household and commercial customer's garbage, recyclables and compostables (SPU,52). Waste Management, Inc. collects payments from commercial customers and then transfers them to the city; under this system the city is not responsible for non-paying commercial customers (SPU, 47). The city is responsible for non-paying residential customers (SPU, 48).

Effectiveness of Mandated Provision of Recycling Opportunities

- **Incentives for waste reduction:** The effect of recycling mandates on waste reduction is generally ambiguous. While the provision of recycling that lowers financial and/or time costs to consumer patrons will likely increase recycling rates, this reduction in cost, all else equal, could reduce the overall cost to consumers of waste generation and dispossession. However, to the extent that the operational costs of recycling are paid for by either tipping fees or recycling itself, then the effects of a mandated recycling program on waste generation reduction may be neutral or even perhaps positive.
- **Incentives to promote recycling and reuse:** How a mandate and its implementation promotes recycling by consumers depends on the services provided and how the services are paid for. If the operational costs of recycling are paid with variable fees on recycling, this will weaken consumer incentives to recycle. If a mandated recycling program reduces the time and effort consumers spend recycling, it will likely increase recycling rates. The introduction of household curbside recycling programs, for example, led to large increases in recycling rates, largely because they tend to reduce the time cost and inconvenience to consumers of recycling. Further, disposers will be incentivized to recycle if it can lower their total waste bill. In a system where disposers pay variable rates for waste handling services and flat rates for recycling there is an incentive to sort recyclables to ensure that they are not being thrown in the trash can where they are charged a variable rate. Several studies, including Fullerton and Kinnaman (1996), have found empirical evidence that when variable rates for waste disposal are charged in small units (such as pay per bag or pound) households may separate and sort recyclables more carefully.
- **Revenue Generation Effectiveness:** Mandates for the provision of recycling services do not necessarily raise government revenues directly, but they may. Depending on the structure of the mandate, jurisdictions may be more or less directly involved in either the fee collection process or the waste management process. For example, mandates could provide government revenue if governments get any proceeds from the sale of recyclables. Mandates could also increase revenues if all people are charged for recycling services but not all people use the service. Thus, the revenue generation potential depends more on the fee structure associated with the mandate or implementation of a mandate and these can vary substantially.
- **Revenue Sustainability:** Again, a recycling mandate does not necessarily provide revenue to the government, but may be an important instrument to help achieve the goals of the Beyond Waste Plan. The sustainability of mandated recycling programs depends on the contractual details between service providers and the government.
- **Administrative costs and complexity:** Mandated provision of recycling opportunities entails increased administrative costs over a system that establishes waste collection practices alone. Beyond this, these administrative and monitoring costs will vary depending on mandate characteristics.

xiii. Variable taxes charged to solid waste collection businesses

Variable taxes charged to solid waste collection businesses are examples of a general, variable instrument. The instrument is general because it does not target any characteristic of waste. Variable taxes are typically based on a percentage of the solid waste collection business's gross revenues. Solid waste collection businesses are frequently the stakeholder that directly pays landfill tipping fees, either at the landfill or at the transfer station. These taxes are often passed on to consumer/disposers, in addition to a charge to cover the collection service. Because the incentive effects caused by tipping fees affect disposers most strongly, details about tipping fees are presented in section 3 "Revenue from disposers".

Examples of Variable Taxes Charged to Solid Waste Collection Businesses

Fee on gross revenues: Revised Code of Washington 91.77.080 establishes that every solid waste collection company in the state may be required to pay a tax equal to 1% of their gross revenues from solid waste collection. The Washington Utilities and Transportation Commission collects the tax and uses the revenues to cover its expenses related to supervising and regulating solid waste carriers (Washington State Legislature 1961).

Proposed tax on solid waste collection businesses: Senate Bill 5441 was proposed in 2011 to allow counties the option to tax the privilege of engaging in business as a utility. This includes solid waste utilities. Solid waste utilities are defined as a "solid waste collection business". The definition of solid waste does not include materials intended to be recycled (Washington State Legislature 1986b). Counties that choose to implement the tax would receive a tax rate based on the gross income of solid waste collection businesses. Tax revenue may only be used for public safety, infrastructure, capital projects and other services. The tax rate may not exceed 6% (State of Washington 62nd Legislature 2011). This bill did not pass session.

Effectiveness of Variable Taxes Charged to Solid Waste Collection Businesses

- **Incentives for waste reduction:** Waste generation incentives are strongest when fees paid by consumers/disposers are charged per unit of waste created. If a collector is charged per unit and passes this cost on to consumer/disposers per unit of waste disposed, then incentives for waste reduction are relatively strong. However, if a waste collector charges a flat fee for waste collection, then the consumer/disposer's incentive to reduce waste is weakened, and higher waste collection service (flat) fees may not lead to less waste generation.
- **Incentives to promote recycling and reuse:** The effect of taxes on consumer recycling incentives is ambiguous; it depends on whether it affects the services that are provided for disposal and recycling collection, and how these services are priced for consumer patrons. If these taxes are passed on to consumer patrons as a general flat fee for disposal service, it would not change the relative cost of disposal versus

recycling, and therefore would have little effect on recycling incentives. If instead all of this cost is passed on as higher variable landfill tipping fees (and recycling fees are not changed), then recycling incentives are strengthened.

- **Revenue Generation Effectiveness:** Along with fees charged directly to disposers, these types of fees/taxes have been effective in the past, because waste disposal and recycling are closely tied to each other in the waste stream. However, where a large fraction of waste is recycled, this funding method is relatively weak.
- **Revenue Sustainability:** As less waste collection services are needed, less revenue will be generated. If these fees are used to fund recycling, then as the fraction of waste diverted away from disposal toward recycling, revenues from disposal fees will decline as costs of recycling increase. The revenues from the fee on waste collection businesses' gross revenues established by RCW 91.77.080 are used to fund expenses related to supervising and regulating solid waste carriers, the revenues are not currently used to fund recycling or waste reduction.
- **Administrative costs and complexity:** A strategy for keeping administrative costs low could include raising the tax rate on already existing taxes on solid waste collection businesses rather than creating new taxes. Business taxes are a well established instrument for raising revenue. Administrative costs for businesses taxes may be comparatively lower than other revenue options.
- Taxes on solid waste collection businesses already exist to some extent in Washington. Currently little if any of the tax revenue goes toward funding recycling and waste reduction. In theory, tax rates could be increased to also provide revenues for funding recycling programs.

6. Disposal Facility operators

In Washington, landfills and incinerators may be owned by the government or by private disposal companies. Government landfills can be owned and operated at the city or county level. Tipping fees charged by government owned landfills or transfer stations were discussed earlier in the "Fees for Landfill Disposal" section because such fees are paid by disposers or solid waste collectors. For private landfills the government may also incur regulatory expenses associated with ensuring that landfills are up to code. These expenses may be covered by taxes and fees charged to private disposal facility operators.

xiv. Taxes and fees charged to private disposal facility operators

Taxes charged to private disposal facility operators are a general, fixed or variable instrument. These taxes and fees may be used to cover the government's regulatory expenses associated with providing oversight for disposal facility operations, as in

permit fees charged in Washington State. The taxes and fees might also be used to raise revenue to fund recycling or waste reduction activities

Examples of Taxes and Fees Charged to Private Disposal Facility Operators

Permit Fees: Revised Code of Washington 70.95.180 dictates that a permit is required in order to operate a solid waste handling facility in Washington State. Local health departments issue the permits and may charge a permit granting fee as well as a permit renewal fee. The revenue raised from permit fees is used to finance the local health departments' operating expenses as it relates to facilities permitting and oversight (Washington State Legislature 1969b). The definition of "solid waste handling" used in the law extends to waste-to-energy facilities, thus the Wheelabrator incinerator in Spokane, WA is also subject to pay the permit fees (Washington State Legislature 1969c).

Waste Disposal Levy: New Zealand passed its Waste Minimisation Act in 2008. The act included the Waste Disposal Levy of $10 per ton on all waste landfilled. Landfill operators must pay the levy but they may pass part of the costs onto consumers. Every few years the levy rate of $10 per ton will be reassessed and could change. Half of the revenues will go to territories; with more populated areas receiving more money. The other half of the revenues will go to the Waste Minimisation Fund. The Waste Minimisation Funds are awarded to the best infrastructure investment or educational ideas. In 2010 there were 163 eligible applicants for the $6 million in funds. The UK, Ireland and parts of Australia also have waste disposal levies (New Zealand Ministry for the Environment 2011). See also the discussion of the Kentucky Pride Fund in the "Variable fees for waste-to-landfill handling services" section.

Effectiveness of Taxes and Fees Charged to Private Disposal Facility Operators

- **Incentives for waste reduction:** Any taxes or fees that increase the operating costs of a landfill might be passed through to the consumer through higher prices for landfill services. The incentive effects to send less waste to the landfill are caused by any increase in the price of landfilling faced by the disposer.
- The waste disposal levy in New Zealand may be passed through to disposers. In order to avoid paying the levy disposers may send less waste to the landfill. Disposers may also have an incentive to evade paying the levy by illegally dumping.
- **Incentives to promote recycling and reuse:** Because New Zealand's waste disposal levy increases the cost of sending waste to the landfill it gives disposers an incentive to search for options other than sending waste to the landfill, such as recycling or reuse.
- **Revenue Generation Effectiveness:** Revenue generation potential depends on the source of fees. The use of permitting fees has limitations for revenue generation

to the extent that firms are willing to invest in disposal facilities in the face of substantial permitting fees. This, in conjunction with a limited demand in terms of the number of waste disposal facilities limits these as a potential revenue source. Waste disposal levies are basically a variable fee on waste disposal. These fees would in large part be passed on to waste disposers. They therefore have approximately the same characteristics as tipping fees, and have a reasonably substantial revenue generation potential when disposal rates are high relative to the need for funds to support recycling.

- **Revenue Sustainability:** Revenue from landfill or incinerator operators will decrease as the amount of waste disposed of in landfills decreases.
- **Administrative costs and complexity:** Permitting fees are used to help cover the administrative cost of ensuring that landfills in Washington State meet certain quality standards.
- Because the number of landfills is far less than the number of disposers, it may be more efficient to charge landfills taxes or fees and allow them to pass the costs through to disposers rather than charging taxes or fees to disposers directly.
- Permit fees charged to landfill or incinerator operators which are currently in use in Washington do not provide any funding for recycling and reuse programs

7. Revenue from energy recovery

Some jurisdictions recover some of the energy embodied in waste instead of sending it to a traditional landfill. Some landfills are equipped to convert landfill gas into energy. Waste may also be converted to energy in a waste-to-energy facility where waste is incinerated. The energy may come in various forms such as natural gas, fuel, or electricity. In many cases private companies own the landfills equipped to convert landfill gas or the waste-to-energy facilities.

xv. Revenue from waste-to-energy facilities

Waste to energy facilities typically have large fixed costs associated with building the facility. While waste sent to traditional landfills has little economic use, waste sent to waste-to-energy facilities may be used as fuel in incinerators. Many landfills now also incorporate the ability to convert landfill gas into energy. Energy recovered from waste is sold per unit to utilities or other entities, and therefore provides revenue per unit produced.

Examples of Revenues from Waste-to-Energy Facilities

Energy Recovery: The city of Spokane, WA owns an 800 ton-per-day waste-to-energy facility and allows the facility to be operated by Wheelabrator Technologies, Inc, a private subsidiary of Waste Management, Inc. The Wheelabrator website identifies the Spokane facility's electricity producing capacity as 26 megawatts, enough to power

26,000 homes in Washington (Wheelabrator Technologies Inc. 2011). The electricity produced by the facility is either put back into operating the plant itself or sold to utility companies (Clark County, Washington 2000, 3).

Conversion of landfill gas to energy: Thurston County, Washington, along with many other counties in Washington State, is served by Roosevelt Regional Landfill. At the landfill, methane gas produced by decomposing waste is used to produce electricity. The electricity is managed by the Klickitat County P.U.D. powerhouse (Thurston County, WA 2011). There are other landfills in Washington that use methane gas to produce electricity; such as the Cedar Hills Regional Landfill located in Maple Valley, WA. The Cedar Hills Regional Landfill is still in its testing stage, but has the capacity to generate enough electricity to power about 24,000 homes in the future (King County 2011). The Roosevelt and Cedar Hills regional landfills are privately owned.

Waste to Energy through combustion: In 2009 693,931 tons of waste generated in the state of Maine was sent to the landfill. In that year, 352,633 tons of waste generated in Maine was combusted at one of the state's waste-to-energy facilities. Additionally over 100,000 tons of waste generated out of state was brought in to be combusted at waste-to-energy facilities in Maine (Maine State Planning Office 2011, 9-10). One large privately owned, but regulated, waste to energy facility is located in Biddeford, Maine. A 1991 New York Times article says the main sources of revenue for the facility are fees collected from the towns that bring their waste to the facility and electricity sales to the Central Maine Power Company (Trash-to-electricity 1991).

Refuse Derived Fuel: In Ontario, Canada some waste is processed into fuel that can be used in manufacturing, electricity generating, or heating applications. The fuel works as a heat source in manufacturing for example cement. The fuel could substitute for coal in electricity generation (Jacques Whitford 2008, 14).

Effectiveness of Revenues from Waste-to-Energy Facilities

- **Incentives for waste reduction:** If the waste-to-energy facility operator receives revenues based on the level of waste processed at the facility, then the operator would like more waste to be brought to the facility. The operator will not have incentive to encourage waste reduction practices among disposers since the facility's revenue may fall when there is less waste to process.
- Waste-to-energy facilities are able to recover some of the energy embodied in waste. This may be a benefit compared to traditional landfilling.
- **Incentives to promote recycling and reuse:** Low cost options to incinerate waste can serve as a disincentive for disposers to seek out waste reduction and recycling opportunities.
- **Revenue Generation Effectiveness:** Waste to energy facilities should be thought of as alternative way to process waste that would otherwise be sent to a traditional

landfill. When waste is combusted a portion of it will remain as ash which must still be sent to a traditional landfill. Waste-to-energy facilities should not be thought of as an alternative to recycling. Compared to traditional landfills waste-to-energy facilities offer the benefit of the ability to generate electricity. However, they may have greater construction and maintenance costs than traditional landfills. Additionally, there is much public opposition to the construction of incineration facilities.

- **Revenue Sustainability:** Regulatory fees from waste to energy facilities are not sustainable on the path towards beyond waste since some facilities may not have enough incoming waste to continue operations and might have to close as less waste is generated.
- **Administrative costs and complexity:** Waste-to-energy facility operators may receive tipping fees per ton and revenue from selling energy. An operator may not invest the large fixed costs required to build a new waste-to-energy facility unless there is a guaranteed steady stream of incoming waste.
- Regulating both landfills and waste-to-energy facilities may be more costly. Environmental compliance costs may be large. The incinerator in Friday Harbor along with two other facilities in Washington have closed or suspended operations in recent years. A cited reason for the closure of the incinerator in Friday Harbor, Washington in 1995 is that the facilities environmental compliance costs exceeded its budget (Clark County, Washington 2000, 3). The incinerator in Skagit County was closed in 1996. The cited reason for closing is equipment failures and high operating costs. The incinerator in Whatcom County suspended operations. The cited reason for suspending operations is that other waste management options such as landfilling were less costly (Clark County, Washington 2000, 3). Prior to 2011 the Ferndale incinerator ceased operations (Wilson Engineering LLC 2011, 16).

8. Revenue from recycled commodities

Collected recyclables may be marketed and sold as recycled inputs to production. Many jurisdictions provide household curbside recycling programs and commercial recycling programs. A portion of the revenue from the sale of the recyclables these programs collect goes to the government in some jurisdictions.

xvi. Revenue from the sale of collected recyclables

Collected recyclables vary widely in their resale value based on their type of material and the availability and price of substitute materials. The market value of recyclables often depends in part on the market value of substitute goods. If it is relatively inexpensive to produce goods from virgin materials as is glass, the market will not

support a high price for the recyclable counterpart. In the case of aluminum, the virgin resource requires much more energy to access and convert and is therefore expensive. Recyclable materials therefore command a higher market price relative to recycling costs. Materials that can physically be collected, transported and processed more easily also typically fetch a greater resale value than materials that are more difficult to recycle.

Examples of Revenues from the Sale of Collected Recyclables

Sale of Recyclables collected from households: Recycled materials can be sold as inputs into production of other goods, much like energy recovered from waste. The cost of collecting recyclables can be partly covered by their resale value (Washington State Department of Ecology 2004a 12). Recyclables collected through Clark County, Washington and the City of Vancouver household curbside recycling collection programs are marketed for resale through a contract with Columbia Resource Company. Revenues from the sold recyclables are split among three stakeholders, Clark County, WA and the City of Vancouver receive a portion of the revenue, Columbia Resource Company receives a portion of the revenue as well as per-ton processing fee, and the curbside recycling collection company receives a portion of the revenue. The portion of revenue that Clark County and the City of Vancouver receive is used to fund residential recycling collection (Clark County Washington 2008, 17-6).

Sale of Recyclables collected from commercial businesses: In 2005 it is estimated that approximately $100 million of the expenses related to providing recycling programs for commercial businesses in Washington was covered by the resale of recyclables collected though the programs (Cascadia Consulting Group 2007, 27). These services are provided by private collection companies.

Revenue from Recyclable Materials: In 2004 the city of Coeur d'Alene, Idaho received revenue of over $30,000 for recyclable materials. In the city separate trucks collect each household's waste and each household's recyclables. Mixed paper, steel, aluminum and plastics are all collected, but glass is not. Recyclables may also be dropped off at schools participating in the drop box recycling program. In 2004 all public schools in Kootenai County, Idaho had recycling collection bins. Funding to cover hauling and processing the recyclables is paid by the county. Collectively in 2004 use of the schools' collection bins removed over 1,000 tons of recyclable materials from the waste stream and brought in over $33,000 in revenue for recyclable materials. The schools receive all of the revenue (Kootenai County, Idaho 2011a).

Potential Revenue from Organic Waste processing: In a feasibility analysis of organic waste management programs for Boulder County, Colorado compost technology end products were identified as potential revenue sources. Setting up facilities to process organic waste would involve initial capital costs and yearly operating expenses, but these may be partly offset by revenue sources from end products. Mulch and high quality compost can be resold for around $20 per cubic yard. Organic waste can be

processed into digester gas which may be used to generate electricity. The process of creating digester gas also produces compost which may be sold. Gasification technologies can be used to produce Syngas which may be burned in a combustion turbine creating electricity. Electricity generated from organic waste is renewable and may be sold to utility companies (Tetra Tech, Inc. 2010, 36). waste-to-energy

Effectiveness of Revenue Generation from the Sale of Collected Recyclables

- **Incentives for waste reduction:** When recycling collection programs receive funding from the sale of recyclables, the costs that users of the programs pay may fall. Typically households are provided recycling collection programs at no extra cost. But commercial businesses often must pay user fees. When these user fees fall there is potential that use of the programs will increase. If it is cheaper to get rid of a product at the end of its life, commercial businesses may put less effort into purchasing long lasting products or avoiding product packaging.
- **Incentives to promote recycling and reuse:** Recycling collection programs will require less outside funding when a portion of their costs are covered by the sale of recyclables. Since less outside funding is required for recycling programs, more recycling programs may be introduced. Expansion of recycling programs is expected to increase recycling rates.
- **Revenue Generation Effectiveness:** In 2011 the scrap value per ton of glass used in calculations by the California Department of Resources Recycling and Recovery was just $4.24 while the scrap value per ton of PET plastic was $307.55(Cal Recycle 2010a). For high value recyclables such as PET plastic and aluminum cans, funds raised from their scrap value may come near to covering the costs of their collection, but for low value recyclables such as glass their scrap value does not begin to come close to fully funding their collection. In some instances, there is tip fee to get rid of low value recyclables, such as glass.
- **Revenue Sustainability:** Presumably markets for recyclable materials will increase as more products are manufactured using recycled materials. All else remaining equal, as recycling rates increase there will be more recyclables to sell and more potential revenues.
- **Administrative costs and complexity:** Administrative costs could potentially be kept low. A revenue option where a private company handles the marketing of materials such as in Clark County, WA might be a good set-up.

9. Revenue from outside the waste stream

xvii. Taxes from outside the waste stream

This category of revenue sources can include financing options targeted at stakeholders not involved in the physical flow of waste from producer to end-of-life management. Bond financing may be a good example of such a revenue source. Revenue from outside of the waste stream is not expected to affect the incentives of stakeholders within the waste stream thus this instrument is not classified in terms of general or targeted and fixed or variable.

Examples of Taxes from Outside the Waste Stream

Bond financing: In 2005 local governments in Washington brought in $7.7 million from bond financing (Cascadia Consulting Group 2007, 7).

Funds from New York's Real Estate Transfer Tax: In the fiscal year 2007/2008 New York's Environmental Protection Fund (EPF) budget was $250 million. $21.5 million of this was allocated to solid waste programs. Reduction and recycling projects receive funding as grants for municipal projects. The primary funding source of the EPF budget is a dedicated portion of New York's Real Estate Transfer Tax. The budget for the EPF is proposed by the governor each year. The legislature must vote to approve the budget each year (New York State Dept of Environmental Conservation 2010, 83).

Funds from the Kansas Stripper Well Settlement and the Petroleum Overcharge Restitution Act: In New York State waste reduction and recycling projects have received funding from the Kansas Stripper Well Settlement and the Petroleum Overcharge Restitution Act. The funding has been distributed as grants for municipal projects. Typically the recipient municipality must provide half of the funding themselves. Some of the types of projects that have received funding include investment in recycling equipment, organics recycling, education programs and waste reduction programs (New York State Dept of Environmental Conservation 2010, 75-76).

Proposed requirement for submission of a Zero Waste plan and payment of refundable deposit: Boulder County, Colorado's Zero Waste Action Plan recommends that event organizers of events attended by 200 or more people on county or partner municipalities' land be required to submit a Zero Waste plan prior to the event. To ensure that the Zero Waste plan is followed the event organizer must also pay a deposit which is only refundable if the event is put on following the plan. Unrefunded deposits could be used to fund ongoing Zero Waste education. The promotion of Zero Waste at large events is expected to raise public awareness of the benefits of recycling and composting (Boulder County, Colorado 2010, 38).

Effectiveness of Taxes from Outside the Waste Stream

- **Incentives for waste reduction:** Revenue from outside of the waste stream is not expected to affect the incentives of stakeholders within the waste stream, except to the extent that the revenues are effectively used to mitigate waste generation through other programs.
- **Incentives to promote recycling and reuse:** These revenue instruments do not directly increase or decrease the cost of recycling or reuse to disposers. However, they can indirectly promote recycling and reuse to the extent that the funds are used to reduce the relative or absolute cost of recycling and reuse to disposers, or to promote these programs in other (effective) ways. They would likely only provide short-term funds or fund small components of the overall waste systems.
- **Revenue Generation Effectiveness:** Effectiveness of "taxes from outside the waste stream" depends on the source and can vary widely for this instrument. Those sources based on relatively large resource base or demand relative to the potential waste management expenditure potential will tend to hold higher potential than others.
- **Revenue Sustainability:** Instruments collecting revenues from outside of the waste stream are not related to the level of waste and so will not necessarily decline as waste is increasingly redirected to recycling and reuse.
- **Administrative costs and complexity:** The administrative costs and complexities are dependent on the specifics of the program, which can vary widely as illustrated above.

10. Comparison of alternative revenue instruments

Sections 2 through 9 have identified a range of policy instruments that are currently or could potentially be used to fund waste reduction and recycling programs in Washington State. Taxes/fees and mandates are discussed as the focus of this study, with a primary emphasis on revenue generating instruments. An important characteristic of the fee instruments is whether or not they are fixed rates or variable rates per unit of waste or recycling. Variable rates for waste provide stronger incentives for waste reduction, recycling and reuse because a disposer's waste bill may be lowered for each unit of end-of-life products diverted away from the landfill.

Under such a regulatory mandate requiring private waste collection firms to provide recycling programs, the government does not necessarily need to raise funds to cover the operating expenses of a recycling program. In Washington, most customers pay for the waste and recycling collection through subscription fees, though the fee for recycling may not always be visible. However the government will still incur costs relating to

enacting, administrating and enforcing the mandates. These costs may be covered with tipping fees from transfer stations, general taxes or, through taxes and fees charged to waste / recycling collectors and disposal facility operators.

An important distinction between sending end-of-life products to a traditional landfill vs. recycling them is the ability of recycling to recover some resources. Collected recyclables are valuable because they may be reused as inputs to production. Some newer landfills have found uses for waste in general such as waste-to-energy facilities and landfills operating with landfill gas recovery.

The political reality is that a single revenue instrument will never be implemented in isolation. Effective funding for the waste management system will require a combined set of revenue instruments. There are many potential interactions between each instrument. It is useful to understand the strengths and weaknesses of each individual instrument. The interactions between each instrument must also be discussed when making an initial comparison of potentially successful sets of revenue instruments to be used to fund Washington State's waste management system.

Table 1 summarizes each potential revenue instrument's relative ranking in five criteria important for Washington's solid waste management system. This summary and the comparisons embodied in it are to be interpreted only in very general terms, because the assessments are largely qualitative, and because many of the important effects of a policy instrument depend crucially on the details of a policy. With these caveats in mind, a comparison may still be useful. In table 1, policy instruments are listed in column 1, and policy criteria are listed across the top row. A "Thumbs up" sign in a cell (👍) indicates that the instrument in column 1 of that cell's row promotes the criterion in that cell's column. A "thumbs down" sign (👎) indicates that the instrument does a poor job of meeting that criterion. Instruments for which the criterion does not apply are marked "NA" (Not Applicable). More thumbs indicate a stronger effectiveness in one direction or another (up to three in most columns). Sustainability is marked as only thumbs up or thumbs down (or question mark) depending on whether or not revenues depend on potentially declining sources (the "magnitude" of sustainability is not considered). Opposing signals indicate that the effect tends to be ambiguous and a question mark signifies that the effect is crucially dependent on the details of a policy approach.

Table 1: Summary of potential revenue instruments and their effectiveness criteria. The magnitude of effectiveness measures should be compared within a given column, not across columns.

Revenue instrument \ Effectiveness criteria	*Waste reduction incentive*	*Recycling & reuse incentive*	*Revenue generation capacity*	*Revenue sustain-ability*	*Low gov. admin. costs / complexity*
i. Extended ProducerResp.	👍👍👍	👍👍	👍	👍	👍👎
ii. Producer Product Type	👍👍	👍👍	👍👍	👍	👍👎
iii. Producer Product Char.	👍👍👍	👍👍	👍👍	👍	👍👎
iv. Advance Disposal Fees	👍👍	👍👍	👍👍	👍	👍👎
v. Other Fees - Purchasers	👍?	👍?	👍	👍	👍👎
vi. Other Rev. Purchasers	👍?👎	👍?	👍	👍	👍👎
vii. Flat Fee Waste-to-Landfill	👍	👎	👍👍👍	👍	👍👍👍
viii. Var. Fee Waste-to-Landfill	👍👍	👍	👍👍	👎	👍👍
ix. Flat Fee Recycling/Compost	👍	👎	👍👍👍	👍	👍👍
x. Var. Fee Recycling/Compost	👍👍	👎👎	👍👍	👍	👍
xi. Fine Illegal Dumping	👍	👍	👎	👎	👎👎👎
xii. Mandated Recycling	👍?👎	👍👍	NA	👍	👍👍
xiii. Var. Taxes Solid Waste	👍👍	👍	👍	👎	👍
xiv. Tax Private Disposal	👍👍	👍	👍👍	👎	👍👍
xv. Revenue Waste-to-Energy	👎	👎	👍	👎	👍👍
xvi. Revenue Sale Recyclables	👎	👍👍	👍	👍	👍👍
xvii. Tax Outside Waste Stream	👎	👎	👍?👍	👍?👎	👍👎

Comparison of incentives for waste reduction: Waste reduction refers to generating less waste at the source. Policy instruments that increase the relative costs of waste production upstream may incentivize reductions in the amount of waste produced. If the cost of waste disposal is not incorporated into a product, especially such that it can influence consumer's purchasing decisions, the price of a product may be "too low;" resulting in overconsumption and disposal. An instrument that internalizes the cost of waste disposal will decrease the creation and purchase of wasteful products and ultimately, the demand for waste disposal services. Upstream instruments, such as extended producer responsibility, especially on product characteristics, are likely to be the most effective at reducing overall waste generation. For example a mandate declaring that waste from packaging is to be avoided, as in Germany where product packaging should be reduced to the lowest necessary weight and volume, is expected to lead to waste reduction (Nakajima and Vanderburg 2006, 4). Both producers and consumers facing upstream prices on packaging or products will in principle tend to gravitate toward those goods with lower charges imposed on the packaging or products.

Downstream instruments such as variable pricing for waste sent to the landfill will, in principle, also lead to waste reduction as well. Consumers may alter their purchasing

habits to reduce variable waste charges by reducing waste. But they may also substitute among waste management alternatives, such as illegal dumping, which will mitigate the waste reduction incentive. Downstream instruments will tend to be somewhat less effective at waste reduction unless incentives to illegally dispose of waste are dealt with explicitly in upstream policies. Further, if waste disposal is charged via a flat fixed fee (not based on waste volume), then incentives for reducing waste (either at purchase or thereafter) is weakened. Thus, downstream charges for landfilling are likely to have a weaker effect on waste reduction than comparable upstream instruments. Finally, if recycling is free or provided at low cost (in order to make recycling more appealing relative to landfill disposal), this may actually weaken incentives to reduce waste through purchase decisions because it makes dispossession of waste less expensive overall

Comparison of incentive for recycling and reuse: An instrument may provide incentives to recycle or reuse if it makes recycling more attractive. This might happen by lowering the cost of recycling or by raising the cost of landfilling so that the cost of recycling is less in relation to landfilling. Reuse might be incentivized if the relative price of new products were increased. Given that waste has been generated through the production and consumption process, the incentive for diverting waste from disposal to recycling and reuse becomes important.

Disposers incur at least two types of costs when they recycle. First, there may be a monetary charge for recycling services. Second, recycling usually requires a time cost to sort and prepare household recyclables. Decreases in the price of recycling or in the time cost spent on recycling are expected to increase the likelihood that a disposer will choose to recycle rather than dispose. For example, a household may be more likely to recycle when it is served by curbside recyclables collection program than when it must self-haul its recyclables.

Alternatively, increasing the per unit cost of landfill disposal decreases the *relative price* of recycling, and will tend to lead to higher recycling rates. The problem is that it also decreases the relative price of littering, and littering will tend to increase as tipping fees increase. Thus, increasing per-unit tipping fees to consumers/disposers will decrease landfill rates. The remaining effect will be split between source waste reduction, increases in recycling, or other disposal or reuse approaches. So in general, downstream instruments are fundamentally weaker at reducing source waste than upstream instruments, and better at diverting waste among the various waste management approaches.

Downstream instruments are likely to be more effective at altering the incentives to choose between disposal and recycling, but this can be problematic when revenue generation for recycling programs is a primary concern. A fee for recycling at a recycling center (the revenues which presumably would be used to cover recycling costs) will tend

to reduce recycling rates --- this is perhaps a fundamental problem faced by recycling programs. However, the timing of the charge matters. A downstream charge, such as a fee per electronic item brought to the recycling center may make it more likely for the disposer to send the end-of-life item to the landfill or illegally dispose of it, rather than to recycle. An upstream instrument, such as an advance disposal (recycling) fee has already been paid by the disposer. Because the recycling fee is paid before the decision to recycle or dispose is made, the disposer will not have an incentive to avoid the recycling fee by choosing not to recycle. Thus, recycling fees are best imposed upstream if not too costly or difficult to do so.

To take this idea further, the familiar deposit-refund system on beverage containers in many states provides the positive incentive for 'disposers' to recycle. Administrative costs of these programs can be high. However, the revenue raising components of a deposit refund system can be high and many. They are discussed in this document including: "Fees to cover the operating costs of a beverage container deposit and refund system," "Container recycling fees" and "Unclaimed bottle deposits"; which appear in the "Producer fees based on product type," "Advance disposal fees," and "Other fees paid by purchasers" sections respectively.

In short, charges for landfilling and other disposal mechanisms are most effective at providing incentives for recycling when charged at the time of disposal. If fees are imposed to cover recycling costs, upstream programs such as advance disposal fee are not as counterproductive as charges at the time of disposal. Further, deposit refund systems have the added benefit of providing a payment to recyclers for delivery, which has shown to increase recycling rates further.

Comparison of revenue generation effectiveness: Revenue generation effectiveness is a measure of how much revenue could feasibly be raised from a given instrument. Revenue generation potential from flat fees charged to disposers (households and businesses) may be larger than variables fees, because variable fees provide an incentive to reduce landfill waste disposal. Potential revenue generation from "Revenue from the sale of collected recyclables" at the time of recycling may be relatively low because the quantity of collected recyclables and their market is relatively small. Potential revenue generation from "Producer fees based on product characteristics" may also be low because such an instrument would incentivize producers to change the characteristics, subject to the fees, that are embodied in their products. For instance a tax on the lead content of televisions would incentivize producers to manufacture televisions with less lead, resulting in lower tax revenues.

Instruments that tax or place fees on broad categories such as waste in general, do not face a constraint of being levied on only a few product or waste types. Flat fees levied on the population at large or every household subscribing to waste collection services have a broad base and the potential to raise large revenues.

Fines for illegally dumping are expected to raise minimal funds. In fact it is very likely that the administrative costs of this instrument will exceed the revenue it provides. However, the instrument is useful for its anti-littering enforcement incentive effects as discussed in Section 11: "Combinations of Revenue Instruments".

Mandates and regulatory restrictions alone do not provide revenue so an "NA" is placed in the box for "Mandated provision of recycling opportunities". The extent to which recycling mandates provide waste reduction incentives depends on implementation. However, if a mandate is designed so as to reduce the costs of recycling to consumers without increasing the cost of waste disposal to landfills, then the costs to consumers of waste disposal will tend to be lower. If, as is more likely, the costs of mandated recycling programs are shifted to landfill fees, then the effect on waste generation incentives is ambiguous.

Comparison of revenue sustainability: An instrument exhibits revenue sustainability if decreases in the level of waste generated or sent to the landfill do not decrease the level of revenue raised from the instrument.

Revenue is unsustainable if revenues decrease as waste production or disposal decreases. A prevalent example of a revenue source with this sustainability problem is the use of landfill tipping fees as a funding source for recycling, which is now commonly used to fund recycling programs. This is not a sustainable revenue source, because revenues from these variable fees will decline when disposal demand decreases which happens when waste decreases and when recycling demand increases.

An important characteristic for revenue sustainability is that revenues to support recycling tend to increase proportionally with increases in total recycling (and recycling costs). Thus, tying fees to the amount of recycling (and carefully accounting for expected subsequent recycling rates) is a reasonable approach. Producer fees, advance disposal fees, and deposit-refund programs are examples of such programs.

Again, flat fees levied on the population at large in the form of property taxes for example, or to each household subscribing to waste collection services, has the potential for revenue sustainability if the number of households subscribing to waste services does not decline. Mandating the use of and payment for waste and recycling services can also provide revenue sustainability.

Comparison of administrative costs and complexity: This criterion describes how costly and/or difficult it is to implement, monitor, and enforce an instrument. These costs can be thought of in dollar terms so that each instrument's administrative costs can be compared to its alternatives. An important characteristic of cost-effectiveness is how the administrative costs of an instrument compare to its success at generating revenue and/or incentivizing waste reduction and recycling.

One difficulty in ranking administrative costs is that they can vary widely depending on the specifics of a policy. Two dimensions are particularly important: the imposition of variable fees enacted per unit require measurement of the number of units, while flat fees are comparatively less complex and less costly to administer. General instruments that apply to broader categories of waste are expected to have lower administrative costs per unit of aggregate waste than instruments targeted at a specific type or characteristic of waste. Thus, for both of these dimensions there is a tradeoff: administrative costs versus effectiveness in either providing incentives or targeting waste types.

It is because of this that many of the upstream instruments are marked as variable (👍👎) in terms of administrative costs. It is noteworthy that many extended producer responsibility programs and producer fees tend to be quite highly targeted at very specific goods or waste elements. The consequence of this is that the costs of administering a large set of highly specific programs is likely to be much more costly than one producer program targeting an aggregate set of wastes (depending on the enforcement mechanism).

Further, the cost effectiveness of administrative costs in relation to revenue generation cannot be easily quantified. Cost effectiveness will depend on the integrated set of revenue instruments used in the waste management system. Therefore, we instead focus discussion on how the administrative costs of a combination of revenue instruments compares to the combinations' abilities to meet the goals of Beyond Waste while ensuring stable revenue generation. This discussion is found in Section 11: Combinations of Revenue Instruments.

Summary of comparison of alternative revenue instruments

Table 1 summarizes the relative strengths and weaknesses of each potential instrument. In general, upstream and relatively targeted instruments tend to be better at incentivizing waste reduction, recycling, and reuse but these instruments also have higher administrative costs. Downstream, flat rate, and general instruments tend to have relatively lower administrative costs, to raise the same level of revenue, but they do not perform as well at incentivizing waste reduction, recycling, and reuse. Revenue generation effectiveness depends loosely on the magnitude of the market or tax base relative to the revenue needs for recycling programs. Historically, the market for landfill services was large relative to recycling revenue needs, but this may change, making this revenue source less viable.

There is a clear trade-off between instruments that excel in achieving goals of the Beyond Waste Plan, namely waste reduction, recycling, and reuse, and instruments that keep administrative costs of the waste management system low. Depending on the priorities of policy makers, different sets of revenue instruments will be attractive for use in Washington State.

Cost effectiveness is an important consideration in determining the potential for success of a funding instrument. Cost effectiveness relates the benefits of a program, including reducing waste through reduction and redirection of potential waste, to the costs of implementing, monitoring and enforcing the program. The use of complex instruments that can incentivize recycling and raise recycling rates may be warranted when the gains from increased recycling rates exceeds the additional administrative costs of a more complex instrument. The gains from increased recycling rates will depend on the type of product, for example diverting a cell phone from the landfill can be more beneficial than diverting an article of clothing from the landfill because of the heavy metals in the cell phone. For revenue instruments targeting specific products more information on those specific products is needed.

11. Combinations of Revenue Instruments

A 30 year goal of Washington State's Beyond Waste Plan envisions that, "A stable and long-term solid waste financing system is in place that supports and enables the transition to Beyond Waste" (Washington State Department of Ecology 2005, 11).The Beyond Waste Plan calls for using waste as a resource and also places an emphasis on generating less waste in the first place (Washington State Department of Ecology 2011f). Steps towards achieving the financing and environmental goals of the Beyond Waste Plan may be achieved in many ways; three of our recommendations are introduced below:

1. Steps towards "A stable and long-term solid waste financing system" may be achieved by increasing the use of instruments that excel in "Revenue Sustainability". Such instruments will continue to generate funds when less waste is generated and/or sent to the landfill.
2. Steps towards "using waste as a resource" may be achieved by increasing the use of instruments that excel in "Incentive for recycling and reuse".
3. Steps towards "generating less waste in the first place" may be achieved by increasing the use of instruments that excel in "Incentive for waste reduction".

In selecting a suite of policy instruments to best meet the goals of Beyond Waste, a simplified integrated set of goals might be the following:

a) Reduce waste generation in aggregate and in particular for toxic materials
b) Redirect waste away from landfill disposal and dumping/littering, and toward recycling and reuse
c) Accomplish these goals in a cost-effective way, accounting for compliance costs and administrative costs.

It was not the intent of this report to provide a comprehensive set of suggestions for solid waste policy design. However, based on existing programs and literature reviewed for this report, we tentatively suggest the following general approaches for consideration, with the substantial caveat that more detailed analysis and empirical work is crucial, and that the specific design of any suite of programs are of utmost importance for eliciting appropriate incentives and cost effectiveness.

1) Utilize Extended Producer Responsibility programs and producer fees for specific goods whose design is likely to benefit from manufacturing innovations, such as:
    a. Complex, high-value manufactured goods, with toxic content are likely to be most successfully targeted with EPR and producer fees.
    b. Instances where product design is conducive to refurbishing and reuse.

Note that administrative/compliance costs are likely to be lower if the industry is characterized by a small number of manufacturers and abundant retailer sites.

2) Utilize advance disposal/recycling fees based on disposable content (e.g. packaging) in conjunction with per unit (e.g. weight) recycling refunds for aggregate, low impact (low toxicity) wastes. These are likely to be more effective for:
    a. Low value, low complexity goods and associated waste
    b. Goods for which packaging waste management costs are high relative to the market value of the new product.
    c. Goods for which recycling center delivery by consumers or collectors is relatively cost effective.
3) Utilize a combination of fixed and variable disposal fees to fund littering/dumping reduction and cleanup programs, and provide additional incentives to redirect waste away from landfill disposal.

We tentatively conclude that Extended Producer Responsibility programs and complementary fees are likely to be effective when production complexity allows substantial degrees of freedom in product design, and refurbishing and reuse may be viable. It appears likely to be a more costly approach, and perhaps less effective for relatively low value goods for which design is less flexible and aggregate packaging is a larger concern than product content. Existing recycling programs are relatively well situated for managing aggregate non-toxic wastes such as packaging and other low-value aggregates. Injecting producers into the waste management business in this context seems likely to be more costly than using advance disposal/recycling funds to further promote more recycling of typical recyclable products, possibly using current recycling systems and infrastructure. Standard sales tax earmark approaches on material goods may be a cost-effective means of generating funds.

Tipping and similar fees for disposal are not sustainable means of funding increased recycling rates, but they can become an important driver of illegal dumping and other less environmentally friendly disposal methods if variable fees are increase substantially to cover higher recycling volume. As such fixed and variable fees can be used in a coordinated fashion to both provide disincentives for disposal, cover the costs of disposal, and fund litter and illegal dumping programs and enforcement. Revenue sustainability is still a difficult issue if recycling rates increase relative to disposal, but increases in recycling rates via advance disposal/recycling fees in conjunction with refunds for recycling will tend to mitigate litter and illegal dumping as well, so the long-term revenue sustainability concern is in turn mitigated somewhat. Additional research is most certainly necessary to examine in more detail the efficacy of these general approaches, and to develop the details.

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