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# Washington State Department of Ecology

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## Electronic Product Recycling Program

### Final Cost Benefit and Least Burdensome Analysis for Amendments to Chapter 173-900 WAC and Chapter 173-303 WAC

*Prepared for  
Ecology's Solid Waste and Financial Assistance Program*

*October 2007*

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# Executive Summary

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## Benefit-Cost Analysis

Based on research and analysis required by RCW 34.05.328(d)(e) the Department of Ecology determines:

*There is sufficient quantitative and qualitative evidence that the probable benefits of an electronic product-recycling program outweigh the probable costs.*

The law creates benefits and costs but it cannot be implemented without the rule. Therefore, Ecology is evaluating the law and the rule together. The rule re-states and implements several of the requirements in Chapter 70.95 RCW – Electronic Product Recycling. The primary focus of this rule is implementing the law, which requires that the cost of recycling be borne by manufacturers for the following electronic products: TVs, computers, laptops, and monitors. This rule includes:

- Creation of “recycling plans” so that manufactures will be able to cover the cost of collection, transportation, processing, and recycling.
- Requirements for collectors, transporters, and direct processors.
- Requirements for retailers, charities, local government, and material management and financing authority.
- Requirements for public outreach.
- Sampling methods used to determine return shares, equivalent shares, and fees.

## Net Benefits

The law, the rule, and the program analyzed together are expected to generate annual net benefits of \$1.7 million, with costs of \$25.9 million and benefits of \$27.6 million. The individual components of costs and benefits are presented this table.

<b>Benefits and Costs of the Recycling Program</b>	
<b>COSTS</b>	<b>\$ 25,935,000</b>
Administrative fees	\$221,500
Collection	\$11,500,000
Transportation	\$1,100,000
Processing	\$12,800,000
Processors dropping out	\$50,000
Sampling	\$141,000
Plans	\$100,000
Forms	\$22,500
<b>BENEFITS</b>	<b>\$27,630,000</b>
Reduced recycling costs	\$130,000
Willingness to Pay	\$27,500,000
<b>NET</b>	<b>\$1,695,000</b>

## **Least Burdensome Analysis**

Based on research and analysis required by RCW 34.05.328(d)(e) the Department of Ecology determines:

*There is sufficient evidence that the rule being adopted is the least burdensome version for those who are required to comply, given the goals and objectives of the law.*

Ecology considered a variety of approaches and made the decision to write a rule that sticks very closely to the requirements of the law. Most of the costs of this rule are actually a transfer of costs from individuals, landfills, collectors, transporters, and processors to manufacturers.

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# **Cost Benefit and Least Burdensome Analysis**

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## **Conclusion**

Ecology determines, based on quantitative and qualitative data, that the probable benefits of the rule are greater than the probable cost. Ecology also determines that the rule is the least burdensome version of the rule that meets the general goals and specific objectives in the law (RCW 70.95).

## **Purpose of this analysis**

The Washington State Department of Ecology (Ecology) is amending the Electronic Product Recycling Regulation, Chapter 173-900 WAC and Chapter 173-303 WAC. The Administrative Procedures Act (RCW 34.05.328(d)(e)) requires two types of analyses before adopting a significant legislative rule – a cost-benefit analysis and a least burdensome alternative analysis. This report provides the results of these analyses and shows the potential impacts associated with the rule.

## **Background**

### ***2004 Recommendations to Legislature***

At the request of Washington lawmakers in 2004, Ecology and the Solid Waste Advisory Committee (SWAC) developed recommendations for how the State can implement and finance a program to collect, recycle, and reuse electronic products. Ecology and the SWAC worked with the representatives below:

- Electronic product manufacturers
- Electronic product retailers and waste haulers
- Electronics recyclers
- Charities, cities, counties, environmental organizations, public interest organizations, and other interested parties

### ***2006 Electronic product recycling law***

Based on the 2004 recommendations from Ecology and the SWAC, Washington lawmakers approved a new law - RCW 70.95N, Electronic Product Recycling - that became effective July 1, 2006.

This new law requires computer and television manufacturers to provide consumer-convenient recycling of their covered electronic products throughout Washington State.

The rule defines covered electronic products (CEPs) as computers (including portable or laptop computers), televisions, and computer monitors used by households, charities, school districts, small businesses, or small governments, located in Washington.

Manufacturers must make these services available to these groups by January 1, 2009.

## Reason for this rule

### Preventing Contamination in Landfills

There are toxic substances in CEPs that, under certain conditions, can leach into ground water when people throw them away in landfills. These toxic substances include:

- Metals - lead, mercury, and cadmium.
- Flame retardants.
- Plasticizers - additives that increase the plasticity or fluidity of CEPs.

Once these toxic substances contaminate ground water it is difficult and costly to fix the problem. Many landfill owners (private companies and municipalities) are experiencing long and expensive lawsuits from the release of these toxic substances from their properties.

### Lead

The potential health effects of lead in humans are well documented.

#### *Children*

- Decreased learning ability can occur at a blood lead level (BLL) of fewer than 10 micrograms per deciliter (ug/dL).
- Behavior problems such as aggression can appear at a BLL of fewer than 25 ug/dL
- Kidney damage and anemia occur at a BLL over 60 ug/dL.
- Reduced birth weight occurs at a BLL fewer than 20 ug/dL.

#### *Adults*

- Increased blood pressure and kidney damage are possible at a BLL of fewer than 10 ug/dL.
- During pregnancy, increased blood pressure and kidney damage appear at fewer than 20 ug/dL, and spontaneous abortion can occur in the 30 to 40 ug/dL range.

Most metals, including lead, usually adhere to soils instead of moving into ground water. However, landfills can produce acidic conditions that increase the chances for ground water contamination to occur.

### Mercury

Mercury is another hazardous substance that needs careful handling and is recognized as a landfill contaminant.<sup>1</sup> The main problem with mercury in landfills is that it can escape as a vapor that later enters the food chain. For example, certain species of fish contain high mercury levels. This requires the state health department to educate Washington's citizens on the safe amount and types of fish they can eat to reduce their mercury exposure, especially for children and fetuses. We know that continued exposure to mercury can cause:

- Neurological damage
- Mental illness
- Mental retardation

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1 ASTDR, Mercury CAS # 7439-97-6, April, 1999, <http://www.atsdr.cdc.gov/tfacts46.html>, downloaded 10/1/07. Health Effects, Mercury, <http://www.epa.gov/mercury/effects.htm>, Downloaded 10/1/07. Mercury, Basic Information, USEPA, <http://www.epa.gov/mercury/about.htm>, Downloaded 10/1/07.

- Muscle spasms
- Irritability and depression

### **Cadmium**

In the case of CEPs, the primary source of cadmium is in the batteries and some of the plastic parts. Cadmium is a known carcinogen and competes with (replaces or reduces impacts of) zinc in many biological systems. It can also replace calcium and magnesium under certain circumstances.<sup>2</sup>

### **Flame Retardants and Plasticizers**

Plasticizers, known as phthalates, and certain flame-retardants that contain bromine are being recognized as another form of contamination from discarded CEPs. The exact effects of these substances on humans are still being researched. However, they are frequently referred to as endocrine disruptors because of their ability to mimic estrogen-like hormones.<sup>3</sup> Performing lab tests on animals and observing them under natural conditions, indicates that male fetuses can become feminized, thereby lowering their ability to reproduce. The highest levels of contamination are often found in water discharge pipes (outfalls) located downstream or below wastewater treatment plants; this is because the current levels of treatment are relatively ineffective at removing these substances.

The qualitative benefits of recycling the CEPs that contain these and other toxic substances, rather than disposing of them in landfills are clear. Recycling is the only reliable, controllable, and effective way to minimize the harmful effects these substances have on humans and the environment.

### **Sustainability and Resource Conservation**

Some of the materials used to make CEPs, especially rare metals, are valuable. The amount of these materials in any one CEP is often small. However, because so many CEPs are made and later discarded, a significant amount of resources are sent to landfills each year. Discarding these resources seriously undermines our efforts to produce a sustainable economy because the materials that are permanently discarded in a landfill must be replaced by new materials. This requires extensive and often environmentally damaging mining, transporting, and manufacturing activities that produce additional contamination. Recycling, when done in an environmentally friendly manner, prevents the loss of these valuable materials by keeping them in the manufacturing stream. It also helps our efforts of attaining a sustainable future.

CEPs contain the materials listed in Table 1, below.

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2 Toxicological Profile For Cadmium, U.S. Department Of Health And Human Services Public Health Service, Agency for Toxic Substances and Disease Registry, July 1999, <http://www.atsdr.cdc.gov/toxprofiles/tp5.pdf>, downloaded 10/1/07

3 Multi-Year Plan For Endocrine Disruptors (FY2007-2013), Office Of Research And Development Us Environmental Protection Agency Draft, August 2007. Filby, AL, T Neuparth, KL Thorpe, R Owen, TS Galloway and CR Tyler. Health impacts of estrogens in the environment, considering complex mixture effects. Environmental Health Perspectives, in press. September 5, 2007

**Table 1**

<b>Reported material recovered by electronics recyclers in the United States.</b>	
[In thousands of metric tons. Modified from National Safety Council (1999) and Sean Magaan (Noranda, Inc., Micro Metallica Corp., oral commun., 1999)]	
Type of material	1998
Glass	13.2
Plastic	6.5
Metals	
Aluminum	4.5
Steel	19.9
Copper	4.6
Combined precious metals (gold, palladium, platinum, and silver)	0.001
Other	3.6
Total	52.3
<a href="http://pubs.usgs.gov/fs/fs060-01/fs060-01.pdf">http://pubs.usgs.gov/fs/fs060-01/fs060-01.pdf</a>	
Downloaded from USGS 9/10/07	

### **Mining Reduction and Resource Conservation**

The electronics industry relies heavily on the mining industry for all of its metal components. Metals come from ores where the metal itself is only a small percentage of the total volume of the material that is mined. Even mining operations using responsible methods create massive disruption of the parent ore body and the surrounding environment. Frequently, many tons of ore must be removed and processed to extract a few ounces of metal. This situation is especially true in the case of gold and other rare elements.

Where less than responsible mining methods are used, the damage to the environment and health impacts can be more serious. Prime examples are the small gold mining operations that are common throughout much of South America. These operations frequently use a mercury amalgamation process that releases large amounts of mercury into the environment where it can contaminate soils and waterways. As discussed above mercury generates significant health effects for wildlife and humans.

Finally, shortages of natural supplies make the conservation of resources more valuable over time. Recycling reduces the damage to the environment and the amount of raw materials that are extracted from the earth.

### **Recycling Facilities**

Many landfill and transfer station operators across the state have started to reject CEPs to prevent contamination. Many local governments have adopted ordinances banning disposal of CEPs. This has caused a rapid increase in the number of CEPs coming into recyclers. There are now an estimated 119 collection entities with over 169 collection sites statewide that are currently accepting CEPs. This service generates recycling of over 22 million pounds<sup>4</sup> of CEPs per year.

Ecology estimates that between 2003 and 2010 the number of obsolete CEPs in Washington State will be:

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<sup>4</sup> Reported recycling total tonnage for CEPs in Washington. Survey data June 2007.

- 4.5 million personal computers,
- 3.5 million cathode ray tube monitors, and
- 1.5 million flat panel monitors.

Ecology expects the amount of recycled CEPs to increase to 56.5 million pounds after we implement the rule.<sup>5</sup>

This rule will also allow recyclers to treat CEPs that come from households (small quantities) separate from those that come from businesses (large quantities). Without this rule, recyclers would have to separate the waste streams and they would be required, under the dangerous waste rule, to treat all of the streams mixed with CRTs as dangerous waste. Recyclers can always keep wastes separate. This rule will make it easier for recyclers merge the waste streams because the CRTs will be exempt.

This rule will also take advantage of a federal exemption for cathode ray tubes (CRTs) allowed to the states and will allow recycling of CRTs to continue and increase.

This rule implements the law. Without the rule the recycling benefits, the reduced liability for landfills, and the resource benefits created by the law will not accrue. This rule implements the law and the law transfers the cost of recycling CEPs to the companies that manufacture the CEPs.

Together, the law and the rule provide a net savings for Washington.

## **Scope of analysis**

This analysis covers the first 20 years of program costs including the costs of Phase 1 and Phase 2 of this rule-making process. The analysis covers both capital and annual costs. Capital costs are annualized on a 20-year basis.

## **Comparison of the current and adopted rules**

### ***Current rule requirements***

Ecology is writing the rule in two phases. We have already implemented Phase 1 of the rule. During Phase 1, Ecology adopted rules that:

- Require manufacturers, collectors, and transporters of CEPs to register with Ecology.
- Set a fee structure and payment schedule for manufacturers.
- Require mandatory brand labeling of all CEPs.

This analysis covers the costs of both phases of adoption.

### ***Description of changes***

For Phase 2 of the rule making, Ecology is adopting the rest of the requirements of the new law. This includes:

- Recycling plan submittal
- Plan review and content

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<sup>5</sup> It is unclear at this time what the relative share of CEPs from business vs. residences will be. Given that a larger share of the TVs may come from homes, Ecology believes at least 45% of the pounds will be residential. However, the share for residences could be much higher.

- Program implementation
- Return share and equivalent share calculations
- Direct processor registration and standards
- Registration and performance standards for collectors and transporters
- Exemption from the Dangerous Waste Rule for recycled cathode ray tubes

## **Baseline for Analysis**

The Electronic Product Recycling law, RCW 70.95N, the existing electronic product recycling rule (WAC 173-900), and the existing Dangerous Waste Rule (WAC 173-303) form the baseline for this analysis. Existing federal and state laws and rules regarding disposal of solid waste, dangerous waste, and electronics also form part of the baseline. However, this analysis covers the costs and benefits of the law and the rule. The reason for this is that the law creates the benefits but those benefits cannot be realized without the rule to implement the law.

### ***Law – RCW 70.95N, Electronic Product Recycling***

The law includes many detailed requirements, which Ecology must follow. Most of the rule is drawn word for word from the law.

### ***Existing rule – WAC 173-900***

The existing rule outlines the

- Definitions for words within the rule.
  - Registration process for manufacturers, transporters, and collectors.
  - Administrative fees.

### ***Existing dangerous waste rule – WAC 173-303***

The current Dangerous Waste Rule would require generators to designate CEPs as dangerous waste.

## **Analysis of costs & benefits**

### **Costs**

#### ***Costs for collectors***

Ecology did a survey of existing collectors and analyzed their costs. Then we extrapolated to all collectors based on the assumption that there must be at least 88 collection sites throughout Washington State that do collection for a plan (see the map in figure 1, below). There may be other collection sites that do not collect for a plan. The law requires that there must be at least one service in each county of the state as well as in cities with a population of greater than ten thousand.

Collection facilities responding to the survey reported they would need the plans to pay the collectors at the rate of \$0.27 per pound for their collections. It is not clear what rates the plans will negotiate with their collectors.

**Staffing collection site during operating hours:** The rule requires staffing during collection times. Only one of the surveyed collection sites reported they had an honor system for dropping off CEPs. All other facilities staff their collection sites during operating hours.

However, this one facility recently decreased its hours of operation instead of adding more staff. They therefore meet the requirement without added costs.

**Storage facilities:** The new rule requires every collection site to store CEPs in enclosed storage areas that are protected from the weather and have solid floors. Alternatively, they must place the CEPs in a container designed to reduce the risk of contamination from glass and other fine solids from the CEPs. Currently, about 5% of collection sites do not have this type of storage area. Ecology estimates it will cost those facilities a total of \$21,000 to install the proper type of storage. The use of trucking containers for storage, as allowed by the rule, may decrease these costs.

**Annual registration:** The rule requires annual registration. Ecology estimates it will cost collectors about \$80 each to submit their annual registration using the electronic registration process. This is a total of about \$7,000 for all facilities.

**Registration updates:** The rule requires collectors to notify Ecology within fourteen days when there is a change to the information provided with their registration. Ecology estimates, on average, that each collector will have about 4 registration updates per year. Assuming a cost of \$50 per hour<sup>6</sup> and 30 minutes to submit these changes, Ecology estimates a total cost of \$8500 a year for collector registration updates.<sup>7</sup>

**Documentation of CEPs:** The rule requires that the plans must collect data on what county each CEP comes from and then provide this information to Ecology. For this analysis, Ecology assumes this cost will accrue to the plans via activity at the collection sites. Ecology expects it will cost an average of \$4,000 per site. Most of the sites however will be located within a large city within a county and it should be obvious that the CEP is from that county. The rule will not require those counties to collect this data. Ecology has identified twenty counties where this assumption cannot be made and the sites will need to collect data so they can report it to Ecology. These counties do not contain a city of 10,000. The total cost for those twenty counties to meet this requirement will be \$80,000.

**Posting information at collection sites:** Recycling plans are required to provide information to collectors for them to post in a visible location at their sites. This is to inform covered entities of how and where CEPs received into the program are recycled. The cost of this is minimal.

**Lost revenue from charges to drop off CEPs:** When Ecology implements this rule, collection sites will no longer be allowed to charge consumers if the collectors are charging a plan for the CEP. This will affect 95% of the collectors, who currently charge to take CEPs. Prices reported now range from:

- \$5.00-\$19.00 or \$0.35-\$1.00/lb for monitors and \$0.40/lb for laptops.
- \$20 and up for televisions.

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<sup>6</sup> The mean wage in Washington for first line supervisors/managers is \$22.29/hr. We assume employer cost for benefits, management: \$13.43/hr for a total of \$35.72/hr. This is rounded up to \$50 to account for collection site overhead. This estimate may be high. In a setting where someone working for the collector may be under utilized because they are waiting for customers, there may be excess hours of “down time” that can be applied to this work.

<sup>7</sup>  $(\$50/\text{hour}) \times (0.5 \text{ hours}) \times (3.9 \text{ updates/year}) \times (88 \text{ collectors}) = \$8,563/\text{year}$  for collector registration updates

This is a loss of \$56,500 per year, per facility, for a total of \$4.9 million.<sup>8</sup>

**Lost revenue from foregone sales of reused parts:** This rule will require collectors to stop stripping parts from CEPs for reuse in order to participate in the program. 29% of these collectors currently do this. Ecology estimates a \$15,000 loss for each of these collectors and a total loss of about \$375,000. The income is not lost to Washington because the rule transfers this income from the collectors to the processors.<sup>9</sup>

**Lost revenue from foregone sales of recyclable parts:** This rule will require collectors to stop stripping parts from CEPs for recycling to participate in the program. 43% of these collectors currently do this. Ecology estimates a \$13,000 loss for each of these collectors and a total of about \$500,000. The income is not lost to Washington because the rule transfers this income from the collectors to the processors.<sup>10</sup>

**Plan participation:** The plans will hire and pay collectors to collect CEPs. Thus, a cost to the collectors will become a cost to the plans. Collection sites will be reimbursed to participate in a plan; the respondents estimated that they want to be reimbursed \$0.27/lb. This is a higher rate than would be necessary to recover the costs the respondents discussed and may indicate a desired profit margin. It is not clear why the respondents estimated the necessary reimbursement as being this high. Ecology estimates 1 million units, weighing 56.5 million pounds, will be collected in the first year. Ecology expects the total reimbursement the collectors will ask for, including the income transfer, to be \$15.1 million.

**Will plans pay?** As stated earlier, collectors said they need to get a high value of \$0.27 per pound from the plans. Ecology believes it is unlikely that plans will be able to pay that much to the collectors. This is because there is a cap on total costs in the law and the plans must also pay for recycling and transport. The cap is \$.50 per pound for collection, transport, and processing. If they fail to collect enough CEPs they have to pay \$.50 to other plans to do the collection for them. Thus, the collectors will have to share the \$.50 per pound with the transporters and processors. Further, the plans will not want to collect more than their share because Ecology gets \$.05 per pound of any \$.50 per pound payments made by one plan to another. Thus once a plan has collected and processed its share of CEPs they will be unwilling to pay more than \$.45 per pound because that is all that they will be reimbursed by the other plans. Given the other costs of transportation and processing, what this limit means is that the estimated \$15.1 million cost will have to come down to under \$11.5 million in order to meet the maximum rate that the plans will be willing to pay. Since Ecology assumes this is the maximum the plans would be willing to pay, given the lowest possible costs of transport and recycling, this will be the cost.

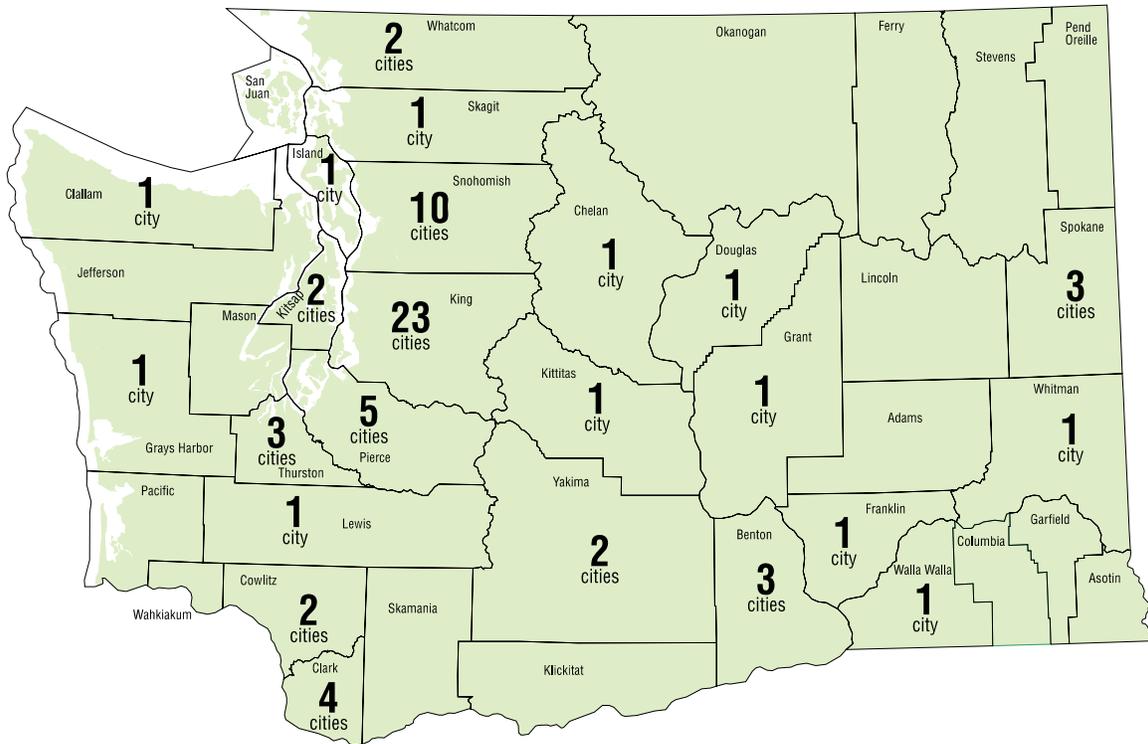
Figure 1: Map of counties and number of cities requiring collection services

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8 (95% of collectors currently charge for CEPs)\*(88 collectors)\*(\$58,583 revenue loss/collector) = \$4.9 million in lost revenue for not being able to charge for collection

9 (29% of collector currently strip components for resale)\*(88 collectors)\*(\$15,000 revenue loss/collector) = \$377,143 loss in revenue for no longer being able to strip components for resale

10 (43% of collectors currently strip components for recycling)\*(88 collectors)\*(\$13,333 revenue loss/collector) = \$502,857 loss in revenue for no longer being able to strip components for recycling



### **Costs for transporters**

The plans will hire transporters to move CEPs from collection sites to processing sites. Therefore, costs to the transporters will become costs to the plans. Ecology surveyed a number of transporters and found that very few companies plan to transport electronics. Additionally, those that were planning on this type of transport found it hard to estimate how much per pound they would have to be reimbursed to participate in a plan.

In another approach, the Washington Utilities and Transportation Commission estimated that it would cost between \$70 and \$83 per hour to transport electronics, an average of \$76.50/hour and therefore \$1.28/minute.

Ecology then estimated the distance from each of the 88 mandatory collection sites to the closest of 8 cities with known processors; this was then doubled to account for a roundtrip. The average roundtrip distance from a collection site to the nearest processor was 114 miles, or 138 minutes.<sup>11</sup> Multiplying the 138 minutes/roundtrip by \$1.28/minute gave an average cost of \$176.50/trip.

According to the three surveys Ecology did receive, the respondents estimated an average load of 11,833 pounds per truckload. Dividing the average per trip (\$176.50) by the average weight per trip (11,833 pounds) gave a reimbursement of \$0.02 per pound for transporting electronics. Ecology estimates that transporters will transport over 1 million units weighing 56.5 million pounds, for a total cost of \$1.1 million.

<sup>11</sup> [http://ops.fhwa.dot.gov/freight/freight\\_analysis/perform\\_meas/fpmtraveltime/index.htm](http://ops.fhwa.dot.gov/freight/freight_analysis/perform_meas/fpmtraveltime/index.htm) average truck speed on I-5

### ***Costs for processors***

The plans will hire processors to recycle the materials. Therefore, costs to the processors will become costs to the plans.

Ecology surveyed processors. Seven processors responded. Most processors currently working in Washington do more than simple processing. They offer collection or transportation services, too.

There are 3 sets of costs that require analysis.

1. The cost of continuing the processing operation as they have in the past.
2. The incremental added costs of meeting requirements that are new for the processor.
3. The foregone revenue for activities that the processor may be giving up if they do not get a contract with a plan.

Ecology estimated the cost of continuing operations based on current charges. Survey results<sup>12</sup> indicate a wide range of charges for processing. The reported costs range from a high of \$0.43 per pound for one company that collects, transports, and processes down to \$0.16 per pound for another company that only does partial processing but will not continue to process under the rule.

Some processors collect and process CEPs. These processors have a different cost for collection than most collectors. If you subtract the collector costs above from the costs of the processors who do both, the costs become negative. This is because they are open for business for other reasons such as repair, reuse, refurbishing, or sales of new items. Therefore, their cost per unit of collection is lower and there are no costs for transportation. This makes it difficult to decide what portion of their costs to attribute to the processing activity alone. Because of this, Ecology took their cost for collection and processing and subtracted out the \$0.02 per pound for transportation, and then divided the remainder of the costs for these facilities in half, arbitrarily splitting the remaining cost between collection and processing. This produced a range from \$0.11 to \$0.22 per pound and an average cost of \$0.207 per pound for processing.

### ***The new costs of the rule***

Most processors already do most of the items required in the rule. However, the rule does add new requirements for direct processors and some of these requirements were not included in the above costs for some of the processors.

For each processor the potential compliance cost is different. The items of concern included costs for:

- Registration.
- Reporting.
- Sampling.
- Environmental health and safety management systems.
- Buying scales.
- More space to operate their business.

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<sup>12</sup> One known processor declined to respond.

These costs did not apply to every processor but produced a range of added costs from \$0.018 to \$0.05 per pound with an average cost of \$0.019. When we add this cost to the \$0.207 above, the cost rises to \$0.226 per pound. Recent information on the prices of processing indicates that processors may not be able to get enough money to cover a \$0.22 per pound cost. It is now unclear where this material will go for processing.

There is a limit to what the processors can charge the plans. The plans that sell to other countries will have very low costs or net gains depending on what is in the containers. Given this, some plans may ship to other countries. Thus, not all the new or existing flow of business will come to the American processors. This does not affect the cost of the program here in Washington but may affect the unquantified cost of contamination affecting other countries.

Existing processors report 22 million pounds of recycled CEPs annually. Ecology has extrapolated from the pounds reported by the smaller processors to an estimated 5 additional collector/processors that may exist in repair shops. This would bring the total pounds currently being processed to 23 million. The current cost of processing these pounds is about \$5.3 million (\$0.226/lb). Ecology believes this is less than half of the total pounds of CEPs that will be processed under the rule. The estimated total pounds of recycling under the rule are expected to be 56.5 million. The cost of processing these pounds is about \$12.8 million.

The Washington range of costs is comparable to averaged costs reported by other states.<sup>13</sup>

**Table 2**

<b>Cost Data from Other States</b>				
State	Collectors	Transporters	Recyclers	All
California	\$0.20		\$0.28	\$0.48
Maine	\$0.12	\$0.06	\$0.19	\$0.37
Minnesota	\$0.17	\$0.05	\$0.04	\$0.27
Maryland: computers only			\$0.05	

One processor does not expect to be able to comply with one of the components of the processor standards. This means they will not be able to get a contract, which will reduce their annual income by about \$50,000.

### **Competition from exports**

American recyclers currently compete with the option of offshore export of CEPs. This will not change. Due to the commerce clause in the US Constitution, Ecology must leave open the potential for export of CEPs to other countries. The plans will be responsible for showing that recycling occurs offshore. However, in some countries, there are fewer compliance issues and the rule can't require recyclers in other countries to comply with Washington's rule. In addition, exporting is not just cheaper, it pays. This provides the potential for private sector economic gains from CEP export, against which most of the American processors compete.

<sup>13</sup> California data from Form 220A, <http://www.ciwmb.ca.gov/Rulemaking/EWaste/Regs061127.doc>, and <http://www.ciwmb.ca.gov/Electronics/Act2003/Retailer/Fee/>. Maine data from Consolodator data and contract information for regions 1 through 4. Minnesota data from <http://www.pca.state.mn.us/oea/plugin/ElectronicsReport.pdf>

There is an economic incentive for manufacturers to sell CEPs to offshore companies because they pay for scrap. For example, these companies will pay:

- \$1.50 per pound for scrap monitors. But, if they are still running they pay \$7 to \$10 per pound. The sale price for a shipping container of scrap monitors is \$2,000 to \$10,000.
- \$2.50 per pound for scrap computers. Ones in better condition may sell for \$25 each. A container load may be worth \$3,200 to \$32,000. Assuming that it costs less than \$2,000 worth of scraps to fill a container, and knowing that it costs manufacturers to process in the United States, there is a potential net gain to manufacturers for selling all types of CEPs at all levels of quality.

Further, Washington is shifting from a system where one individual pays for the recycling of their own equipment to a system where manufacturers pay for this recycling. Because it costs too much for individuals, compared to manufacturers, to export CEPs it raises the potential that manufacturers will see a net gain if they export CEPs for processing. This makes exportation a very attractive option for manufacturers.

The processors must charge the plans to do the recycling required by the rule. Manufacturers are therefore comparing the potential for a minimal net gain with the potential for a net cost as they develop their strategy and select a plan. Manufacturers who want to protect their brand names may not want to follow the path of exporting the CEPs. However, manufacturers with less known brand names do not have this issue and may choose an independent plan that finds a way to divert flow to exports. In addition, the processors must set their prices as they negotiate with the plans, knowing they are competing with net gains.

In the long term it will be hard for American processors to compete. Given this, the actual cost of the plan activities may be much lower than the processing costs estimated below. However, because it was the desire of all the parties at the table to design a program that would work within the US, the costs associated with processing in the US has been estimated as a worst-case cost.

### ***Costs for sampling***

RCW 70.95N.110 requires statistically significant sampling to determine the percentage return share by brand name. This sampling will cost the plans. The rule requires:

- Ecology to develop a quarterly schedule for when sampling is done at the facilities of direct processors used by plans.
- Plans to make sure that the processor's staff or their own supplemental staff are available to perform sampling with minimal disruption to normal operations.
- An independent third party, selected from an Ecology-approved list, to observe sampling.

### **Sample allocation and days**

The total necessary number of samples per year to get a 95% confidence interval and a 0.005 significance level is 10,070 units. Ecology assumes that 4 plans will be conducting sampling,

and that 6 processors may handle material for the plans.<sup>14</sup> Based on the sampling method the total required days of sampling to get the sample size will be 108 days each year.

Staff labor costs

Ecology assumes a sampling crew of 5 members will be required for each sampling day, including 1 manager and 4 staff.

Mean wage in Washington for first line supervisors/managers: \$22.29/hr<sup>15</sup>  
 Employer cost for benefits, management: \$13.43/hr  
 Total: \$35.72/hr

Mean wage in Washington for material movers, hand: \$12.39/hr<sup>16</sup>  
 Employer cost for benefits, material moving: \$7.31/hr  
 Total: \$19.70/hr

Total crew cost is \$114.60 per hour. Thus, the total labor cost per 8-hour sampling day is \$916.80 per day. The cost of 108 sampling days is \$99,014.40 annually.

Third party labor costs

Plans will also need to employ one third party observer per sampling day. Ecology expects the plans will compensate this person similarly to a professional statistician.

Mean wage in Washington for statisticians: \$31.55/hr<sup>17</sup>  
 Employer cost for benefits, professional: \$13.43/hr  
 Total: \$44.98/hr

The total labor cost per sampling day for third party observers is \$359.84 per day. The cost of 108 sampling days is \$38,862.72 per year.

Equipment costs

Sampling will require specialized equipment including, but not limited to, the items in Table 3:

**Table 3**

Type of Equipment	Cost
Scale (registered with Department of Licensing, 400 pound capacity)	\$1500
Dollies or other appropriate equipment for moving units	\$500
Programmable (wireless) bar code readers, printers, stickers	\$1000
Computer capable of running a sampling database program provided by Ecology	\$700
Digital camera for photographing unidentifiable units	\$200
Maintenance and replacement costs after the first year	10% per year

<sup>14</sup> Based on the plans of current processors responding to the survey.

<sup>15</sup> Bureau of Labor Statistics

<sup>16</sup> Bureau of Labor Statistics

<sup>17</sup> Bureau of Labor Statistics

Each plan will be required to supply equipment. Since these are fixed costs for each contractor, Ecology will estimate total costs assuming 4 plans must purchase and maintain equipment. Total annualized<sup>18</sup> equipment costs are \$875 each year per plan, or a total of \$3500 each year.

Total sampling costs: \$141,000 per year.

#### Processor costs

The processors will have to set aside time and space for sampling. This cost will have to be wrapped into the amount a processor charges a plan and will have to be small. Only two processors discussed sampling with Ecology. One processor reported that they may not have sufficient room for sampling. Because no processor reported expected costs the costs are unknown.

#### ***Costs for CEP recycling plans***

The rule requires manufacturers to participate in a plan and set up the Standard Plan.

The rule will allow manufacturers to opt out of the Standard Plan if they receive Ecology approval to use an independent plan. Ecology assumes that manufacturers will only use an independent plan if it costs less. Therefore, the cost of the Standard Plan would be the highest cost option.

The plans must cover the cost of collection, transportation, processing, recycling, and sampling for their manufacturers. These costs are included in the sections above. Plans must also submit a plan, pay a fee for review of the plan, do record keeping, participate in public outreach, and submit reports.

Being a part of an independent plan may generate costs for manufacturers; however, no one is required to create an independent plan so these are not required by the rule. Further, Ecology assumes the manufacturers will only form an independent plan if the cost is lower than participation in the Standard Plan.

At the time of this writing, work on the Standard Plan has begun. The costs of the plan, plan review fee, record keeping, audits, public outreach, and reports are still not available for this Cost Benefit Analysis. As a placeholder, Ecology assumes these requirements will cost \$100,000 per year.

#### ***Registration costs***

Ecology has tried to develop a simple registration process for the transporters, collectors, direct processors, and manufactures. Ecology estimates it will take between five minutes and two hours for each company to fill out the registration form. If Ecology assumes a cost of \$50 per hour, then it will cost between \$4 and \$200 for transporters, collectors, direct processors, and manufactures to register. Manufacturers who have many brands and collectors running more than one site will need more time to fill out the form. If 300 companies require \$75 worth of time to fill out the forms this will cost \$22,500.

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<sup>18</sup> Equipment cost is annualized based on a real discount rate of 2.1% and a return on capital of 8%.

## ***Uncertainty and analysis results***

The following variables probably generate costs that this analysis does not address.

### **1. Cost of CEP recycling plan**

The cost of collection, transportation, processing and recycling dominates all other costs. The cost is highly dependent on the number of pounds and on how competition affects the rates the collectors, transporter, and processors charge.

For the first 5 years, the maximum cost that the manufactures will pay to the collectors, transporters, and processors is \$.45 per pound. This is because the law sets the reimbursement rate for plans that do not collect their equivalent share. If the rate that collectors, transporters, and processors offer to plans totals more than \$0.50, then they will not collect or process very many CEPs. The range of costs reported by each component of recycling is large and costs will shift as the market adjusts. The market should be competitive if there are sufficient processors and costs could fall over the first few years. They will also pay \$.05 per pound for each pound that they under collect in administrative fees. Given that this will be an 11% increase in their recycling costs, Ecology assumes the plans will try to meet their equivalent shares.

### **Cost of Travel for Sampling**

It is unclear where the third party observers will be traveling to observe sampling activities so we did not estimate this cost.

### ***Qualitative costs***

The qualitative costs of the rule include the need for many collectors and recyclers to reorganize how they do business. This is an expensive process in terms of time and effort. For some companies their primary business is to collect and reuse parts and products. These companies also do some of the activities that constitute recycling. A few of these companies will decide to drop the recycling activity and become collectors while the rest will pay for the added requirements in the rule and will become registered direct processors. They are deciding between the added revenue from the plans for collection coupled with the loss of sales of parts for metals extraction versus the additional revenue from plan payments for recycling coupled with the cost of complying with the direct processor requirements.

Two companies are trying to figure out what new niche they can fill because they do not expect the plan payments to cover their current costs and they expect they will not be able to continue to dismantle computers in order to sell parts for recycling. One of these companies has decided they will not continue processing but the other is still considering its options.

In the case of computers, more than one processor has indicated they can sell them for recycling in other countries for more than they receive for recycling in Washington. Some may choose to do this. As stated earlier, the downstream cost of contaminant releases in other countries is not known.

Retailers will have some costs because they need to look at the Ecology web site before ordering CEPs to make sure the brand name is listed. At one time, Ecology expected there would be some costs because some companies would not list their brands. However,

compliance has been good. Retailers with new brands, who previously sold white box<sup>19</sup> CEPs, will be in the program as manufacturers.

## **Benefits**

Chapter 173-900 WAC provides for the recycling of covered electronic products (CEPs) once they are no longer wanted. This rule generates benefits by reducing potential damages from hazardous components of discarded electronic products and from conservation of the resources that they contain.

Ecology estimated the willingness to pay for recycling of CEPs is at least \$.49 per pound because that is what the public is already paying.<sup>20</sup> Based on an assumption that 42% of CEPs are being recycled now, then at a zero price to consumers, 56.5 million pounds may be recycled under the rule. Ecology has extrapolated this willingness to pay to all the electronic waste and estimated the willingness to pay is \$27.5 million.

Ecology must evaluate the benefits based on the effect of the rule. The law should increase recycling and reduce the number of electronic products that reach landfills. This is beneficial because most electronic products have some contaminants. Recycling should increase because the recyclers will no longer charge the consumers, while disposal at landfills will continue to cost. The rule transfers the cost to the manufacturers. This makes proper recycling of the equipment more likely.

There are five benefits of the law:

- The potential to reduce contamination in landfills.
- Reducing the average cost of recycling.
- Reducing the cost of separating electronics.
- Reducing illegal dumping.
- Willingness to pay to recycle unwanted electronics.

### ***Reduced costs of landfill cleanups***

In the past, landfill cleanups have been very expensive. CEPs have added to the contaminant load in landfills. Recycling will reduce this. However, Ecology has to examine the likelihood that this rule will prevent such cleanups.

To protect the landfill areas, some local governments, transfer stations, and landfill owners have already taken action to refuse electronics or to separate electronic products from the waste stream. As the costs for product separation increase, the landfills have shifted some of these costs to the consumer by refusing to take the discarded products or by charging extra for them. Unfortunately, this has made it harder for consumers to dispose of electronic equipment properly.

Now that landfills are lined, the high cost cleanups should be rarer or the need for cleanup may take longer to occur.

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<sup>19</sup> White box is the term used in the industry for unlabeled product that can be labeled at the store.

<sup>20</sup> See Appendix 3.

Clearly, some part of this benefit remains because individuals will breakdown the CEPs and put them in their garbage pails and the transfer stations and landfills will be unable to return them. However, given that society has already moved part way toward this recycling scenario there is already a reduced likelihood of these high cleanup costs. Therefore, Ecology did not quantify this benefit.

### ***Reduced costs of recycling***

Sometimes an activity becomes cheaper per unit if the volume of recycled material increases. Companies in Washington report that they are preparing for this change in volume.

The 57% of those respondents that do recycling and public collection at the same site have costs ranging from \$.16 to \$.43 per pound with an average cost of \$0.32 cents per pound. This is lower than the average charge of \$0.49 that facilities are currently charging. If these companies become direct processors this will bring down the average cost per pound of recycling. However, these small companies have lower throughput and thus the cost savings may only apply to 4% of the total product. Therefore the cost reduction will be at most \$0.13 per pound. It is difficult to extrapolate whether there will be new companies that follow this model so this estimate can only be extrapolated to the estimated 42% of recycling currently being done. If these companies can handle sufficient volume, the savings would be at most \$130,000 per year.

### ***Reduced separation costs***

Some landfills and transfer stations still take electronics. The landfills that do take electronics reported that they were smashed and buried. Other transfer stations and landfills do not take the CEPs or separate them from the waste stream. It is possible that some local governments, transfer stations, and landfill owners will have lower separation costs. Separation costs may or may not be affected because large transfer stations sometimes set up multiple areas to recover other resources such as refrigerators, wood-waste, and construction materials. We cannot quantify this possible benefit.

### ***Reduced costs of illegal dumping***

Sometimes people who can't afford to dispose of their unwanted electronics properly will dump them illegally. This is costly in terms of time and effort to remove them and dispose of them properly. This cost will be reduced. Illegal dumping is not rare but it is also atypical. If it were not, there would be county estimates of the cost of cleaning these up. It is just not common enough to track. Given the uncertainty of this cost reduction, the analysis does not estimate this benefit.

### ***Willingness to pay***

To estimate a lower bound *willingness to pay*,<sup>21</sup> Ecology analyzed the prices that individuals and businesses are currently paying, in Washington, to recycle electronic products.<sup>22</sup> Ecology

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21 Ecology cannot estimate full willingness to pay because we only have data on current prices. This is therefore a lower bound on willingness to pay. Willingness to pay means that people want something because it is beneficial to them and they are, therefore, willing to pay for it. It is one measure of how much a thing is worth to them. In this case, the lower bound of willingness to pay is defined based on what people are actually paying for a variety of programs in order to be able to recycle or get rid of the electronic equipment. One commenter in Phase 1 of the rule making misunderstood the meaning of willingness to pay. This method does not measure the cost to the landfills because the service may be heavily subsidized in order to reduce the probability of contamination. It is merely what people have been paying, on average, to recycle.

also took into consideration the results of a Consumer Electronics Association survey that found 42% of households recycle their electronic waste.<sup>23</sup>

Using this information Ecology came up with an average rate per pound that represents what consumers are currently paying for recycling. The average cost of collection, transportation, and processing being paid is \$0.49 per pound. This rate is then extrapolated to the 56.5 million pounds that will be recycled under the program each year. Ecology estimates the willingness to pay for electronic product recycling by Washington citizens is \$27.5 million.

\$27.5 million dollars may or may not be a conservative estimate of the benefits of willingness to pay. Whether this over or understates the willingness to pay depends on the shape of the demand curve. Since no one has observed the demand curve, it is not possible to know.

The estimate may be conservative for the following reasons:

- A person who pays a price for a one-time-only service is willing to pay at least that amount but might have been willing to pay more.
- The avoided cost of contamination may have been higher than Ecology estimated. This is because the analysis does not count the benefit of proper disposal or the cost of improper disposal by individuals who were unwilling to pay a fee. This latter cost would be the cost of proper disposal, which is imposed on others, or the potential cost of the contaminants not captured by the current system.
- There will be more locations for individuals to turn in the equipment. The increase in locations will reduce any previous travel costs associated with taking the unwanted electronic product to a recycling center.

It may over-state the benefits for the following reasons:

- Some of the people who are not participating now may be outside the current system because they were unwilling to pay this rate. The recycling program provides a convenient way to dispose of electronic products at no cost as opposed to charging the owners. On the other hand, it is possible that they were not participating because the alternative of not recycling and instead placing it in the garbage was free because it was included in their monthly garbage rate and the marginal cost was zero.

### ***Qualitative Benefits***

Companies that generate dangerous waste might have had to designate their CRTs as hazardous waste without this rule. Under this rule, the CRTs can be recycled and the exemption for designation for CRTs as dangerous waste is clear.

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22 In some areas people cannot dispose of them via the garbage and so this may represent a willingness to pay to get rid of the CEPs.

<sup>23</sup> One commenter indicated that Ecology had misread the article cited here. The article states: "Likewise, though 69 percent of the survey respondents say they recycle household trash all or most of the time, 42 percent say they recycle electronics and 43 percent say they recycle appliances with the same frequency." The commenter indicated that most electronics go to charity or to friends and family. The article shows that 88% do. The question for this analysis is, what happens when they are finally discarded. Recheck of article 10/18/06, [http://www.findarticles.com/p/articles/mi\\_m0KWH/is\\_12\\_43/ai\\_n15978785/print](http://www.findarticles.com/p/articles/mi_m0KWH/is_12_43/ai_n15978785/print)

Landfills have been responding to the contaminants in CEPs, especially the lead in CRTs by turning them away. Citizens can easily hide CEPs in their garbage for collection. Once they receive a CEP, landfills and transfer stations cannot hold CEPs without it being a long-term liability. In the long term, if this continued, people would not have been able to discard their CEPs and this would have created pressure in the form of illegal disposal and demand for the recycling program which the law and this rule creates. Ecology believes that the rule and the CRT exemption together have created an orderly transition without a spike in costs.

The landfill and transfer station charges appear to give some indication of the cost of contamination to the landfills (Appendix 2). The charges appear on average to subsidize TVs and to charge extra for monitors and computers. Some reported breaking even financially on their recycling program. In discussions, landfills and transfer stations state they do not make money on the recycling.

Reducing waste alleviates the demand for space in landfills and the demand for the resources that would go into new materials that are saved for reuse through recycling. Fifty-six million pounds is a lot of material. Reducing the size of landfills and reducing the garbage haul is an offsetting gain that reduces the net cost of the rule outlined in the cost section.

Complying with the law has benefits. The law requires Ecology to write this rule. The law clearly places the cost of recycling on the manufacturers and Ecology has written the rule so that they will be able to do this in a manner that is as cost effective and as market driven as possible.

The rule language follows the law as closely as possible. Most costs are directly related to requirements of the law. Only where the law has required Ecology to write requirements but given Ecology flexibility to write these as needed has Ecology written in new costs. Thus, Ecology expects the cost effectiveness and certainty created by the rule, which implements the law, is beneficial in and of itself. Given that a rule was required, the companies responsible experienced costs associated with uncertainty about the content of the rule. For those companies that must comply, having certainty about the law's requirements has benefits in that they can now make their plans.

The rule creates a level playing field between the manufacturers to the extent possible under the law. A level playing field was difficult to create in this setting because the law is very prescriptive. The law creates a comparative advantage for large companies by allowing companies with over 5% of the return share to form an independent plan. Ecology focused on reducing the costs of collector standards, processor standards, and the cost of the Standard Plan.

This rule will create jobs in Washington because of the income transfer it creates. This rule is unusual in that it transfers the cost of disposal from Washington citizens, businesses, and government bodies to manufactures of TVs, computers, and monitors, which are generally outside of Washington. This transfer of costs creates a net income effect for Washington households, governments, and businesses. The income effect will generate jobs. These gains will not be counted here because they are accompanied by losses outside of the state. Further, as the rest of the country adopts similar programs, eventually manufacturers will add the cost of the recycling to the prices of CEPs.

Ecology used the 1997 OFM input output table to estimate labor impacts.<sup>24</sup> The table uses industry and labor inputs and outputs to show the effects on different sectors from small economic changes.

Ecology allocated the share of the savings, from not having to pay for recycling, to each sector based on the share of total output. We based the share for education on the rest of the available savings.

Net cost impacts for the rule were included for the additional costs created by the rule. The savings effect combined with the net cost impacts for specific sectors creates a net increase of approximately 343 jobs within Washington. It is likely that some of this effect is offset elsewhere by job losses outside of Washington. This does not include any injection impact from cash flowing into Washington from outside Washington for recycling work done here because it is likely that the prices of electronics will have an offsetting increase over time. Unemployment is low enough in Washington that most of it is frictional unemployment.<sup>25</sup> Thus, new jobs must cause labor to move into Washington or reduce the supply of labor to other sectors. Therefore, no gain is quantified for job creation.

**Quantified net benefits**

Ecology expects the net value of the law and the rule together will be \$1.7 million per year.

Table 4: Net Benefits

<b>Benefits and Costs of the Recycling Program</b>	
<b>COSTS</b>	<b>\$ 25,935,000</b>
Administrative fees	\$221,500
Collection	\$11,500,000
Transportation	\$1,100,000
Processing	\$12,800,000
Processors dropping out	\$50,000
Sampling	\$141,000
Plans	\$100,000
Forms	\$22,500
<b>BENEFITS</b>	<b>\$27,630,000</b>
Reduced recycling costs	\$130,000
Willingness to Pay	\$27,500,000
<b>NET</b>	<b>\$1,695,000</b>

**Least Burdensome Alternative Analysis**

RCW 34.05.328(1)(e) requires Ecology to “determine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection.”

24 <http://www.ofm.wa.gov/economy/io/default.asp>

25 Frictional unemployment is those workers who are between jobs but who are waiting for the right job at the right salary. They may also be workers who are unwilling to move.

Based on research and analysis required by RCW 34.05.328(d)(e) the Department of Ecology determines:

*There is sufficient evidence that the rule is the least burdensome version of the rule for those who are required to comply, given the goals and objectives of the law.*

Ecology considered a variety of approaches and ended with a rule that sticks very closely to the requirements in the law. Most of the costs of this rule are actually a transfer of costs from individuals, landfills, collectors, transporters, and processors to manufacturers.

The legislature chose to require the manufacturers to internalize the costs of the recycling program in their overall costs of doing business because it would have the least impact on in-state retailers and Washington citizens.

### **Sampling Savings**

Ecology has designed the sampling process so that it avoids unnecessary costs in the following ways:

- We have simplified the sampling to avoid over collection of data.
- We have selected the minimum sample size that is statistically significant, which is the minimum required by law.
- We are providing a list of approved third party sampling observers that the plans can hire. The third party will become accustomed to the logos and this should speed up the sampling if questions arise.
- One major potential cost of the rule is the possibility of moving costs from one plan to other plans by manipulating the sampling data. If any plan controls more than 40% of the return share the potential gain to that plan, and cost to its competitors, could be over \$1 million per year. Thus, the integrity of sampling is critical. The sampling portion of the rule gives the plans and processors only 24 hours notice (more notice can be given if the notice would otherwise be given on a holiday or weekend). This should reduce the ability of the individual who controls throughput to the processor to game the system by manipulating the samples that arrive at the plant.
- The primary possible cost of this rule for those who are required to comply derives from the \$0.50 per pound transfer payment, which is in the law. \$0.45 of this is transferred to plans that do more than their equivalent share and \$0.05 is paid as an administrative fee. This creates a cap of \$.50 for companies that do less than their equivalent share and an incentive of \$.45 for companies that do more than their equivalent share. It is unlikely that the actual cost of collection, transport, and processing will be this high. Therefore, the transfer payment has the potential to increase the cost of the rule to plans that under-perform. By submitting the data immediately after samples are taken, and by having the third-party observer provide data to Ecology and the plans, adjustments can be made by the plans to assure they meet their targets.

### **Direct processor performance standards**

Performance standards evaluated early in the rule development process were very costly. These have been abandoned because most plans would probably have opted to export the waste to less developed nations for recycling. The highest cost item was financial responsibility. In many cases, it would not have been available, even if the companies could afford it.

The processor performance standards have been taken from the requirements in the EPA's Responsible Recycling Practices for Electronics Recyclers Facilitator Draft Straw proposal (version 15). This rule is the first performance standards for electronic product processors being considered for adoption in the country. By using the EPA voluntary standards, we anticipate that other states that follow in Washington's footsteps will adopt similar standards. This will allow Washington's processors to compete in the national market.

***Collector performance standards***

The primary location for sampling has been shifted from collection sites to processing sites.

***Transporter standards***

Transporter standards evaluated early in the rule development process were costly and have been abandoned.

***Exemption from dangerous waste requirements***

Televisions and monitors, with cathode ray tubes (CRTs), would normally designate as dangerous waste. This would be costly. This rule will allow an exemption for processors that recycle TVs and monitors with CRTs. These are granted using an exclusion language based on a federal rule found at 40 CFR 261.4A, 261.39A, 261.40, 261.41, and 260.10 and will be adopted into chapter 173-303 WAC.

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<http://www.electronicrecycling.org/bdms/Reports/ProductType.aspx?producttypeid=4;&measure=units>
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# Appendices

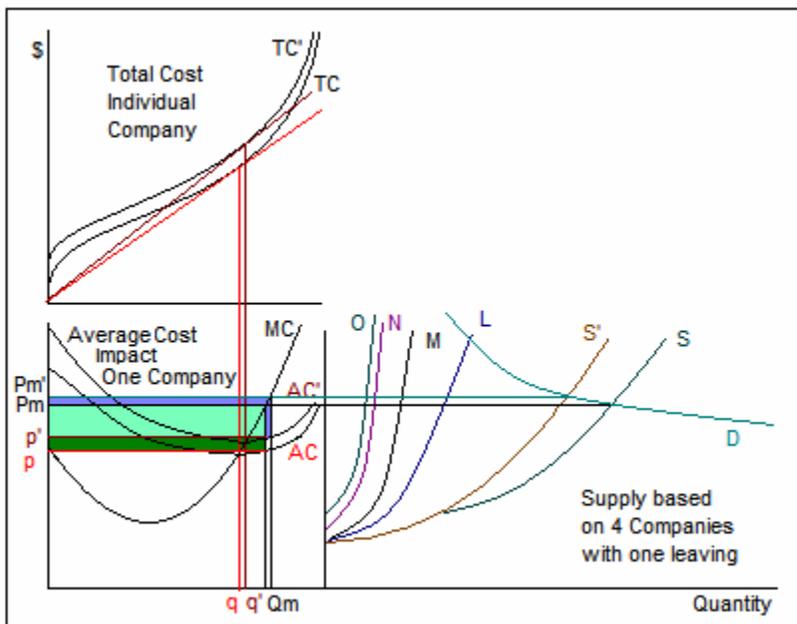
## Appendix 1: Effects of a Competitive Market

In Phase 1, one commenter indicated that Ecology does not understand the market because manufactures are price takers (in other words, they have no control over market prices). The commenter described actions by other sectors and major retailers over which the company had no power. The law gives Ecology a model that places the cost on the manufacturer. However, *through the competitive market some of these costs will be shifted to the consumer.*

It is normal in a competitive market for an individual manufacture to experience market actions that indicate it has no market power. The electronics market is extremely fluid with multiple new entrants, new products, reduced prices for old products given market saturation, and major players merging every year. These factors generate significant price and quantity shifts in every reported time period.

Costs imposed on industry, especially one this fluid, will tend to be shared with the consumer. It may not appear to be so, given that demand for old product drops each year with market saturation. However, the change does take place if demand is taken as a separate phenomena, that is quality driven and unaffected by the fee. Within the theoretical structure that supports the statement that the fee will be shared with the consumer, it is important to note that the fee is *not* a marginal cost. It is a flat amount of cost added to the total cost. This flat cost adds to the average cost but does not affect the marginal cost of any additional unit unless the manufacture grows sufficiently to shift into another fee tier. Thus, in the very short run, the profit margin for a given manufacture drops. Graphic A1 below represents one scenario.

Graphic A1: Theory of Cost Allocation and Price Changes



Note: If you print this in black and white, the bright green prints as light gray,

*the dark green prints as dark gray, and the purple prints as medium gray.*

Key:

- Graphically the profit margin drops from the bright green plus dark green areas to just the light purple area. If all manufactures stay in the market then this is the primary effect.
- Manufactures represented by supply curves labeled “N”, “M”, and “L” have lower average costs and remain in the market. “O” represents manufactures that have an insufficient profit margin to pay the fee. These manufactures may decide not to sell their product in Washington. Ecology expects these manufactures will leave the market to produce something else, then the supply at each price level will decrease, shifting from S (the original total supply curve) to S' (the total supply curve after the one company leaves). This would cause a price increase (P<sub>m</sub> to P<sub>m</sub>' ), giving the manufactures that remain a profit increase represented by the light purple area. In terms of the net profit impact for the individual firm represented in the graphic above, it would depend on whether the pale green area is larger than the dark green area. When this happens in a market that is experiencing falling prices, such as electronics, any price increase due to a fee would merely reduce the speed with which prices fall.

## Appendix 2: Current Electronic Recycling Rates

2006 Rates	Locations	Monitors	Computers (Desktop PC's)	Laptops	TV's
<b>King County website</b>					
Trashbusters	Seattle	\$13.00	\$10.50	\$13.00	\$27.50
3RTech, LLC		\$15.00	\$3.00	\$0.00	\$15.00
Computer Bank Charity		\$10.00	\$2.00	\$10.00	
Computer Equipment Resources	Carnation	\$10.00			
Computer Giveaway Project		\$5.00	\$9.10		
George Electronix	Bellevue	\$7.50	\$10.00	\$0.00	\$37.50
Happy Hauler	Seattle	\$12.00	\$7.80		\$21.50
InterConnection	Seattle	\$10.00	\$5.00		
Micro-Recycle		\$10.00	\$10.00		
PC-Recycle	Bellevue	\$10.00	\$1.00	\$40.00	
PC-Salvage	Tacoma	\$10.00	\$9.10		\$14.70
Philip Services Corp	Seattle, Tacoma	\$12.40	\$10.40		\$19.60
Rabanco	Seattle	\$15.00			\$35.00
Re-PC	Seattle	\$10.00	\$2.50		\$30.00
	Seattle, Tacoma, Bellevue, Bothell, Issaquah, Redmond,				
Staples	Burien, Kent	\$12.00	\$8.00	\$8.00	
Total Reclaim	Seattle	\$10.00	\$9.10	\$2.80	\$14.70
<b>Snohomish County website</b>					
County Recycling and Transfer Stations		\$14.00	\$10.00	\$10.00	\$23.50
<b>City of Tacoma website</b>					
Centerforce		\$10.00	\$10.00		
Philip Services Corp	Tacoma	\$12.40	\$10.40		\$19.60
PC Salvage	Tacoma	\$10.00	\$5.00	\$5.00	\$10.00
Staples	Tacoma	\$12.00	\$8.00	\$8.00	
<b>Spokane</b>					
Earthworks Recycling	Spokane	\$15.00	\$10.40	\$3.20	\$34.00
<b>Thurston County website</b>					
Thurston County Recycling Days	Thurston County	\$10.00	\$10.00	\$10.00	\$10.00
Thurston County Waste and Recovery Center	Thurston County	\$15.64	\$15.64	\$15.64	\$15.64
<b>Clark County</b>					
CREAM Recycling Program	Vancouver, Washougal	\$0.00	\$0.00	\$0.00	\$0.00

2006 Rates	Locations	Monitors	Computers (Desktop PC's)	Laptops	TV's
<b>Nationwide</b>					
Apple Computers			\$30.00		
Dell			\$15.00		
HP			\$23.50		
IBM			\$29.99		
<b>Average</b>		\$10.84	\$10.20	\$8.97	\$20.52

Note: Landfills and transfer stations charge less on average.

September 2007 Charges	Computer	Monitor	Computer and Monitor
HP	\$21	\$29	\$46
Dell (Dell products only)	\$0	\$0	\$0

2007 - Average charges at landfills and transfer stations<sup>26</sup> to take CEPs

Type of CEP	Average cost	\$ per pound
Computers	\$7.67	\$0.64
TVs	\$13.81	\$0.25
Monitors	\$8.79	\$0.44

NOTE: The \$/lb depend on assumptions regarding weight. There is a trend to weight through time. For example computers are getting smaller, TVs with the same screen size are lighter with the phase out of CRTs but screen size is increasing. Thus the static numbers in the literature may be inaccurate for forecasting into the future.

<sup>26</sup> Purdy, South Prairie, Tacoma, Puyallup, Snohomish, Thurston.

### Appendix 3: The Demand Framework

In order to measure the value and the cost of recycling, Ecology used prices being paid in areas where TVs, Computers, and Monitors can't be disposed of as garbage. No consumer surplus was claimed in the document, although it almost certainly exists. There is no data available for a demand curve so consumer surplus can't be calculated. If consumer surplus were added in, then the estimated value must by definition be higher.

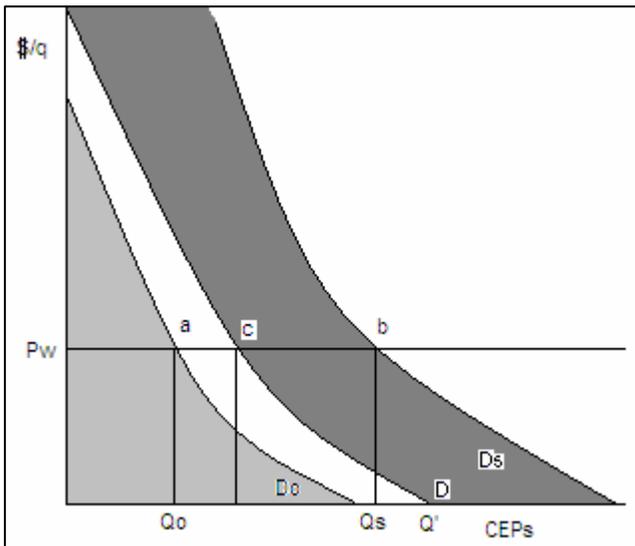
Since only the existing prices and quantities are available Ecology used the price/quantity equilibrium to estimate willingness to pay.

Willingness to pay is a function of the available options. In much of the state people are not allowed to dispose of TVs, Computers, and Monitors as garbage. The current equilibrium price and quantity reflect that in those areas. In the remainder of the state people are allowed to dispose of TVs, Computers, and Monitors as garbage.

#### Supply and Demand for Disposal and Recycling

The rule creates a change that adds to an existing ongoing shift in behavior. As landfills, transfer stations, and collectors stop being willing to take TVs, Computers, and Monitors as garbage, the total statewide demand for recycling will increase. The demand curve would shift out to the right, in graphic A3:1, from  $D_0$  to  $D$ . Therefore one would expect that for the same price, more tonnage would be collected for recycling.

Graphic A:3:1: Demand Shift and Societal Willingness to Pay.



Ecology does not expect the supply effects of this rule to change world prices for either purchased used electronics or recycling services. Washington is too small being 0.5% of the world economy. Therefore this graph is drawn with a flat supply curve (in graphic A3:1 this is at  $P_w$ , the world price of electronics available for recycling). As the demand increases and the price to the consumer changes to zero, the amount that will be recycled shifts from  $Q_0$  (current quantities) to  $Q'$  (in 2009). Note that even though the

price is zero, the cost to the consumer is not zero and includes transporting the CEP to a collection site.<sup>27</sup> Alternatively some collectors may pick up the CEPs for a fee.

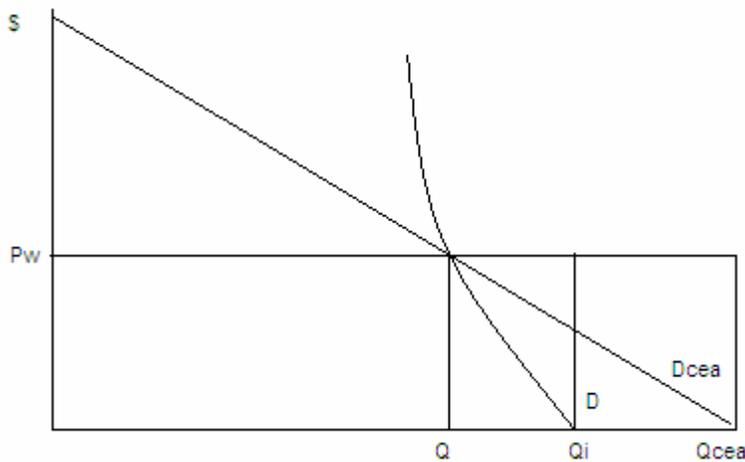
<sup>27</sup> Work in progress; this version 11/13/06, Understanding Preferences for Recycling Electronic Waste in California: A Contingent Ranking Study, <http://www.economics.uci.edu/docs/micro/f06/Saphores.pdf>

The optimal quantity of recycling would be a function of societies' willingness to pay and the full societal cost of proper disposal as opposed to illegal dumping, recycling, and reduced contaminants in landfills. Graphically, this would be point "b" at quantity  $Q_s$  if the world price reflected the full cost of recycling. However, we will never see the optimal equilibrium point b, so we don't know where  $Q_s$  is relative to  $Q'$ .

### The Shape of the Demand Curve

There is reason to believe the demand is relatively inelastic. This is the basis for drawing the curves as Ecology did above. (See the curve labeled D in the graph below.) When a person decides to get rid of a CEP in any area where garbage disposal is no longer an option, the CEP has to go somewhere. If people had elastic demand, then we would find much more illegal dumping, and dumping into other people's dumpsters. In other words, if people have elastic demand, dumping would occur in the area from  $Q$  to  $Q_{cea}$ . People with low willingness to pay (34%) store old CEPs in their homes<sup>28</sup> until they have to get rid of them (i.e. an expensive move to make). If the demand were extremely price responsive, or elastic, then most would then dispose of them illegally.

Graphic A:3:2: Relative Slope of the Demand Curve



In Washington there is some of this illegal disposal and use of other people's dumpsters, but we are seeing something small, which is more likely to look like  $Q$  to  $Q_i$ . The curving line is drawn to have only a small percentage being dumped illegally. Counting only the amounts that seven of the recyclers reported gives us a total of 22 million pounds being

recycled. Ecology extrapolated to a missing respondent to obtain 23 million pounds. If the curve is more flat, then that would imply a large share of this large amount of waste is being illegally dumped. People would be up in arms if this were the case because county cleanup crews and apartment owners with dumpsters would be carrying the cost of separation and recycling for those whose willingness to pay lies below the charges. Those who have to pay for the disposal of the illegally dumped and dumpster disposal of CEPs would be carrying a large share of the total cost.

---

This concludes that consumers are willing to pay \$0.13/equivalent mile to increase e-waste recycling convenience. Downloaded 9/10/07.

28 Public Opinion Research on Electronics Recycling, SoundStats, August 2002, Washington Citizens for Resource Conservation, PRR Inc. and Northwest Research Group, Inc..

## Appendix 4: Survey Data on Willingness to Pay

Several entities have done surveys on willingness to pay for recycling. Ecology reviewed these in June of 2007 and September of 2007.

Note: The values in the surveys below, with the exception of the New Zealand study, are lower than the highest prices currently being charged at some recycling collectors here in Washington. This is especially true of the TV prices. Thus the high end of the demand curve can't be characterized.

\*\*\*\*\*

Survey data is available from New Zealand on willingness to pay at  
<http://www.mfe.govt.nz/publications/waste/eee-disposal-apr06/html/page1.html>

Respondents who were willing to pay for the safe disposal of their televisions or computers were asked whether they would be willing to pay at a number of different price points. Calculated across the total sample:

- 1 percent indicated they would be willing to pay \$50 or more (20 percent \$50, 4 percent \$60, 2 percent \$70 and 5 percent more than \$70)
- 35 percent were willing to pay \$40 or less (2 percent \$40, 11 percent \$30, 12 percent \$20, 5 percent \$10, 2 percent \$5, and 3 percent less than \$5)
- 34 percent said they were not willing to pay anything, or were unsure.

\*\*\*\*\*

Survey data indicating willingness to pay is available at  
<http://www.productstewardship.net/PDFs/libraryElectronicsWCRCReport.pdf>

SoundStats August 2002 Page 12  
PRR  
Northwest Research Group, Inc.

Q6 – Suppose that when you go to buy your next television, you find out the television will cost you an extra \$15 because the price includes a prepaid recycling fee. As a result, would you...? (Base = All Respondents [n=407])

- The majority (86%) of all respondents report that they would buy the television they want anyway even if it would cost extra \$15 because the price includes a prepaid recycling fee.
- Respondents with an annual household income of less than \$30,000 are more likely than respondents with an annual household income between \$30,000 and \$50,000 to say they would buy the television they want regardless of the extra \$15 due to the prepaid recycling fee (94% compared to 80%, respectively).
- Respondents with an annual household income between \$30,000 and \$75,000 are more likely than respondents with an annual household income of less than \$30,000

to say they would try to buy a television from a different state or over the Internet to avoid paying the recycling fee (12% compared to 2%, respectively).

- Respondents with children are more likely than respondents without children to say they would buy a less expensive television (6% compared to 1%, respectively).
- Decide not to buy any television 2%
- Buy the television you want anyway 86%
- Buy a less expensive television 2%
- Try to buy a television from a different state or over the Internet to avoid paying the recycling fee 8%
- None of the Above 1%

Q7 – Suppose you upgrade to a new computer system and no longer want your old one. If you knew that it would cost you \$20 to recycle the old one, and it was illegal to put it in the garbage, would you be more likely to...?

(Base = All Respondents [n=407])

- Over half of all respondents (55%) report that if they were upgrading to a new computer system, they would take their old computer system in for recycling and pay the \$20.
- Female respondents are more likely than male respondents to say they would take their old computer in for recycling and pay the \$20 (60% compared to 50%, respectively).
- One-third (34%) of respondents say that would store their old computer at home.
- Respondents aged 18 to 44 are more likely to store their old computer system at home (37% compared to 19% of respondents aged 55 to 64).
- None of the Above 6%
- Store the old computer system at home - 34%
- Take the old computer system in for recycling and pay the \$20 - 55%
- Put it in the garbage anyway - 4%

\*\*\*\*\*

In Florida a survey asked people about their willingness to pay for recycling, however they only listed a range from \$1 to \$10.

[http://www.dep.state.fl.us/waste/quick\\_topics/publications/shw/electronics/ManateeCountyFinal\\_E-Scrap\\_Report.pdf](http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/ManateeCountyFinal_E-Scrap_Report.pdf)

\*\*\*\*\*

One article indicated people are willing to pay \$0.13 per mile to have recycling be more convenient. <http://www.economics.uci.edu/docs/micro/f06/Saphores.pdf>

## Appendix 5: Ecology Processor Survey Questions

Note to Readers:

Most processors were only able to answer part of these questions.

Data came from 7 processors.

### Revised Processor Survey

Thank you for filling out this survey. It will help Ecology estimate the cost of changes to the rule.

Please put in your code \_\_\_\_\_.

If you can't answer some of the questions, please give us the information you do have.

When you answer the questions please consider all your costs including things that people usually forget such as:

- *reporting*
- *record keeping*
- *compliance costs*
- *professional services*
- *equipment*
- *supplies*
- *labor*
- *increased administrative costs*
- *lost sales or revenue*

### Why are we redoing the survey?

The rule is being changed based on feedback from the last meeting. So it is likely that some things will have changed, especially for companies that were afraid they would lose a revenue source.

**Some companies fear they will lose business. Therefore, as a starting point, we need to understand your current costs and revenues and how the rule will change these.**

1. What is the current total value of your revenue in processing Electronic Products?
2. Do you currently take CEPs? yes \_\_\_\_\_ no \_\_\_\_\_
3. Employees: We need to estimate your costs on a cost per employee basis.  
How many employees do you currently have? \_\_\_\_\_
4. What percentage of your revenue is from CEPs? How many tons per year are from CEPs?
5. What percentage of this revenue is at risk if you can't obtain a contract with a plan?

6. How much do you currently charge, on average, per pound to handle CEPs

	Retail	Public Agency	Contracts
TVs	_____	_____	_____
Monitors	_____	_____	_____
Desktops	_____	_____	_____
Laptops	_____	_____	_____

7. Please indicate which kind of CEPs you currently handle and what you do with them. If you know the approximate annual weight or number of units please write that in the blanks.

Weight	Sell for Reuse	Dismantle For Parts	Dismantle For Recycling
TVs	_____	_____	_____
Monitors	_____	_____	_____
Desktops	_____	_____	_____
Laptops	_____	_____	_____

Number of Units	Sell for Reuse	Dismantle For Parts	Dismantle For Recycling
TVs	_____	_____	_____
Monitors	_____	_____	_____
Desktops	_____	_____	_____
Laptops	_____	_____	_____

If you have dismantled for materials and feel you cannot be a processor under the rule will you opt to:

- Be a collector and not to be a processor, you could not dismantle CEPs for materials. How would that affect your annual revenue? \$ \_\_\_\_\_
- Not be a collector for a plan and continue doing what you are doing now and have a reduced flow of materials coming through your business? How would that affect your annual revenue? \$ \_\_\_\_\_

**From here on please think about how much the rule will change your costs:**

- Do you have a certified scale? Yes \_\_\_\_\_ No \_\_\_\_\_  
 How much did it cost? \_\_\_\_\_  
 Would you consider using a truck scale or public scale? Yes \_\_\_\_ No \_\_\_\_\_  
 How much would it cost? \_\_\_\_\_

11. Given the following list of requirements, how much would it cost you to comply with each:

12. Do an EMS. An EMS includes the items below. Cost? \$ \_\_\_\_\_
- Identify environmental impacts, and legal and regulatory requirements;
  - Establish environmental goals, objectives and targets;
  - Plan actions that work toward achieving identified goals;
  - Plan for emergency preparedness and response; and
  - Provide management support.
  - Establish roles and responsibilities for the EMS and provide adequate resources;
  - Train and assure they are capable of carrying out responsibilities
  - Establish a process for communicating about the EMS within the business.
  - Monitor key activities and track performance;
  - Identify and correct problems and prevent recurrence; and
  - Provide a measurement system that quantifies the application of the model.
  - Conduct annual progress reviews;
  - Act to make necessary changes to the EMS; and
  - Create and implement an action plan for continual improvement.
  - Have a worker safety and health management plan that conforms to a consensus-based standard covering worker health and safety such as ANSI Z10 or to a similarly rigorous in-house standard.
  - Have a plan for responding to and reporting exceptional releases that could pose a risk to worker safety, public health, or the environment. Such releases include emergencies such as accidents, spills, fires, and explosions. The direct processor must submit this plan to all appropriate emergency responders—e.g., police, fire department, hospitals.
  - Be conformable with ISO 14001, Institute of Scrap Recycling Industries' Recycling Industry Operating Standards ("RIOS"), the International Association of Electronic Recyclers' ("IAER's") standard, or other standards designed at a level appropriate for the processing of CEPs at the facility.
  - Ensure all employees understand and follow the portions of the EMS relevant to the activities they perform.

Ensure safety and legal compliance

*Capital costs* \_\_\_\_\_

*Labor costs* \_\_\_\_\_

*Consulting or professional services* \_\_\_\_\_

Provide a sheltered enclosure, an appropriate catchment system, which protects CEPs and wastes from adverse atmospheric conditions and floods, which is secure from unauthorized entrance and has clearly labeled containers and/or storage areas

*Capital costs* \_\_\_\_\_

*Labor costs* \_\_\_\_\_

*Consulting or professional services* \_\_\_\_\_

180 day storage maximum

*Capital cost* \_\_\_\_\_

*Labor costs* \_\_\_\_\_  
*Consulting or professional services* \_\_\_\_\_

Assure that any CEPs and CEP components to be transported are packaged in compliance with all applicable transport laws and rules

*Capital costs* \_\_\_\_\_  
*Labor costs* \_\_\_\_\_  
*Consulting or professional services* \_\_\_\_\_

Assure that you direct each material stream to a facility that employs technologies designed to accommodate all the contents of the stream in a manner protective of worker safety, public health, and the environment

*Capital costs* \_\_\_\_\_  
*Labor costs* \_\_\_\_\_  
*Consulting or professional services* \_\_\_\_\_

Direct materials that are not directed to reuse, to materials recovery unless doing so poses unacceptable risk or is not technically feasible. IE expensive is not a sufficient reason to dispose at a landfill.

*Capital costs* \_\_\_\_\_  
*Labor costs* \_\_\_\_\_  
*Consulting or professional services* \_\_\_\_\_

The following components must be removed and managed in conformance with all applicable laws.

- Mercury containing components
- Batteries
- CRTs and leaded glass
- Circuit boards

*Capital costs* \_\_\_\_\_  
*Labor costs* \_\_\_\_\_  
*Consulting or professional services* \_\_\_\_\_

How much will it cost you to not be allowed to use prison labor? \_\_\_\_\_

#### Reporting and Record Keeping

13. How much will it cost you to do an Annual report to the Plan? \_\_\_\_\_

The total weight in pounds of CEPs including documentation verifying processing of that material for:

CEPs collected, reported by county, not including CEPs gleaned for reuse or refurbishment

CEPs recycled

Non-recycled residual from CEPs

Final destination for the processing of CEPs and their components and final destination for disposal of residuals

CEPs received from each nonprofit charitable organization primarily engaged in the business of reuse and resale used by the plan  
CEPs that were received in large quantities from small businesses, small governments, charities and school districts

14. How long do you keep your records? \_\_\_\_\_

15. How much would it cost you to keep the records for the Plan for 3 years?

*Space needed* \_\_\_\_\_

*Labor costs* \_\_\_\_\_

## Appendix 6: Ecology Collectors Survey

Thank you for filling out this survey. It will help Ecology estimate the cost of changes to the rule.

Ecology will provide you a code if you wish for this information to remain confidential.

Please put in your code \_\_\_\_\_

When you answer the questions please consider all your costs including things that people usually forget such as:

- reporting
- record keeping
- compliance costs
- professional services
- equipment
- supplies
- labor
- increased administrative costs
- lost sales or revenue

**We need to understand your current costs and how the rule will change your costs.**

1. How many hours per week are you open for operation now? \_\_\_\_\_

2. How many employees does it take to staff the site during operating hours? \_\_\_\_\_

How many employees do you have? \_\_\_\_\_

What are the labor costs to staff the site during operating hours? \$ \_\_\_\_\_

3. Do you currently have enclosed storage areas protected from the weather and have impervious floors?  YES  NO

If no, how much would it cost to get this type of storage? \_\_\_\_\_

4. Given the following requirements, how much would it cost you to comply with each:

Document what county the CEP came from and provide that information to the plan. \_\_\_\_\_

Post recycling information provided by the plans at the collection location. \_\_\_\_\_

Submit registration via email or internet service. \_\_\_\_\_

5. We are trying to find out how many times in a year you expect to update your registration. Any changes to the following must be submitted to ecology within fourteen days of the change under this rule. How often do you expect the following things to change in a year:

contact and location information \_\_\_\_\_  
business license information \_\_\_\_\_  
permit information \_\_\_\_\_  
description of services provided \_\_\_\_\_  
geographic areas where services are provided \_\_\_\_\_  
hours of operations \_\_\_\_\_

6. Do you currently charge to take a CEP?  YES  NO

If yes, under what circumstances? \_\_\_\_\_

How much do you charge? \$ \_\_\_\_\_

7. Do you offer pickup services?  YES  NO

If yes, how much do you charge? \$ \_\_\_\_\_

8. How much revenue will you lose from this source if you become a collector for a plan and can't charge for CEPs that are dropped off? \$ \_\_\_\_\_

9. How much will a plan need to pay per pound to persuade you to participate?  
\$ \_\_\_\_\_

10. Do you ever check whole CEPs to see if they work and send them somewhere for resale or resell them yourself?  YES  NO

If yes, how much revenue per year will you lose if can not resell whole CEPs for the plan. You may still resell CEPs, but they can not be counted towards the plan for collection reimbursement. \$ \_\_\_\_\_

11. Do you ever check components of the CEP to see if they work and strip them for resale or reuse?  YES  NO

If yes, how much revenue per year will you lose if you can not resell or reuse components of CEPs that you count towards a plan for reimbursement?  
\$ \_\_\_\_\_

12. Do you ever strip components for recycling?  YES  NO

If yes, how much revenue will you lose if you have to stop doing this in order to participate in the program? \$ \_\_\_\_\_

13. Based on your current knowledge, would you be willing to participate in this program?  YES  NO