Policies to Manage Electronics Waste: An Analysis of US and EU Regulatory Initiatives

by

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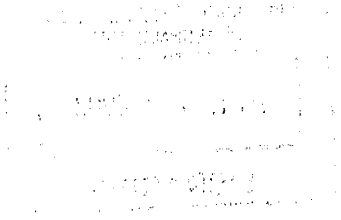

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Abstract

Policies to address the environmental challenges associated with the disposal of electronics waste are being developed in the US and the EU. This paper offers a standard critique of those policies and also analyzes them in terms of the likelihood they will induce innovation in response to their requirements.

The US proposal relaxes the hazardous waste handling requirements for cathode ray tubes and mercury containing equipment, with the intent that more of them will be recycled. However, the rule does not contain any requirement that recycling occur, and the economic incentives to do so are minimal. Technological innovation and diffusion of current technology are both unlikely responses to the proposed rule. In addition, the rule does not apply to many users and types of electronics equipment, thereby only addressing a very small portion of the overall electronics waste issue. The rule fails to consider other materials found in electronics equipment and issues regarding recyclability, recycled content, secondary markets, and materials substitution.

Two of the EU proposed directives are much more comprehensive in their coverage of electronics waste. They require certain recycling targets to be met and mandate the elimination of some hazardous substances from electronics equipment. Diffusion and incremental innovation are likely responses, with perhaps radical innovation only as the targets become more stringent in future years. The directives require additional clarification regarding the types of electronics equipment covered, financing mechanisms, the structure of the recycling targets, the granting of exemptions, and the development of secondary markets.

Portions of the two EU proposed directives may be challenged under World Trade Organization rules. An analysis shows that provisions in the directives could face some difficulty in obtaining exemptions. A growing disconnect between global trade rules and the making of environmental policy is examined.

Finally, one additional proposed EU policy that would require manufacturers of electronics equipment to consider the life cycle environmental impacts of the equipment during its design and manufacture is analyzed. At present, innovation is an unlikely response to this directive, though the inclusion of specific performance requirements could substantially improve it.

Suggested modifications are offered for each of the policies examined.

Thesis Supervisor: Nicholas A. Ashford
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List of Acronyms

AEA	American Electronics Association
ANEC	The European Consumer Voice in Standardization
APC	American Plastics Council
APME	Association of Plastics Manufacturers in Europe
BAN	Basel Action Network
BEUC	European Consumers Organization
CBA	Cost Benefit Analysis
CECED	European Domestic Appliance Industry
CENELEC	European Committee for Electrotechnical Standardization
CFC	Chlorofluorocarbons
CFR	Code of Federal Regulations (US)
CGCAP	California Global Corporate Accountability Project
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DEEE	Directive on the Environmental Impact of Electrical and Electronic Equipment
EACEM	European Association of Consumer Electronics Manufacturers
EC	European Commission
EEA	European Environment Agency
EEB	European Environmental Bureau
EEE	Electrical and Electronics Equipment
EIA	Electronics Industry Alliance
EICTA	European Information, Communications and Consumer Electronics Technology Industry Association
EMAS	Eco-Management and Audit Scheme
ENS	Environmental News Service
EP	European Parliament
EPA	Environmental Protection Agency (US Government)
EU	European Union
EUR	Euro
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
HC	Hydrocarbons
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
IAER	International Association of Electronics Recyclers
ICER	Industry Council for Electronic Equipment Recycling (UK)
ISO	International Standards Organization
IT	Information Technology
ITIC	Information Technology Industry Council
JBCE	Japan Business Council in Europe
LCA	Life Cycle Analysis
MCE	Mercury Containing Equipment
MFF	Materials for the Future Foundation

MOU	Memorandum of Understanding
MSW	Municipal Solid Waste
NEMA	National Electrical Manufacturer's Association (US)
NEPSI	National Electronics Product Stewardship Initiative
NGO	Non Governmental Organization
NSC	National Safety Council (US)
ORGALIME	Liaison Group of the European Mechanical, Electrical, Electronic, and Metalworking Industries
OTA	Office of Technology Assessment (US Government)
PBB	Polybrominated biphenyls
PBDE	Polybrominated diphenylethers
PC	Personal Computer
PCB	Polychlorinated biphenyls
PIU	Performance and Innovation Unit (of the UK Government)
PVC	Polyvinyl chloride
PWB	Printed Wire Board
RCRA	Resource Conservation and Recovery Act (US)
ROHS	Restriction of the use of certain Hazardous Substances
SPS	Sanitary and Phytosanitary Agreement
SVTC	Silicon Valley Toxics Coalition
TBT	Technical Barriers to Trade
TCLP	Toxicity Characteristic Leaching Procedure
TIA	Telecommunications Industry Association
US	United States
WEEE	Waste Electrical and Electronics Equipment
WRI	World Resources Institute
WTO	World Trade Organization

1 Introduction

There can be little doubt that electronics equipment and information technology are having a dramatic effect on modern society and economics. Though public proclamations about the new economy have subsided, the changes brought by the early stages of the information age are just beginning, and there seems to be no end to the desire of consumers for more varied and sophisticated electronics. Even electronic items that are not usually considered to be "high tech" are becoming so, as we are promised the next generation of refrigerators that can sense when we are running low on food.[1]

While this example may seem trivial, the economic impact of the electronics sector has been very real and it is expected to be one of a handful of critically important industry sectors in the foreseeable future. High technology, just one segment of the electronics sector, generates approximately ten percent of the US gross domestic product, employs over nine million people, and has the highest exports of any US industry sector ($150 billion in 1996) (WRI, 1998, p. 18).[2]

In addition to providing economic and quality of life benefits, the computer and electronics sector was viewed for a long time as a clean industry. Gradually, however, information concerning worker health and environmental impacts near production facilities began to come to light. In truth, the electronics sector has a broad range of significant social and environmental impacts. These include use of toxic chemicals and carcinogens, air and groundwater pollution, ozone depletion, poor worker relations, the inequity of the digital divide, concerns about worker health, intense water and energy use, and climate change (WRI, 1998; CGCAP, 2002).[3] Many of these areas have already been the target of advocacy campaigns and public policies.

One additional area that is now beginning to receive increased attention from policy makers is the toxicity and sheer volume of solid waste associated with the end-of-life management and disposal of electrical and electronic equipment (EEE). Recognition of the environmental effects of waste electrical and electronic equipment (WEEE) has prompted regulatory initiatives in both the United States and Europe. The proposed policies in the two regions have taken very different forms, and it is timely o offer a serious critique of their strengths and weaknesses in making significant improvements in the management of WEEE.

1.1 Standard approaches to environmental regulation

Examining whether proposed policies will make dramatic improvements in environmental problems is not unique to WEEE, of course. Ideas for far reaching change have been expounded in reference to worker health and safety, as well as for environmental issues in other industry sectors. Indeed, it has been argued that industry transformation will be required in order to reach

[1] Items that were never electronic in the first place are becoming equally sophisticated, as the development of a knife that can sense when it has been exposed to bacteria attests (see ongoing projects at the MIT media lab for other examples, http://www.media.mit.edu/).

[2] CGCAP (2002, p. 6) put the high tech sector at 8% of GDP in 1998 and with revenues of over $200 billion in 2000.

[3] One estimate of the inputs required to produce one 150 mm. silicon wafer that would be used to make computer chips included 285 kWh of energy, 250 pounds of atmospheric gases, 63 pounds of liquid chemicals, 7 pounds of hazardous and 82 pounds of non-hazardous waste, and 2,800 gallons of water (WRI, 1998, p. 21).

environmental goals such as Factor 10 (Ashford, 2002; Carnoules Statement, 1997). Though improvements have been made in terms of the environmental impacts of many products and services, increasing levels of consumption and the relatively slow diffusion of the best environmental practices throughout the world economy mean we will be hard pressed to meet the environmental problems we now face (McDonough and Braungart, 1998; Andersen and Massa, 2000; PIU, 2001).[4]

In addition, new environmental issues are emerging and these are increasingly characterized by indeterminacy and ignorance (Ashford, 2002; Wynne, 1992).[5] Hence, any inclination to wait for better or more precise scientific or risk assessments may not, in fact, clarify the situation or the illuminate the best option for policy makers. Information is also coming to light that indicates the effects of environmental pollution can be realized at much lower exposure levels than previously thought.

In an atmosphere that includes new risks, lower thresholds for health effects to be observed, and increased uncertainty, the regulator faces a considerable challenge. Regulatory interventions may no longer be able to rely on some of the standard analytical methods or solutions. Standard methods would include techniques such as cost benefit analysis and risk assessment (Ashford, 2002a).[6] Standard generic solutions include use of economic instruments, encouraging voluntary agreements, information disclosure, use of environmental management systems, cooperative governance, and seeking stakeholder participation (Ashford, 2002; Fiorino, 1999).

In response to the recognition that the usual tools may no longer be sufficient, techniques such as trade-off analysis and technology options analysis are gaining prominence and acceptance in the literature (Ashford, 2000; Ashford, 2002a; O'Brien, 2000). Generic approaches to problems have also been found lacking, creating a broader following for concepts such as the precautionary principle (Hemmelskamp et al, 2000; Freytag et al, 2002). In general, use of the precautionary principle is increasing, and has been legitimated by studies such as EEA (2001) which found that, historically, early warnings have generally been on target and policies have erred on the side of being too little too late.

While there is some broad dissatisfaction with the traditional tools and approaches, unfortunately, the newer ideas do not necessarily work together harmoniously. For example, when industry consultation and stakeholder participation become part of the implementation process for the precautionary principle, the underlying premise of acting proactively can become diluted. Those likely to be affected by any new policy, generally industry, are rarely eager to adopt a proactive approach to a problem that is uncertain and will be expensive for them to address. Thus, the traditional techniques and methods have inherent flaws that policy makers are generally aware of, yet adopting an amalgamation of current wisdom leads to conflicting ends.

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[4] This is not to say that technological diffusion and eco-efficiency are not desirable. The basic point is that neither would be enough, on its own, to address environmental problems. To put it in the blunt terms of one commentator: "Relying on eco-efficiency to save the environment will in fact achieve the opposite -- it will let industry finish off everything quietly, persistently, and completely" (McDonough and Braungart, 1998).

[5] Examples of recent environmental concerns include the impact of endocrine disrupting chemicals and the connections between industrial chemicals and various diseases (see Ashford, 2002).

[6] For critiques of cost benefit analysis and risk assessment, see Fischoff (1977), Hornstein (1992), Ashford (1998), O'Brien (2000), Ashford (2000), Ackerman and Heinzerling (2002), and Christoforou (2002).

Fortunately, there is a way out of the mental and analytical box. Policy makers need not be caught up in endless debates about the allocation of resources in a zero sum game that is played out in a static equilibrium, nor must they engage in protracted negotiations and consultations with a wide range of stakeholders about future regulatory initiatives. Rather, policy makers can approach current policy challenges by using what might be called innovation-oriented environmental regulation.[7]

1.2 Innovation

Use of the word "innovation" might give people pause, as the concept is frequently bandied about in many different contexts and including it in the rubric of environmental regulation may seem to add a level of unnecessary complication. This need not be true, however. For the purposes of innovation-oriented environmental regulation, there are only a few key points that must be understood.[8]

Let us first define some key terms. Innovation is the first commercially successful application of a new idea.[9] Innovation is distinct from invention and from diffusion. An invention is an idea or a concept for a new product or process, while diffusion is the widespread use of an innovation by others in the market.[10]

Innovation by definition means a departure from the usual ways of doing things, but there are varying degrees of departure that are captured by the terms incremental, radical, and disruptive.[11] An incremental innovation is a minor improvement along the lines the product or process is currently developing and for which it is valued. A radical innovation is a dramatic improvement along those same lines, while a disruptive innovation represents a transition to a new technology or a new paradigm.[12] Disruptive innovation often results in changing the way people think about the product or process, and in the development of new characteristics that are subsequently

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[7] This is the title of Hemmelskamp et al (2000).

[8] For additional reading on innovation, see Foster (1986); von Hippel (1988); Dosi et al (1988); Freeman (1992); Utterback (1996); Branscomb and Keller (1999); Christensen (2000); and Branscomb and Auerswald (2001). For reading on EU regulations and innovation, see Leone and Hemmelskamp (1998) and EC (1995).

[9] This paper will generally not be considering institutional or social innovation, which would not necessarily fall within the bounds of this definition.

[10] These definitions are loosely taken from Utterback (1996, p. 193). Note that the distinction between innovation and diffusion is not always clear, as subsequent users can modify the original innovation to suit their own needs. On this point, see Ashford (2000, fn 2).

[11] In the some of the literature, the term "radical" has been used to mean "disruptive" as defined here. The distinctions on the different types of innovation are taken from Christensen (2000). The key point is to distinguish those innovations that are evolutionary from those that are revolutionary and displace incumbent products, processes, and/or actors.

[12] Disruptive innovations can also follow the valued attributes of the old technology, but it is much more likely that those attributes will be delivered in a new way. These terms do not cover all forms or dimensions of innovation. For example, Henderson and Clark (1990) draw distinctions between architectural and modular innovations. Architectural innovation changes the way product components are linked, but does not change the core components or design concepts. Modular innovation changes the core components without affecting the linkages. Incremental innovation is an evolutionary change in components, but the core design concepts and the links between them are unchanged. Disruptive innovation establishes a new set of core design concepts, embodied in components that are linked together in a new architecture.

demanded by users. Disruptive innovation also often results in a change of leadership in the affected industry.[13] Furthermore, disruptive innovations generally do not come from the industry leaders themselves, but from new entrants.[14] This is generally true even if industry leaders are aware of the possibility of the innovation in advance and often if the initial development of the innovation took place within a leading company.[15]

Christensen also uses the term "sustaining" to refer to technologies that improve the performance of established products (or processes) along the lines of performance that mainstream customers in major markets have historically wanted (Christensen, 2000, p. xviii).[16] Sustaining technologies, though they can be incremental, radical, or discontinuous in character, are also distinct from disruptive innovations because disruptive technologies have different performance attributes than those that are relevant in established value networks (at least at first).[17]

1.3 Innovation and regulation

Now armed with these basic definitions and concepts, it is possible to begin to think about designing environmental policies in a new way. First, we must recognize that the technologies that are available today may not be the technologies that will adequately or sufficiently address the environmental problem, and that those technologies may not even be provided or developed by the regulated industry or existing firms. Second, the development of new technologies that are able to meet the environmental challenge means that any risk-cost tradeoff calculations made on the basis of existing technologies will not be accurate.[18] In fact, new technology can deliver the win-win situation of having greater risk reduction at less cost.[19] Third, based on the level of environmental protection sought, it should be possible to design regulatory initiatives to encourage technology diffusion or incremental, radical, or disruptive innovation, as necessary, to meet the policy goals.

The basic process on how to go about designing innovation-oriented regulations was set out in Ashford et al (1985, p. 429). Very simply, the policy maker must answer three questions. (1)

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[13] This point is particularly important, and has its roots in Schumpeter (1939). Note, however, that incremental innovation is believed to be responsible for approximately half of the technological and productivity advances and half the economic benefits from new technologies (Christensen, 2000, p. 64; Utterback, 1996, pp. 134, 217). Small improvements in eco-efficiency would be an example of incremental innovation in the environmental arena.

[14] New entrants can refer to new firms, firms who exploit new areas of business, or spin offs/outs from established firms. For additional reading on who delivers disruptive innovation, see Foster (1986, especially p. 116); Porter (1990, especially p. 133); Utterback (1996, especially pp. 51, 164, 203-209); Ashford (2002b), and Christensen (2000).

[15] For additional explanation, see Christensen (2000, pp. xx, 34-36, 90, 151, 219); Utterback (1996, pp. 161-162, 194-195). For techniques on identifying disruptive innovations, see Utterback (1996, pp. 52, 135); Christensen (2000, pp. 236-244). For what incumbents should try to do in the face of a disruptive innovation, see Christensen (2000, pp. 113-114).

[16] Sustaining innovations are also usually successfully developed by incumbent firms.

[17] Anderson and Tushman (1990) have made a similar characterization using the terms "competence enhancing" and "competence destroying".

[18] Compliance costs are often uncertain or unreliable for the old technology as well. It is difficult for policy makers to verify the accuracy of cost estimates provided by industry, and industry has an incentive to inflate those costs. In addition, estimates often fail to account for economies of scale and learning curves. See Ashford (1985) and Ashford (2000).

[19] For an explanation of how this can be so, see Ashford (2000).

What technological response is desirable? Should a regulation encourage product or process change, diffusion or innovation? (2) Which actors are likely to innovate? (3) What kinds of regulations and/or incentives are likely to elicit the desired response? Obviously, different answers to these three questions will push the policy maker to choose different types of regulatory initiatives.[20]

The stringency of the regulation is often a determining factor when choosing the desired technological response. A regulation is stringent if it requires a significant reduction in emissions, compliance is very costly with current technology, or if compliance requires a technological change (Ashford, 1985, p. 426). Note that technological change may be necessary to meet either of the first two criteria. In any case, the question is whether technological change is necessary, that is, whether the regulation will induce an innovative response.[21] Indeed, regulations that are not stringent enough may actually inhibit innovation because it would be possible to comply with existing technology. In the US, where regulation has generally set firm targets while leaving flexibility in how they can be achieved, regulation has spurred some innovation when it was stringent and thoughtfully designed (Ashford, 2002). In contrast, European regulations are developed in a less confrontational way than in the US, and are therefore less innovation-inducing (Gouldson and Murphy, 1998; Wallace, 1995). European authors have concluded that stringent regulation is essential to bring about significant technological changes (Gouldson and Murphy, 1998).

Stringent, that is, innovation inducing, regulation is likely to draw substantial criticism from industrial actors. It will be claimed that the costs of meeting the regulation are too high or it is not technologically possible to do so. And this is precisely the point—it may not be possible to do so with current technology, hence the regulation is innovation inducing. There are plenty of examples where costs were substantially lower than predicted and initial claims about impossibility proved wrong.[22]

Here is where the conflict with the newer trends in regulation outlined above enters in. If industry is invited to the table through stakeholder dialog or cooperative governance, for example, they will attempt to guide the regulations toward what they perceive to be their best interest; that is, away from stringent requirements with their assumed high cost and, worse, their potential to encourage the development of new technologies which those actors sitting at the negotiating table will probably not be able to provide. Thus, the inclination to be inclusive when designing regulatory initiatives can in fact prevent the very innovation that is desired.[23]

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[20] For an application of a similar technique called dynamic-incentives analysis, see Mazzanti and Zoboli (2001).
[21] Note that all firms need not innovate in response. What is important is that a few do so; the technology can diffuse to other actors later. See Ashford (2000, p. 85).
[22] See Ashford (1985, especially pp. 431, 463), OTA (1995, especially pp. 73-75), and Ashford (2000).
[23] For more on regulatory capture by industry, see Stigler (1971), Caldart and Ashford (1999) and Coglianese (1997). Note also that a credible threat of a stringent regulation in the absence of a negotiated agreement may encourage those at the table to negotiate in good faith. Similarly, discussion about the means by which targets can by reached is less likely to corrupt a regulatory initiative, provided the targets themselves have been independently set (see Wallace, 1995). In contradiction, the electronics industry has specifically claimed that "regulatory standards are best defined by the industry in industry-consensus standard-setting processes" (AEA et al, 2001, p. 4).

Using innovation to help deliver environmental improvements thus highlights two complementary problems. One is that including industry stakeholders in the regulatory agenda and goal setting process is likely to result in the development of targets that are not stringent, and therefore not innovation inducing, and therefore possibly not capable of achieving the desired policy goals. The second, broader implication is that whether or not industry influences the regulatory process, leading firms and current technologies are not likely to deliver the next generation of environmentally beneficial technologies or results.

This latter point is in particular contrast to two of the current approaches to environmental regulation, embodied in the ideas of reflexive law and ecological modernization.[24] Both of these approaches assume that firms or industries that are currently causing environmental problems can rehabilitate themselves and become green or sustainable.[25] Yet this clearly flies in the face of innovation literature, because in order to make this transformation these firms would have to create and sustain disruptive innovations. Even if they had the willingness and the opportunity to do so, they would almost certainly not have the capacity.[26]

1.4 Innovation and policies to manage electronics waste

Having now made a case that innovation theory can generally guide and inform the making of environmental regulations, we now turn to whether those same theories could or should be applied to the specific example of electronics waste.[27] This question is particularly timely, since the US and the EU both have such initiatives under development.

Fortunately, some guidance on selecting policies to encourage diffusion or innovation is available (Ashford, 2000, p. 99; Ashford 2002), as shown in Figure 1.

Figure 1 Conditions favoring regulatory strategies for innovation and diffusion

Innovation	Diffusion
Large residual risks even after diffusion and/or high costs of diffusion	Distance from the efficient frontier* (opportunities for significant and adequate risk reduction)
Innovative history/innovative potential or opportunity for new entrant	Non-innovative history; "essential" industry/product line
Multimedia response desired	Single medium response adequate
Multihazard industry	Single hazard problem
Flexible management culture	Rigid management culture

*defined by the most cost-effective methods of risk reduction

[24] For more on these concepts, see Teubner (1983) and Mol (1995), respectively.
[25] The methods that can be used to do this supposedly include environmental management systems, application of life cycle analysis, and other techniques that were highlighted earlier (also see Ashford, 2002).
[26] For additional detail on willingness, opportunity, and capacity, see Ashford (2000) and Ashford (2002).
[27] Innovation is most frequently undertaken by private, profit seeking actors. This means that innovative activity will probably not be directed toward activities that are not valued in markets, such as the reduction of waste. The role that innovation can play in delivering a broad range of benefits, including environmental benefits, has already been recognized by governments (see EC, 1995; EC, 2000a).

Certainly some segments of the EEE market stand out as particularly eligible for policies encouraging innovation. IT, telecommunications, and consumer electronics are some obvious examples of market segments with an innovative history, multiple hazards associated with production and final disposal, and a flexible management culture.[28] EEE production facilities would also certainly have multimedia impacts. Even a cursory examination indicates that regulatory strategies encouraging innovation may be appropriate for the EEE industry.

In addition, the concerns highlighted at the beginning of this chapter, including new risks, lower thresholds for health effects to be observed, and increased uncertainty of environmental impacts encourage decisive action to be taken sooner rather than later. One need only consider the Superfund sites that are related to EEE industries[29] and the difficulties already being experienced in disposing with WEEE to see that the time for policies targeted at WEEE has arrived. Actions underway by the US and EU confirm this view.

Keeping in mind this brief overview of innovation theory and how it might be applied to environment regulation, let us now look at the proposed policies to manage WEEE in the US and the EU. Chapter Two summarizes and analyzes US policy and Chapter Three does the same for EU policy. Recommendations for improvement are offered for each. Chapter Four discusses potential problems EU policy may have in overcoming a challenge in the World Trade Organization. Chapter Five offers some preliminary thoughts on a very early additional WEEE initiative being circulated in the EU, and Chapter Six concludes with some final observations and policy recommendations.

[28] Knoth et al (2001) confirm the ability of the EEE sector to innovate. WRI (1998, p. 16) cites the example of the computer industry in the US deriving over 3/4^{ths} of its revenue from products that had been on the market for less than two years (for a chemical company, the figure would be less than 25%). The innovative capacity of Silicon Valley EEE firms has been the topic of considerable research. See also Christensen (2000) and CGCAP (2002).

[29] Santa Clara County California, i.e., Silicon Valley, has the highest number of Superfund sites of any county in the US, with 80% of them related to the electronics industry (WRI, 1998, p. 22; see also CGCAP, 2002, p. 11). For information, see http://www.scorecard.org.

2 US Policy

2.1 Background

Over the last few years in the United States, WEEE has been the subject of increased public discussion and policy attention. Reports such as "Exporting Harm" from the Silicon Valley Toxics Coalition (SVTC and BAN, 2002) have raised the public's awareness of the issues surrounding WEEE and focused media attention on the topic. Some states have begun to ban WEEE from landfills. Policy makers are particularly interested in WEEE because it is a growing waste stream and contains both hazardous and valuable material. US policy makers are also closely following developments in the EU with the draft of the WEEE directive. Electronics waste in the US has been referred to as "a new environmental challenge" (EPA, 2002a, p. 40509).

Though at present WEEE is only 1% of the Municipal Solid Waste (MSW) stream (EPA, 2001), it is a waste stream that is quickly growing. Even at 1% of MSW, the amount of WEEE generated in 1999 would be equivalent to 2.3 million tons.[30] Note that while EPA documents refer to generally to WEEE, they are often actually only referring to computers.[31]

Approximately 57 million computers and TVs are sold each year to businesses and households in US (EPA, 2002a, p. 40509). Around 20 million personal computers became obsolete in 1998 (NSC, 1999, p. 28), and most of them are believed to still be in storage (EPA, 2002).[32] Of those computers that were disposed of, a small portion were recycled[33] and most were landfilled.[34] It

[30] EPA (1999c) states that 230 million tons of MSW were generated in 1999. The SVTC claims that WEEE is 2-5% of MSW (SVTC, 2001a; SVTC and BAN, 2002), which would put the amount of WEEE generated in 1999 at 4.6-11.5 million tons. SVTC (2001a) estimates 5-7 million tons of EEE become obsolete every year, and this figure only includes computers, televisions, stereos, cell phones, and electronic appliances and toys.

[31] Computer CPUs, monitors, and peripherals (mainly printers); TVs; and telecommunications routers and switches were studied in the NSC Baseline Report (1999), which forms the basis for much of the data used by the EPA (and others). The percentage of WEEE comprising MSW waste therefore depends on what is included in the definition of WEEE; the EPA definition, even if based on NSC (1999), is actually quite narrow.

[32] If the 20 million computers that became obsolete in 1998 were all disposed of, that would generate 300,000 tons of waste (conversion from NSC, 1999, p. 15). The EPA (2002a) estimates that, on average, each household has 2-3 TVs or computers in storage and that more are stored by businesses; SVTC (2001a) cites a figure that 75% of all computers sold in the US are in storage. With computers and TVs combined, the EPA estimates 20-24 million units are added to storage each year (EPA, 2002a, p. 40509). If a computer has been in storage for one year, it is generally assumed to be at the end of its useful life (NSC, 1999, p. 14).

[33] The NSC states that 11% of Personal Computer (PC) Central Processing Units (CPUs) that became obsolete in 1998 were recycled. If the CPUs that were refurbished and resold or donated by third party organizations are included, the figure increases to 14%. If recycling is calculated as the number of PC CPU units recycled vs. the number of units shipped in 1998, the recycling rate is 6%. (NSC, 1999, p. viii) It appears that the NSC includes refurbishment, reuse, and recycling in the statistics just cited. These figures have been quoted widely in EPA and other literature, sometimes inaccurately. Using the amount of WEEE recycled in 1998 according to the NSC (1999) and the amount of WEEE generated in 1999 (2.3 million tons), the recycling rate is around 6%. SVTC and BAN (2002) claim only 3% of computers were reused in 1998; SVTC (2001a) says that 2-3% of the waste described in that publication (see footnote 30) was recycled. EPA (2002a) states that only around 1% of household Cathode Ray Tubes (CRTs) are recycled (this would include TVs and computer monitors) (p. 50510). In any case, the EPA (2002a) claims that "many" used computers are resold or donated for reuse, which would presumably mean they would be considered as reused or recycled, yet this seems quite at odds with the low percentages just described. In

is estimated that the number of computers that will become obsolete between 2001 and 2004 is around 240 million (NSC, 1999, p. 39).[35] The current lifetime of a computer is around 3-4 years, and is decreasing (NSC, 1999, p. 13).[36] Shorter life spans for EEE and the introduction of new EEE devices will only increase the amount of WEEE as time passes.

Hazardous materials such as lead, mercury, cadmium, and hexavalent chromium are contained in WEEE. CRTs in computers and TVs contain 4 pounds of lead on average[37] (EPA, 2002a, p. 40509), which is enough to usually be classified as hazardous waste based on the toxicity characteristic leaching procedure (TCLP) test.[38] Mercury from electronics has been cited as the leading sources of mercury in municipal waste (EPA, 2001) and some experts believe that WEEE is the largest remaining contributor of heavy metals generally to the solid waste stream (EPA, 2000). Brominated flame retardants, which are often applied the plastics used in EEE, are also of concern.

EEE is made with valuable resources and requires substantial energy inputs to manufacture. Many products contain parts that could be "profitably refurbished and reused with little effort" (EPA, 2000, p.2) and in 1998, over 112 million pounds (56,000 tons) of material were recovered from electronics, including glass, steel, plastic, and precious metals (NSC, 1999). Simply discarding WEEE means these resources are lost and additional pollution is generated in finding virgin materials and manufacturing new products (EPA, 2000).[39] Reuse and recycling of raw materials conserves natural resources, and avoids air and water pollution and greenhouse gas emissions (EPA, 2001). "Reusing and recycling these materials saves valuable natural resources and avoids their disposal in landfills and incinerators" (EPA, 2002a, p. 40509).

The EPA has recently proposed a new rule regarding WEEE, specifically CRTs and mercury containing equipment (EPA, 2002a). In additional to the rationales outlined above, the EPA thought action was necessary because some organizations that recycle or dispose of CRTs might be "confused" about whether hazardous waste rules apply to computer or television monitors

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contrast to recycling statistics for WEEE, 70% of major appliances were recycled in 1998, when calculated as units recycled over units shipped that year (NSC, 1999, p. viii). The overall recycle rate for MSW is 28% (EPA, 1999c).

[34] In the case of households, "most" CRTs (computers and TVs) go to landfills (EPA, 2002a, p. 41510). The EPA estimates that in 1997, 3.2 million tons of electronics waste went to landfills (SVTC and BAN, 2002). Note that this is more than the estimated 1% of MSW in 1999 (2.3 million tons). Though "take back programs have been available for some time to major corporations and large purchasers of electronic equipment" (EPA, 2002a, p. 50510), it isn't certain exactly how WEEE from these sources is handled.

[35] The NSC estimates over 60 million PC CPUs (and over 24 million CRT monitors) will become obsolete each year starting in 2002 (NSC, 1999, p. 39). A similar estimate from the ENS (2002) put the number at 250 million computers over the next five years.

[36] The initial lifespan of a desktop PC with a Pentium II processor was said to be 2-3 years. Assuming the computer goes on to second user, the total lifespan can be up to 4 years. Earlier desktop systems were assumed to have total lifespans of up to 6 years, while the lifespan for notebooks is 2-3 years for the initial user and up to 4 years in total (NSC, 1999, p. 13). Lifespans can change with the development of new technologies or changes in economic conditions.

[37] Though it can be as much as 8 pounds (ENS, 2002).

[38] The average concentration of lead in leachate from colored CRT glass through the EPA TCLP test is 22.2 mg/l, well above the 5 mg/l required to classify a material as hazardous waste. CRT glass may also contain mercury, cadmium, and arsenic, at very low concentrations. (EPA, 2002a)

[39] For example, consumption of plastic resins by EEE industries in the US in 1995 and 1996 was around 3 billion pounds (1.5 million tons) per year (NSC, 1999, p. 10; APC, 2000, p. 10).

(EPA, 2002, p. 1). The EPA would also like to see the nascent TV and computer glass recycling industry grow. The salient details of the proposed rule are outlined below.

2.2 Overview of proposed rule[40]

The purpose of proposed rule is to "encourage greater reuse, recycling, and better management of this growing waste stream, while maintaining necessary environmental protection" (p. 40509). Though the introduction to the rule refers to electronics waste generally, the substance of the rules bears on Cathode Ray Tubes (CRTs) and Mercury-Containing Equipment (MCE) only.

2.2.1 Cathode ray tubes

CRTs are "vacuum tubes, made primarily of glass, which constitute the video display components of televisions and computer monitors" (p. 40509). Most of the text refers to computers and TVs, but CRTs from other sources (medical, automotive, appliance) are also covered by the proposed rule.

All parties who dispose of CRTs are not equally affected by the proposed rule. By law, households that dispose of CRTs are exempt from hazardous waste regulations. Non-residential generators of hazardous waste who generate less than 100 kg per month (referred to as conditionally exempt small generators) are not subject to most hazardous waste regulations. Generators of 100-1000 kg per month are subject to the Resource Conservation and Recovery Act (RCRA) subtitle C standards, but are allowed to comply with certain reduced regulatory requirements. Facilities that generate more than 1000 kg per month of hazardous waste must comply will all regulations in the Code of Federal Regulations (40 CFR 262.34).

With the proposed rule, the EPA would amend the regulations such that CRTs would not be considered waste under the following conditions:

- a user is sending a CRT to a reseller for potential reuse
- used CRTs are undergoing repairs before resale or distribution
- unused CRTs are being sent for reclamation
- used CRTs are being recycled, if they are managed under certain conditions.

In short, used CRTs from any source that are sent for reuse, including after minor repairs, are not considered waste. If a non-household entity sends used or unused CRTs directly to a landfill or incinerator for disposal, that entity is a generator of waste.

There are also a number of WEEE related rules that are already in effect (p. 40512). For example, whole circuit boards and shredded circuit boards being sent for reclamation are not solid waste[41], and nor are whole used circuit boards that contain minor battery or mercury switch components, provided they are being sent for continued use, reuse, or recovery.

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[40] This summary is based on the proposed rule (EPA, 2002a), and page citations refer to this document, unless indicated otherwise.

[41] Assuming they are stored in containers that prevent any release to the environment prior to recovery and that they are free of mercury switches, mercury relays, nickel-cadmium batteries, and lithium batteries.

The changes in waste regulations that were thought to be a barrier to the recycling of CRTs are meant to provide the following benefits (p. 40512):

(1) less lead sent to landfills and combustors
(2) added resource value of specialty glass and lead
(3) lower waste management costs
(4) less regulatory uncertainty about CRT recovery and recycling
(5) less use of raw lead in CRT glass manufacturing
(6) better melting characteristics, improved heat transfer, and lower energy consumption in CRT glass manufacturing furnaces
(7) improved CRT glass quality
(8) lower emissions of lead from CRT glass manufacturing.

The bulk of the EPA proposed rule is directed at used CRTs going for recycling. Intact CRTs[42], whether used or unused, are not solid waste unless they are disposed of. Used, broken CRTs sent for recycling are not solid waste if they meet certain storage, labeling, and transportation conditions, and if they are not speculatively accumulated (see p. 40513). Used, broken, imported CRTs being sent for recycling would have to follow the same rules, and, used, broken, CRTs being exported would not be subject to hazardous waste export requirements, assuming they met the same conditions.

Used CRTs undergoing glass processing would also not be wastes, if handled as indicated (on p. 40513), and with a few more additional requirements during processing (particularly that temperatures are not high enough to volatilize lead). The processed glass from used CRTs would also not be a solid waste, if it is being sent for recycling to a CRT glass manufacturer or a lead smelter, provided it has not been speculatively accumulated and is not used in a manner constituting disposal. Processed glass from used CRTs sent for recycling to other facilities is not a solid waste if it is packaged and labeled in accordance with 40 CFR 261.39(a) and there has not been any speculative accumulation. If processed glass is sent for any kind of recycling that involves land placement, it is subject to 40 CFR 266 subpart C, governing recyclable materials used in a manner constituting disposal.

In summary, for those entities for which the proposed rule would apply, used CRTs that are being sent for reuse would not be considered waste. Intact CRTs are not waste unless they are being disposed of. Used, broken, CRTs sent for recycling are not waste, and nor would the processed glass resulting from CRT recycling operations be considered waste, provided it is being sent for recycling.

2.2.2 Mercury containing equipment

MCE includes a wide variety of meters, gauges, and switches.[43] Most MCE contains a few grams of mercury, though some has more. Broadly speaking, the proposed EPA rule would

[42] Intact CRT means a CRT remaining in the monitor with a vacuum that has not been released.
[43] EPA 2002a does not precisely define MCE. In several places examples of MCE are given, and they include items such as thermometers, manometers, barometers, hagenmeters, relay switches, mercury wetted switches, mercury regulators, meters, temperature gauges, pressure relief gauges, water treatment pressure gauges, sprinkler system

categorize MCE as universal waste. The EPA believes this will facilitate the collection of MCE and reduce the amount of mercury entering municipal landfills and incinerators. Approximately 3000 lbs of MCE are generated each year by businesses (p. 40517).[44] Households and small quantity generators would not be affected by the proposed rule.

Wastes are eligible for a designation as universal waste if they are hazardous, generated by a wide variety of establishments, not exclusive to a particular industry, generated by a large number of generators, and generated in small quantities. MCE meets each of these criteria. Universal waste handlers must mark MCE clearly and handle it accordance with universal waste management standards. Most of the existing universal waste requirements (40 CFR 273) for small and large quantity handlers would also apply to handlers of MCE. These requirements cover waste management standards, accumulation, transport, packaging, labeling and marking, accumulation time limits, employee training, response to releases, off-site shipments, and exports. Large quantity handlers have additional notification and tracking requirements.

Designating MCE as universal waste means that facilities generating MCE must not follow hazardous waste guidelines, including all the necessary paperwork, which makes it easier for them to transport MCE to central locations, and therefore for it to be recycled or properly disposed of.

2.3 Costs and benefits

The EPA estimated the number of CRTs affected by the proposed rule and the costs associated with the new rule. 16,100 tons of CRTs are currently subject to regulations, and this is projected to increase to 17,500 tons under the proposed rule, with the additional CRTs being diverted from export or landfill and instead recycled. The new rules are projected to save CRT handlers $3.5 million per year due to reduced administrative, transportation, and disposal/management costs, with average savings per company of $755 for small quantity generators and $1740 for large quantity generators.

A similar exercise was conducted for the proposed MCE regulations. Approximately 550 tons of MCE would be affected by the rule,[45] and total cost savings of $273,000 per year would accrue, primarily (nearly 75%) to generators and the remainder to reporters and waste brokers.

The benefits of the proposed rule include "conservation of landfill capacity, increase in resource efficiency, growth of a recycling infrastructure for CRTs and possible reduction of lead emissions to the environment from CRT recycling" (p. 40522). The EPA estimates that 2600 tons of CRTs per year would no longer be landfilled under the proposed rule, saving 456,000 cubic feet of landfill capacity. The use of processed CRT glass brings several benefits to glass

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contacts, power plant water treatment gauges, and variable force counterweight wheels used in coal conveyor systems (pp. 40516-7). EPA (2002c, p. 3) has a bit more precision about the various types of MCE, including how much mercury they typically contain.

[44] This figure seems unbelievably low. EPA (2002c, p. 7) states that facilities generated 550 tons of MCE in 1997, which would appear to be a more reasonable number, given the estimated more than 1800 facilities generating MCE waste.

[45] This is stated on p. 40521, and is much more in keeping with EPA (2002c, p. 7) than with the claim of 3000 lbs on page 40517.

manufacturers, such as improving heat transfer and melting characteristics in furnaces, lowering energy consumption, and maintaining or improving the quality of the final product. The EPA believes the proposed rule will "facilitate the growth and development of the CRT glass processing industry in the United States by reducing regulatory barriers to new glass processing firms becoming established" (p. 40522). The proposed rule should also reduce lead emissions to the environment by diverting CRTs from municipal landfills and waste-to-energy facilities.

2.4 Analysis of proposed rule

The proposed EPA rule has a number of shortcomings, and they start with the definition of terms. Although the rule makes a passing, early reference to "electronics waste" (EPA, 2002a, p. 40509), the text is exclusively focused on CRTs and MCE. Unfortunately, these are only two components of a much larger electronics waste stream. This will be discussed in more detail in Section 2.5.

2.4.1 Unclear MCE definition

The proposed rule is quite clear on what a CRT is, and which CRTs are subject to the rule, but the definition of MCE is entirely missing. All that is provided is a list of examples of MCE equipment. Though most MCE has only a few grams of mercury or less, some items may contain as much as 90 kg of mercury (EPA, 2002c, p. 3). It is not clear from the proposed rule if the list of devices is exhaustive, or if there is any upper or lower limit to how much mercury a particular device may contain and still fall under the proposed universal waste rule. At present, there does not appear to be a reason why any piece of equipment containing up to 90 kg of mercury could not fall under the proposed rule, whether it is electronics waste or not.

2.4.2 Will MCE be recycled

Furthermore, there is little certainty that the MCE will actually be recycled once it has been designated as a universal waste. While the proposed rule makes it easier to collect MCE in centrally located facilities, final disposal and recycling requirements have not been changed (EPA, 2002). It may be overly optimistic to assume that mercury or scrap metal would be recycled from a large collection of centrally stored thermometers, manometers, and pressure relief gauges. The proposed rule itself states that the new rule will make it easier for MCE to be sent "for recycling *or* for proper disposal" (EPA, 2002a, p. 40518, emphasis added). The proposed rule could go a long way toward encouraging the former by building in some recycling requirements or incentives for universal waste handlers who are dealing with MCE.

2.4.3 Claimed benefits

The uncertainty about the benefits of the MCE portion of the rule may be reflected in the fact that all the potential benefits listed in the proposed rule are derived from the CRT portion of the legislation.[46] There is no attempt to outline how much mercury or scrap metal would be diverted

[46] These include (1) conservation of landfill capacity; (2) increase in resource efficiency; (3) growth of a recycling infrastructure for CRTs; and (4) possible reduction of lead emissions to the environment (EPA, 2002a, p. 40522). These also appear in the economic analysis (EPA, 2002b, p. 83).

from landfills, any environmental benefits that might bring, or any benefits that may accrue to those who use recycled mercury or scrap metal in their own manufacturing processes.[47] These oversights make it impossible to truly discern the impacts of the MCE portion of the rule.

There is very little information provided on the environmental impact of the proposed rule.[48] What was the rationale for focusing on CRTs and MCE in the first place? Why are lead and mercury the priorities when dealing with electronics waste?[49] How much lead and mercury are released to the environment from current electronics waste disposal practices?[50] How much of that would be prevented with the proposed rule? What are the environmental, financial, and human health benefits from decreased lead and mercury releases? Are there any additional environmental, financial, or human health impacts that would result from an increase in lead or mercury recycling? Answering questions such as these would highlight more of the positive effects the proposed rule might have.

2.4.4 Unreliable cost data

The only one of the above questions that was even attempted was the financial impact of the proposed rule. The underlying financial calculations are set out in other documents (EPA, 2002b; EPA, 2002c), and only a summary appears in the proposed rule. Given the widespread use of electronics equipment, it isn't surprising that the financial calculations rely on a large number of very uncertain assumptions. Some of the key assumptions are underpinned by very little data, and the economic analysis is very narrowly constrained to the impact on the original users of CRTs and generators of MCE waste. In addition, there is very little attempt to monetize the environmental benefits associated with either rule, or to otherwise explain why those benefits might be significant. It seems hard to believe that the MCE portion of the rule, for example, could be driven by the assumed savings of $273,000 per year (this is only $106 per generator per year on average).[51] Yet there is little in the proposed rule to actively encourage the recycling of MCE materials, which is ostensibly the only other major benefit.

Similarly, the savings from changes in CRT regulation result in a total savings of $3.5 million per year, and while this sounds more reasonable on its face, it is still only $755 and $1740 for

[47] EPA (2002c, p. 28) does contain slightly better coverage of the MCE benefits, which are listed as "(1) increase in regulatory efficiency and improvement in the implementation of the hazardous waste program; (2) establishment of consolidation facilities; (3) increase in recycling by regulated and non-regulated entities; and (3) (sic) reduction in mercury emissions"; yet even here there is no supporting detail on how the recycling will be facilitated, and the reduction in mercury emissions is assumed to be the result of improved recycling.

[48] In fact, EPA (2002d) notes that many of the environmental impacts from CRTs occur during manufacturing and use, yet these two stages of the CRT lifecycle are totally ignored in the proposed rule.

[49] EPA (2002d) states that impacts from both lead and mercury are low relative to impacts from other materials in CRTs.

[50] According to tests done by the Australian government, circuit boards had a higher TCLP lead levels than monitors, yet circuit boards are not covered in the proposed rule, and, indeed, already have some exemptions from hazardous waste regulations. (In the Australian test, circuit boards tested at 142 to 1,325 mg/L compared to 22.2 mg/L for colored CRT glass found by the EPA and the 5 mg/L for classification as a hazardous waste in the US.) See Commonwealth of Australia (1999, p. 13).

[51] And even these are probably overstated (EPA, 2002c, p. 24). But this is because the existing economic analysis is tightly constrained and only looks at the costs/savings for the original generators of MCE waste; it does not consider the effects on other market players, nor does it monetize or elaborate on the environmental benefits. Including these other factors could change the stated economic impact of the proposed rule.

small quantity generators and large quantity generators, on average, respectively.[52] Yet again, there is no requirement that, for example, CRT glass manufacturers use at least a certain portion of recycled CRT glass in their manufacturing. In both the MCE and the CRT cases, the stated cost savings are relatively small, the environmental benefits (though perhaps real) are not well articulated, and it is presumed the recycling industries will naturally appear, even though no additional requirements or encouragement are in place to facilitate the development of that industry. This latter point is particularly surprising, since industrial development figures so prominently in the rhetoric surrounding the proposed rule.

2.4.5 No increase in collection

The proposed rule does not change the requirements or incentives for households or other parties exempt from current waste regulations.[53] The US Census (2001) indicates that 54 million American households own at least one computer. The EPA estimates the total number of computers in use by original users in the US is around 55.5 million (where original users do not include entities that are exempt from hazardous waste regulations, such as households) (EPA, 2002b, p. 10). Therefore, to a first approximation, only half of the computers in the US are even subject to the proposed rule. In reality, the fraction is even lower after conditionally exempt and small quantity generators are accounted for. At present, 80% of WEEE received by electronics recyclers comes from manufacturers and large corporate users (NSC, 1999, p. 7).[54]

Furthermore, take back programs have been available for some time to major corporations and large purchasers of electronic equipment (EPA, 2002a, p. 50510), and since 1985 the EPA has considered material that is reused by a second party in a fashion similar to its original purpose not to be waste (EPA, 2002a, p. 40511). From a large business' perspective, the proposed rule would do little to change their incentives on whether to use a take back program or not, assuming one is available. There is nothing in the rule to encourage new participants, whether businesses or households, to recycle their electronics waste.[55] It may be a bit easier for recyclers, already in possession of CRTs and CRT glass, to make efficient use of them, but the only way to obtain more of them is to increase collection. Yet this is left to the so-called CRT glass recycling industry, while that industry does not receive any direct policy support.[56]

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[52] The economic savings are also probably overstated (EPA, 2002b, p. 74). Again, however, this assumes the scope of the economic analysis is appropriate. EPA (2002b) does make reference to possible monetary benefits resulting from improved human health due to changes in CRT disposal practices, but the benefits are not quantified or elaborated on.

[53] The NSC (1999, p. 42) states that "individual users and small businesses contribute only a small fraction of the electronic equipment that is recycled", which indicates that there is considerable room for improvement, especially considering the number of units owned by these parties.

[54] For third-party organizations, the figure is 75% (NSC, 1999, p. 7).

[55] For example, households might be encouraged to donate computer equipment if they received a tax break similar to the one large businesses receive for donating such equipment (see EPA, 2000).

[56] The SVTC also warns that additional recycling in the US could translate into increased exports of WEEE.

2.4.6 NGO critiques

A handful of environmental groups have offered other criticisms of the proposed EPA rule.[57] For example, it is possible that local governments may become repositories for discarded equipment, since the recycling infrastructure is not yet in place. This, however, seems unlikely. CRTs would probably either be recycled or disposed of much as they are now, rather than fall into the hands of local governments. This is especially true since the proposed rule does not address the issue of household WEEE directly. Similarly, the MCE would be handled by universal waste handlers, rather than local government. It isn't clear how, in either case, the burden or costs borne by local governments would be substantially greater than it is now. This could change if local recycling companies begin asking for government assistance in setting up additional recycling infrastructure, however.

Environmental groups have also pointed out that the proposed rule does not speak directly to recycling standards or address improper domestic recycling.[58] This, also, is not entirely convincing, because the proposed rule does reference existing regulations from the CFR that would govern how CRTs, CRT glass, and MCE must be handled. Any improper handling would have sanctions attached, as embodied in current law. However, it is true that there are minimal reporting requirements for CRT and MCE recycling and disposal, which will make enforcement and data collection difficult. In addition, though some disposal routes may be legal, that does not mean they are without any environmental impacts.

2.4.7 The problem of exports

The SVTC has been particularly concerned about the export of WEEE overseas for "recycling", and it is on this point that environmental groups may have their most forceful critique of the proposed rule. Used, broken CRTs meeting the packaging, labeling, and accumulation requirements under the proposed rule would not be considered waste, and therefore would not be subject to the hazardous waste export requirements of 40 CFR part 262, subparts E and H. As far as the regulatory paperwork is concerned, it appears the proposed rule would make export of CRTs easier, and, indeed, in the analysis done to support the rule, it is assumed that 13-22% of CRTs would still be exported after the rule went into effect (EPA, 2002b, p. 23).[59] Both the SVTC and the EPA base their analysis on the cost structure imposed by current technologies.

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[57] These are based on a joint press release put out by the SVTC and the GrassRoots Recycling Network. The press release is available at http://www.grrn.org/e-scrap/e-scrap_release_05-30-02.html.

[58] At the moment, there are not any standards for exposure to hazardous substances during disassembly of EEE in the US (CGCAP, 2002, p. 18).

[59] Under current conditions, the EPA estimates exports at 22%. The decrease is assumed to occur because of changed economic incentives resulting from the proposed rule, but it isn't entirely convincing that the behavior of waste handlers will change substantially in light of the relatively small economic impact. The SVTC claims that of the WEEE collected in the western US, 50-80% is exported (see SVTC and BAN, 2002). The NSC (1999) found that the destination of more than 50% of the CRTs collected by recyclers and third party organizations in 1997 and 1998 was unknown, and that it as "likely" that "many" of them were exported (p. 32). To reach the EPA estimate of 22% of CRTs being exported, it is necessary to assume that less than 30% of those CRTs with unknown destinations were exported. This seems improbable, based on the findings of the NSC (1999). If 50% of those CRTs with unknown destinations were exported, nearly 35% of the total number of CRTs would be exported. If 75% of those CRTs with unknown destinations were exported, nearly 50% of the total number of CRTs would be exported. The effect of the proposed rule on exports is not at all certain, given the apparent discrepancy in the EPAs initial

2.4.8 Lack of follow through on prior analysis

The proposed rule on CRTs is based on earlier work done by the Common Sense Initiative's Computers and Electronics Sector Subcommittee (see EPA, 2002a, p. 40512). One of the working groups of the subcommittee was charged with examining how to overcome barriers to pollution prevention, product stewardship, and recycling (EPA, 1999a). While it is true that one of the areas of inquiry for the subcommittee was to analyze the barrier to recycling of CRTs caused by waste regulations (EPA, 2002a, p. 40512), that was only one of several lines of inquiry.[60] There is no reference in the proposed rule to any of the other workstreams, including the work that was done by the subcommittee in analyzing residential collection pilot programs for WEEE, which were "so successful in New York, Massachusetts, and California that their local sponsors have decided to permanently continue the programs" (EPA, 1999b). In fact, Massachusetts and California have since gone on to ban CRTs from landfills entirely.[61]

2.4.9 Summary of analysis and links to innovation

The proposed rule, though well meaning, has a number of built in shortcomings. It is not clear what will be included as MCE under the rule. The environmental and health benefits of the proposed rule are stated only very generally, though they could be substantial, and the financial analysis is very tightly constrained so that it ignores potentially important costs and benefits. There is nothing in the rule, such as a recycled content provision, that will explicitly support the recycling industry the rule claims to be developing. The rule only applies to certain users of CRTs and MCE, and there is very little incentive to increase the collection of WEEE from them or other parties. Finally, the rule only covers a small fraction of the growing EEE waste stream. This latter point will be discussed in more detail in the next section.

In addition, the proposed rule has failed to develop any latent innovative potential. The rule seemingly is underpinned by a cost benefit analysis, but it is essentially unable to quantify the benefits, and the cost calculations fall victim to many of the shortcomings referenced in Chapter 1.[62] Further, it appears that all the requirements for the CRT and MCE portion of the rule can be met without any action on the part of industrial actors, that is, without any need for technological diffusion, to say nothing of innovation. As designed right now, the proposed rule does not contain any requirements, and offers little incentive, for waste generators, handlers, or treatment facilities to change their operations in any meaningful way, let alone adopt or develop new

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assumptions from the data collected by the NSC (1999). In June, 2002, China was reported in several major newspapers to be clamping down on WEEE imports, which may make export from the US more difficult.

[60] The Common Sense Initiative was specifically mentioned in Fiorino (1999) as an example of cooperative governance, which may explain its limited impact on the proposed rule.

[61] Many states have legislation that is farther reaching than the EPA proposed rule. See http://www.ncel.net/ewastelist.html for a current overview.

[62] All cost benefit analyses have the trouble of accurately estimating the costs and the benefits. However, the use of this type of analysis either implies 1) that the technologies that will be used are known, from which it follows that a) costs can be determined with some acceptable level of accuracy, and b) an innovative response is not considered necessary; or 2) an innovative response is necessary to reach the policy goals, which case a) costs based on current technologies are inaccurate. Given the language in the proposed rule about its overall aims and claimed benefits, it seems innovation should be necessary, in which case the cost benefit analysis is based on technology that will be obsolete in addition to relying on numerous uncertain assumptions and significant extrapolation.

technology. There is some chance that organizational or institutional innovation may occur in response to changes in the logistics or volume of WEEE collection, but any developments along these lines is fortuitous and not by design. Some suggestions are offered at the end of this chapter on how to design innovation into the regulation in order to actually reach the stated policy goals.

2.5 A more systematic approach for the management of WEEE

As was mentioned above, the EPA proposed rule makes reference to WEEE, but only applies to CRTs and MCE. Other EPA literature focuses almost exclusively on computers as well (see EPA, 2000).[63] However, it is obvious that WEEE includes much more than simply items with CRTs or mercury, or even computers generally. Consider the following information, taken from the American Plastics Council (APC, 2000, p. 4):

Figure 2 Examples of EEE[64]

Residential	Commercial/Industrial	Both
Brown Goods Televisions Audio/stereo equipment VCRs Radios Video cameras Speakers	**Electrical Equipment Materials** High power materials or high voltage materials (e.g. large transformers) Transformers Small electric engines Distribution equipment low voltage switches Low voltage industrial equipment and relays Electrical materials installations (e.g. circuit breakers)	**Data Processing** Personal computers Monitors Small & intermediate systems Mainframes Keyboards
Small Domestic Appliances Vacuum cleaners Hair dryers Coffee makers Electric knives Irons Fryers Food processors Toasters/toaster ovens Fans Microwaves	**Medical Equipment** X-ray equipment Ultrasonic equipment Computer tomographs Oscilloscopes Recording and printing measuring instruments	**Telecommunications** Telephones Facsimilies Answering machines Public telephones Cellular phones Pagers Transmission equipment

[63] NSC (1999) also focuses on personal computers, citing them as the "product of greatest consequence to the level of electronics recycling in the United States" (p. 28). The stated reasons for this are that the number of computers shipped to the US is growing rapidly, and their useful life is decreasing. These statements are both true. However, the proposed EPA rule only addresses one part of a computer system, the CRT, and does little to encourage the reuse or recycling of the remaining components of the system. In addition, the prevalence of notebook computers is increasing, and they are more difficult and expensive to recycle (NSC, 1999, p. 31), and they do not have a CRT at all. In fact, shipments of CRT computer monitors to the US was projected to peak in 2001.

[64] The International Association of Electronics Recyclers also has a similar list of EEE (IAER, 2002a), and both the IAER and APC categories are very much in line with the categories of WEEE cited in the WEEE directive (EC, 2001).

Residential	Commercial/Industrial	Both
Large Domestic Appliances	**Office Equipment**	**Other**
Refrigerators	Copiers	Wire and cable
Freezers	Printers	
Washing machines		
Clothes dryers		
Dishwashers		
Ovens		

The APC, International Association of Electronics Recyclers (IAER), and the European Commission (EC) are converging on a definition of EEE that will look quite similar to the one above. Though the EPA mentions WEEE as a growing problem, the EPA proposed rule only focuses on a very limited number of WEEE items.

It was also mentioned above that the EPA proposed rule does not have any bearing on households or conditionally exempt small generators. However, pilot scale collection programs for WEEE have been underway in the US for some time (leaving aside those being done in Europe), some conducted with EPA funding. The amount of WEEE that could be collected from households and the experience gained from pilot projects should already have provided enough impetus for action on the EPA's part.

2.5.1 Need to target a higher fraction of WEEE

Let us imagine that the EPA proposed rule were extended to households, and that they were required or encouraged to recycle items with CRTs, particularly computers. Even then, in the absence of other incentives, chances are that around 25% by weight of the items collected would be recycled, assuming that the CRT is recycled and the rest of the computer is not.[65] This is shown in Figure 3, detailing the materials found in a typical desktop computer (adapted from SVTC, 2001a, p.10).[66]

[65] If iron and aluminum were also recycled, the total recycling rate would be 59%.
[66] ICER (2000, p. 32) estimates the breakdown of a typical PC as: 30% ferrous metal, 12% non-ferrous metal, 25% glass, 27% plastics, 6% circuit boards (of which 2% is precious metals and 4% waste).

Figure 3 Composition of a typical desktop computer

Component	Content (% of total weight)	Weight of Material (lbs)	Use/Location
Silica	24.8803	15	Glass, solid state devices/CRT, PWB
Plastics	22.9907	13.8	Includes organics, oxides other than silica
Iron	20.4712	12.3	Structural, magnetivity/(steel) housing, CRT, PWB
Aluminum	14.1723	8.5	Structural, conductivity/housing, CRT, PWB, connectors
Copper	6.9287	4.2	Conductivity/CRT, PWB, connectors
Lead	6.2988	3.8	Metal joining, radiation shield/CRT,PWB
Zinc	2.2046	1.32	Battery, phosphor emitter/PWB, CRT
Tin	1.0078	0.6	Metal joining/PWB, CRT
Nickel	0.8503	0.51	Structural, magnetivity/(steel) housing, CRT, PWB
Barium	0.0315	<0.1	Vacuum tube/CRT
Manganese	0.0315	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Silver	0.0189	<0.1	Conductivity/PWB, connectors
Cobalt	0.0157	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Tantalum	0.0157	<0.1	Capacitors/PWB, power supply
Beryllium	0.0157	<0.1	Thermal conductivity/PWB, connectors
Titanium	0.0157	<0.1	Pigment, alloying agent/(aluminum) housing
Antinomy	0.0094	<0.1	Diodes/housing, PWB, CRT
Cadmium	0.0094	<0.1	Battery, blue-green phosphor emitter/housing, PWB, CRT
Bismuth	0.0063	<0.1	Wetting agent in thick film/PWB
Chromium	0.0063	<0.1	Decorative, hardener/(steel) housing
Mercury	0.0022	<0.1	Batteries, switches/housing, PWB
Gold	0.0016	<0.1	Connectivity, conductivity/PWB, connectors
Ruthenium	0.0016	<0.1	Resistive circuit/PWB
Selenium	0.0016	0.00096	Rectifiers/PWB
Indium	0.0016	<0.1	Transistor, rectifiers/PWB
Germanium	0.0016	<0.1	Semiconductor/PWB
Gallium	0.0013	<0.1	Semiconductor/PWB
Arsenic	0.0013	<0.1	Doping agents in transistors/PWB
Palladium	0.0003	<0.1	Connectivity, conductivity/PWB, connectors
Vanadium	0.0002	<0.1	Red phosphor emitter/CRT
Europium	0.0002	<0.1	Phosphor activator/PWB
Niobium	0.0002	<0.1	Welding alloy/housing
Yttrium	0.0002	<0.1	Red phosphor emitter/CRT
Platinum	< 0 (sic)	< 0 (sic)	Thick film conductor/PWB
Rhodium	< 0 (sic)	< 0 (sic)	Thick film conductor/PWB
Terbium	< 0 (sic)	<0 (sic)	Green phosphor activator, dopant/CRT, PWB

Only collecting monitors with CRTs, while encouraging CRT recycling specifically, runs the risk of missing an opportunity to increase the overall recycling rate for WEEE. Not only are CRTs only a quarter of the weight of a computer, they are also only a small fraction of WEEE generally. The NSC (1999) gathered actual data from recyclers on the materials they process from some categories of WEEE (computer CPUs, monitors, and peripherals (mainly printers); TVs; and telecommunications routers and switches). Even with this limited selection of WEEE, CRTs comprise less than 20% of the pounds recycled, and around 15% of the units recycled.[67] (See Figure 4 and Figure 5)

Figure 4 Recycling of computers, telecommunications equipment, and TVs (pounds)

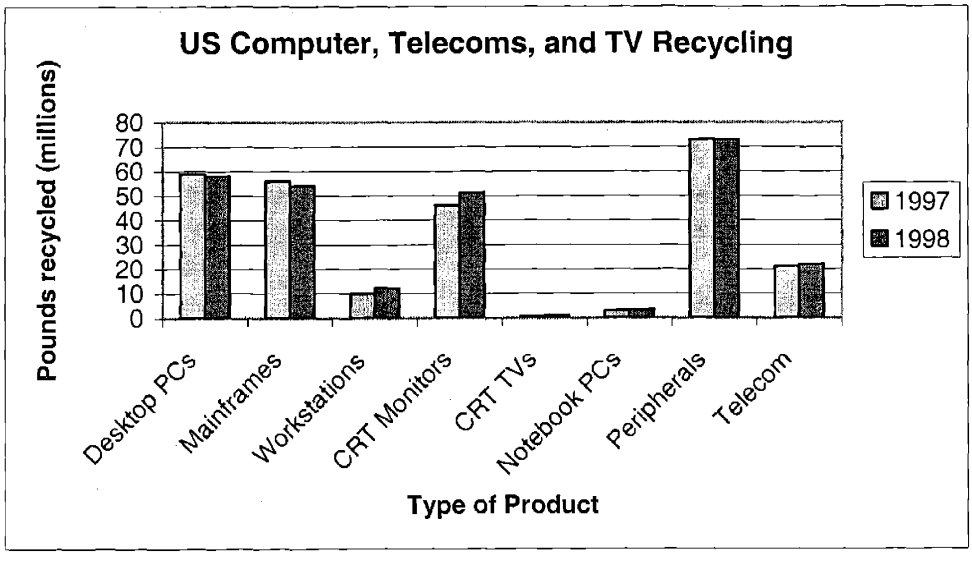
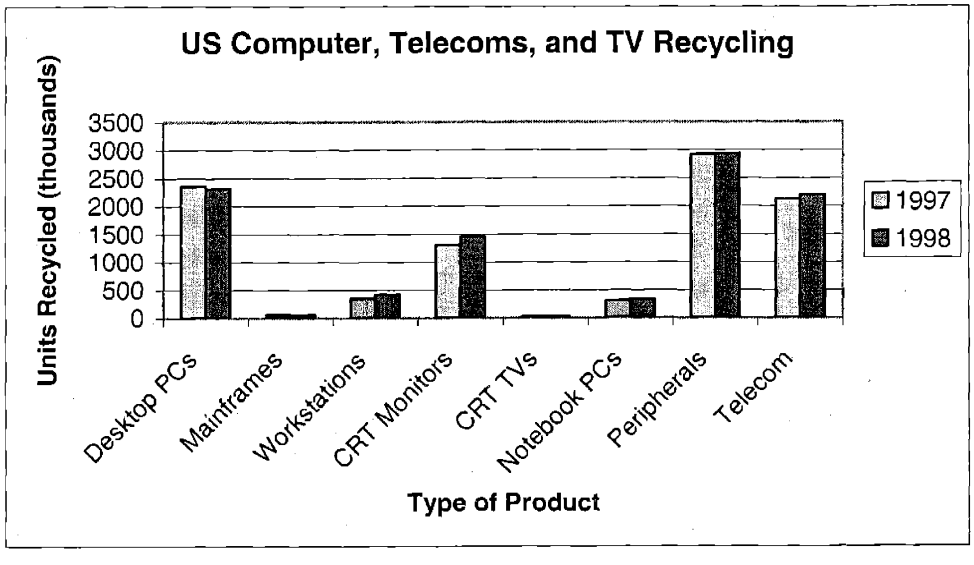


Figure 5 Recycling of computers, telecommunications equipment, and TVs (units)



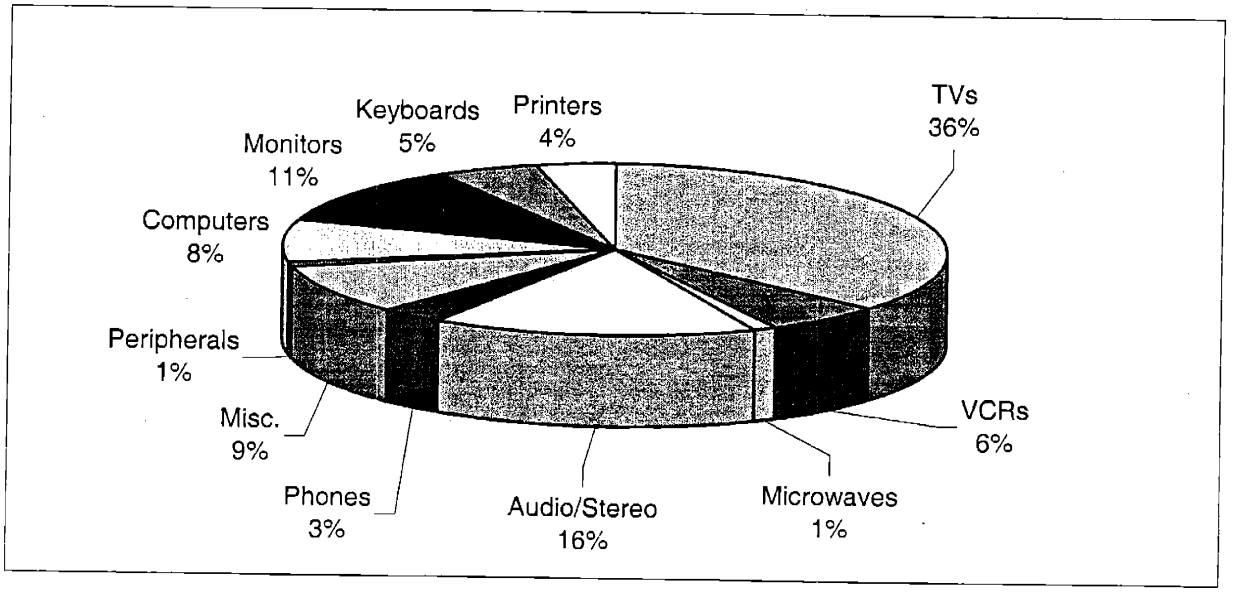
[67] NSC (1999) also notes that around 25% of the CRTs (and a sizable fraction of desktop computers) handled were done so by third parties, as opposed to recyclers.

Thus, in a situation where only computers were collected and the focus of a proposed rule was CRTs, only 25% of the material collected would be recycled. If the categories of WEEE are slightly expanded to include computers, TVs, and telecommunications equipment, the recycled fraction decreases even more. These possibilities are presented only for discussion, but they do highlight that the EPA rule only addresses a small fraction of the WEEE problem. It is essential that any new rules on managing WEEE consider more aspects of the waste stream that simply the CRT.

2.5.2 Experience with household collection programs

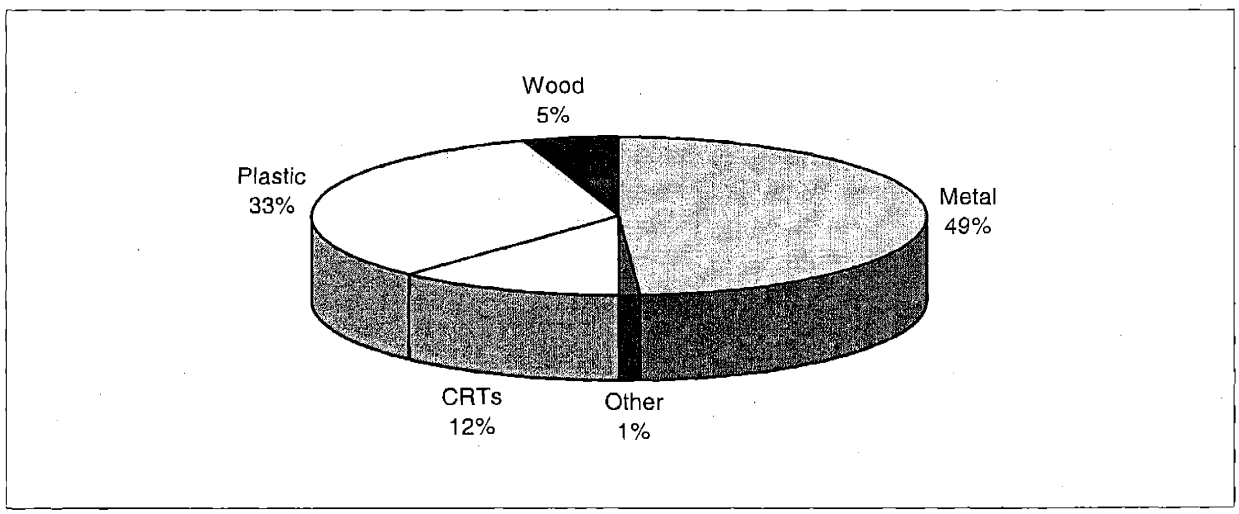
Fortunately, the EPA and others have collected some data on this point. The EPA did an analysis of five residential WEEE collection pilot programs (EPA, 1999), and some of the quantitative data from that analysis are shown below. Figure 6 shows the percentage breakdown of the different items that were collected, using data across all five pilot programs (EPA, 1999, p. 44). Items with CRTs account for less than half of the items collected.[68] Figure 7 shows the material collected by weight, using data across two collection events (APC, 2000, p. 7; based on EPA, 1998), and CRTs are only 12% of the materials collected.

Figure 6 Percentage of items collected in five collection events



[68] Note that these data are not directly comparable to the prior figures because these data are for pilot household collection programs, and the prior figures were based on what material is currently received by recycling companies.

Figure 7 Materials by weight collected from two collection events



Clearly, any initiative targeting CRTs for recycling would need to be complemented by other measures encouraging reuse and recycling of the other materials found in WEEE. This is particularly important if households are included, and it becomes increasingly critical as the definition of WEEE expands beyond computers and TVs.

The question then becomes if a WEEE policy were implemented with recycling as a primary objective, what types of materials would be collected. Fortunately, more detailed data collected from across two residential collection programs (EPA, 1998) is available to answer this question, and is presented in Figure 8 (APC, 2000, p. 8; based on EPA, 1998).[69]

[69] Unfortunately, data showing the ultimate breakdown of materials collected from the five collection events is not present in EPA (1999). EPA (1998) analyzed two collection programs that were later included in the analysis in EPA (1999).

Figure 8 Summary of types and weights of post-consumer residential electronics

Material	Total Weight (in lbs)	Percent of Total Weight
Total Wood	1.545	4.9
Total CRT (mostly glass)	3,842	12.19
Total Plastic	10,424	33.09
Scrap plastic[1]	4,105	13.03
Carcass	3,719	11.8
Clean plastic[2]	2,564	8.23
Phone plastic	7	0.02
Total Metal	15,362	48.76
Metal	8,281	26.28
Motor	1,273	4.04
Wire	874	2.77
Aluminum	441	1.4
Cast aluminum[3]	23	0.07
Copper	562	1.78
Disk drive[4]	440	1.4
Transformers	1,156	3.67
Yokes[5]	429	1.36
Fans	240	0.76
Radiators	1,203	3.82
Freon tanks	441	1.4
Total Other	332	1.05
Refine boards[6]	234	0.74
Power supply	21	0.07
Capacitors	38	0.12
Batteries	4	0.01
Toner	35	0.11
Totals	31,505	100

1. Scrap plastic refers to plastic pieces that are contaminated with paint, connectors, or foam or have two types of plastic molded together.
2. Clean plastic is plastic that is homogenous and free of all contaminants.
3. Cast aluminum is a heavier type of aluminum that is less malleable.
4. A disk drive is a device that computers use to store information. It may be metal or plastic.
5. A yoke is a copper and steel metal assembly at the neck of the CRT.
6. A refine board is a higher grade of board (i.e., mother board, processors) in which the metals have more value

The APC claims these data show that there are "few large, homogenous streams of materials that can be targeted for recycling" (APC, 2000, p. 8).[70] However, if we assume that wood, CRTs, clean plastic, and metal can be reused, recycled, or recovered, then 51% by weight of residential WEEE could easily be diverted from landfill.[71] This is a dramatic improvement over the current situation, and over any rule that would focus primarily on CRTs.

In addition, scrap plastic could become recyclable if the different types were separated and the use of paint, connectors, and foam were minimized. Aluminum, cast aluminum, copper, and refine boards could presumably be recycled as well. This would bring the total recyclability to over 2/3^{rds}, using current technology.[72]

The APC went on to do some more detailed worked on one of the five community collection programs (Hennepin County, MN) to see what plastics could be recycled.[73] Over a two week period the program collected approximately 3000 lbs of plastics, 67% of which was from TVs and 18% from computers.[74]

In the APC analysis, plastic parts were rejected as unacceptable for recycling if they (APC, 2000, p. 12):

1. contained metallized coatings or paint
2. were made of highly density-variable structural foam
3. obviously contained glass filler
4. contained greater than 25 percent metal by weight
5. contained composite plastics, such as printed circuit board materials
6. had 20 percent of its surface covered by labels or lamination that could not easily be removed
7. contained more than three types of plastic.

Using these criteria, only 35% of the incoming plastics were considered suitable for recycling. The APC recognizes that the criteria are strict, because the APC was interested in choosing plastics for use in high end products. Thus, these data should not be interpreted to say that only 35% of the plastics from residential WEEE could be recycled. All this tells us is that 35% of the plastic could be recycled for use in high-end applications under the economic and technological

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[70] The APC is able to reach this opinion even though they also claim there is little data and the data is difficult to interpret (APC, 2000, p. 4). APC (2000) also acknowledges that recycling WEEE from residential waste is more difficult because the infrastructure is less developed, the equipment is older, there is a wider range of items, and quantities are uncertain. The APC study has thus chosen a very difficult test case, and it would almost certainly be easier to recycle WEEE from commercial sources.

[71] DMC, an electronics recycling company based in New Hampshire, claims that over 97% of material from WEEE currently going to landfills is reusable (see DMC, undated). The data from the APC and the statement by DMC both assume current technology.

[72] The EU WEEE directive (EC, 2001) requires 50-80% reuse/recycling and 70-80% recovery by weight of WEEE, depending on product category. (The main difference between reuse/recycling and recovery is that under recovery incineration is allowed.)

[73] A simple and easy way to increase the recyclability of plastics would be to mandate that a certain percentage of the plastic in new EEE be recyclable. Such a requirement may even be able to specify high end or low end uses in the recycled plastics market.

[74] Data on plastics recycling and the secondary markets for plastics materials is largely available only from industry sources, due to a lack of academic research in the area (Boks and Stevels, 2001).

conditions that were prevalent at the time (late 1990s). While use in high-end applications may be preferable, a higher percentage of plastics could be recycled if one were willing to contemplate use in lower value applications.[75] Of course, improved technology could also increase the recycling rate.

Figure 9 shows the reasons why plastic from TVs and computers was considered unsuitable for recycling (APC, 2002, pp. 12-13). What these data indicate is that a few changes could dramatically increase the amount of plastic that could be recycled. For both TVs and computers, elimination of labels/lamination and coatings/paint would increase the acceptance rate by 58-63%. Reducing the number of types of plastics in computers would increase the acceptance rate by an additional 25%.[76]

Figure 9 Reasons why plastics were considered ineligible for recycling

	TVs	Computers
Overall contribution to total amount of plastic	67%	18%
Rejection rate	74%	36%
Rejection for label/lamination	29%	28%
Rejection for coatings/paint	29%	35%
Rejection for multiple factors	37%	
Rejection for some other criteria	4%	
Rejection for more than 3 types of plastic		25%
Rejection for large amounts of metal		10%
Rejection for structural foam		2%

Note that while nearly 75% of the TV plastic is rejected, it still comprises 2/3rds of the final amount of plastic that could be recycled. On the other hand, computer plastic is twice as likely to be accepted, but still only makes up 18% of the final total. This would imply that computer plastic is of higher quality, but present in smaller amounts.

However, this may change. From 1992-1999, the percentage of TVs in residential WEEE in Hennepin County decreased from 71% to 41%. In contrast, computers and monitors went from 6% to 25% over the same time period (APC, 2000, p. 7). If this trend continues, greater amounts of recyclable plastics would be available from residential WEEE collection, even defining recyclable using the APC criteria.

Three types of plastics comprised 95% of the total recovered from the residential WEEE in Hennepin County, as shown in Figure 10 (APC, 2000, p. 13).

[75] Plastics from WEEE recyclers is already being used in low end applications such as lumber, outdoor furniture, and roadbed material (NSC, 1999). The APC (2000) also mentions that one company has the potential to use 6,000 tons per year of recycled WEEE plastic in road material, and another company could use 6,000 tons per year in laminated flooring. Use of higher end plastics in the original EEE would also allow for higher end uses of the recycled material (Boks and Stevels, 2001).

[76] The NSC (1999) also stressed the importance of overcoming the inability to recycle mixed plastics.

Figure 10 Types of plastics found in Hennepin County residential WEEE

Plastic Resin[77]	Television Plastics	Computer Plastics	Miscellaneous Plastics	Percent of Total Sample
HIPS	75%	5%	50%	59%
ABS*	8%	57%	24%	20%
PPO	12%	36%	11%	16%
PP	3%		3%	2%
Other	2%	>1%	2%	2%
PE			6%	1%
PC/ABS		2%		>1%
PC			2%	>1%
PVC			2%	>1%

*This category includes a minor amount of SAN (styrene acrylonitrile).

In their study, the APC showed that it is possible to get 100% pure HIPS from TV plastics (APC, 2000). If the trend discussed above holds, however, the number of TVs will decline and the number of computers will increase, which will decrease the availability of HIPS and increase the percentage of ABS and PPO. Nevertheless, the point remains that only three types of plastic dominate the sample, and a pure stream can already be distilled from one of them.[78]

What the studies reviewed above show is that concentrating on CRTs alone will not be nearly enough to manage WEEE. Fortunately, when collecting WEEE, broadly defined, from households, more than 50% of the material by weight could be recycled with current technology. This could increase with relative ease to over 67%, and it is even possible to recycle some of the material in a closed loop. All this has already occurred in pilot programs that received minimal policy support. Commercial WEEE recycling should be able to achieve equal or higher recycling rates, because the stream of waste is more predictable and generally of higher quality (APC, 2000).

The question now becomes how much is this going to cost. Data from EPA (1999) indicate that the costs of handling household WEEE ranged from $0.10 to $0.50 per pound collected. These figures should be used with caution, as they reflect pilot scale programs that used different data sets and collection methods.[79] In general, net costs were driven by disassembly costs, followed

[77] HIPS High Impact Polystyrene; ABS Acrylonitrile Butadiene Styrene; PPO Polyphenylene Ether/High-Impact Polystyrene blend; PP Polypropylene; PE Polyethylene; PC/ABS Polycarbonate/Acrylonitrile Butadiene Styrene blend; PC Polycarbonate; PVC Polyvinyl Chloride.

[78] Boks and Stevels (2001, p. 520) state that "technology as such is not perceived as an obstacle for end-of-life plastics processing."

[79] The EPA proposed CRT rule could arguably change the economics of these programs as well, but only to the extent that costs are driven by the expenses associated with complying with hazardous waste regulations for CRTs. Cost data from pilot collection programs in Europe falls in the lower half of this range (calculated from EC, 2000).

by transportation and disposal costs.[80] The APC estimated that processing costs to the recycler are $0.23 to $0.52 per pound, depending on the sorting method used (APC, 2000, p. 19).[81] This brings the total cost of collection and recycling to $0.33-$1.02 per pound.[82] Net cost per pound collected and recycled should decrease as programs expand, markets for recovered materials develop, and sorting becomes more efficient (EPA, 1999; APC, 2000).[83] Most of the material that generated revenue was from computers and CPUs. This could be considered a positive finding, as the percentage of material from computers and CPUs will be increasing with time, thus making household collection of WEEE more profitable.

Different collection schemes have different strengths. Curbside collection was more efficient in terms of pounds collected per resident, but less efficient in terms of items collected per dollar of program cost, while one-day collection events were less efficient in terms of lb collected per resident but more efficient in terms of items collected per dollar of program cost. Cost per item collected was lower for one-day collection events than for other methods.[84] (EPA, 1999)

The EPA (1999) claims that the costs of residential WEEE collection programs are still high relative to other disposal methods (presumably landfill or incineration).[85] However, while this may be true on its face, we cannot assume that the cost for each disposal method reflects total social costs. No environmental impacts were analyzed in any of the studies, nor were any avoided or added costs related to those impacts included in the financial calculus.

2.5.3 The WEEE recycling industry

According to the NSC (1999), the WEEE recycling industry in the US is quite concentrated. The top 5 firms handle 50% of the total WEEE (as the NSC defines it), and the top 10 firms process 75% of the total. Overall, 75% of the firms have fewer than 40 employees and 41% have fewer than 10 employees. Around 150,000 tons of WEEE (including parts, circuit boards, and plastic housings) were recycled each year in 1997 and 1998 (NSC, 1999, p. 24), plus an unknown amount that was handled by third parties.

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[80] EPA (1999) uses the term "demanufacturing" instead of "disassembly". Note also that any technological innovation is unlikely to directly affect collection costs, though it could bring down the cost of disassembly and disposal.

[81] Recycling costs in Europe are generally lower than this range (as calculated from EC, 2000). Improved sorting technology could have a significant impact on overall costs.

[82] For the typical 60 pound computer referenced in SVTC (2001a), the cost to collect and recycle the computer would be $20-$61. If the computer costs $600, this would be 3%-10% of the purchase price; if the computer costs $1000, this would be 2%-6% of the purchase price.

[83] In Massachusetts, where there is a ban of CRTs from landfills, the cost of CRT recycling fell by 60% in 2 years, from $0.25/lb to $0.15/lb. Prices have continued to decrease since then. See http://www.state.ma.us/dep/recycle/crt/crtqanda.htm for more information.

[84] Net collection, demanufacturing, and disposal costs for one-day collection events were 3-35 cents per lb and other collection methods cost 7-28 cents per lb. For a more thorough synopsis of the strengths and weaknesses of different collection schemes, see EPA (1999, p. 4).

[85] EPA (1998) cites household collection programs as costing $0.080 to $0.44 per lb, compared to $0.04 per pound for trash and $0.05 per pound for traditional recyclables. The SVTC (2001a, p. 4) claims it costs $10-$30 to recycle a computer and $25-$50 for disposal, though this estimate may not include the costs of collection. Note that the SVTC range of $10-$30 for recycling matches the range calculated using a typical 60 pound computer (SVTC, 2001a) and the recycling cost per pound cited by the APC of $0.23-$0.52 per pound.

The NSC report also gathered data on the raw material outputs from the WEEE recycling industry in 1997 and 1998. Raw material output averaged 50,000 tons per year, with selected materials shown in Figure 11 (NSC, 1999, p. 36). Based on 1998 data, this would translate into $2 million of aluminum, $5.5 million of copper, and $1 million of steel.[86]

Figure 11 Selected raw materials outputs from WEEE recyclers

Material	Tons per Year
Glass	13,700
Steel	7,950
Plastic	5,650
Aluminum	5,050
Copper	1,200
Precious Metals	950

It is interesting to note that the possible demand for recycled plastic from just two companies mentioned in APC (2000, p. 18) is more than the entire annual amount of recycled plastic produced by WEEE recyclers surveyed by the NSC (1999). This could be an indication that a considerable market for recycled plastic already exists, and that the "low-end" applications ignored by the APC are legitimate avenues for recycling.[87] The APC also notes that manufacturers are already making design changes in products to allow for future plastics recovery, and that the commercial sector will probably take the lead in developing innovative recycling technology.

2.6 Policy recommendations

The EPA has stated that its goal is to "promote greater product stewardship of electronics" and that they will work toward this goal in three ways (EPA, 2001, p.3):

1) increase reuse and recycling of used electronics
2) ensure that management of electronics is safe and environmentally sound
3) foster a life-cycle approach to product stewardship, including environmentally conscious design, manufacturing, and toxics reduction for new electronic products.

Unfortunately, the EPA has missed an opportunity in the proposed rule to demonstrate a strong commitment toward these aims.[88] In addition, they have failed to capitalize on the possibility of

[86] For comparison, the proposed CRT rule was projected to deliver $3.5 million in cost savings per year. To think about it another way, the $8.5 million of raw materials could be collected each year (assuming 1998 prices and quantities) if an average of 1.1 lb of WEEE were collected for each citizen of the US. The EU WEEE directive, as currently amended, sets a collection target of 13.2 pounds (6 kg) per person per year.

[87] This discrepancy could also be the result of different data sets or analytical techniques.

[88] The EPA's proposed rule also offers little in terms of reduction or reuse of EEE, even though these waste management techniques are above recycling in the EPA waste management hierarchy (EPA, 1999c). The proposed rule also ignores an entire study done by WRI and funded by the EPA on policy frameworks to stimulate environmental technology in the computer and electronics sector, which recommended, among other things, closing, dematerializing, and detoxifying the product chain (WRI, 1998, p.54).

encouraging innovation in response to the proposed rule. However, based on information already available, and in some cases collected by the EPA, there are several ways forward.

2.6.1 Expand coverage

The EPA cannot continue to ignore WEEE generated from households. This is a substantial portion of the waste stream, and a number of pilot projects to manage residential WEEE have been very successful. Industry coalitions like the Electronics Industry Alliance (EIA) have funded some regional recycling pilot projects and would like to see improvements in the recycling infrastructure. The NSC (1999) and the EPA (1998) also cite the need for a recycling infrastructure for WEEE.[89] The EPA should build on their own success, and the success of others, and expand the scope and scale of such programs. At present, there is nothing to prevent households from landfilling all of their WEEE, and very little that discourages them from doing so. Collection programs should also be better at gathering data on the types of items collected, the materials generated by recycling, environmental impacts, and financial costs. This will allow the programs to be fine tuned and adjusted in the future. WEEE legislation will have to expand its coverage to encompass household WEEE.

The EPA should expand its understanding of WEEE and recognize that it is a waste stream that is much larger than simply CRTs, MCE, or computer equipment. With that in mind, future policies should be designed to be systematic and address the entire waste stream, rather than only a small fraction of it. The EIA characterized the EPA's proposed rule as "an important piece of the multi-faceted solution that is necessary to promote environmentally sound and affordable electronics recycling in the United States" (EIA, 2002), indicating that industry is also aware that the proposed rule is the beginning of a larger solution.

2.6.2 Encouraging innovation

There is also plenty of room in the proposed rule, and any other rules that may follow from it, to encourage innovative responses to the management of WEEE. Given the growing EEE waste stream, its recognized and diverse set of environmental impacts, and the inherent innovativeness of many of the industrial actors responsible for WEEE, this area is a prime target for innovation-oriented environmental regulation.

Let us first look at CRTs and MCE specifically. As currently designed, the proposed rule is unlikely to elicit even technological diffusion in response to its requirements. Contrary to the theory introduced in Chapter 1, the proposed rule is not stringent in any way. In fact, if anything, it makes the handling of CRT and MCE waste easier while not setting any additional requirements.

It is also not entirely clear what the overall goal of the policy is. The EPA's own calculations only show a small increase (less than 10%) in the number of CRTs that would be regulated as a result of the rule being in place.[90] This could indicate that the EPA does not think the problem is

[89] In contrast to WEEE, recycling of postconsumer plastics packaging exceeded 1.6 billion pounds in 1996 (NSC, 1999, p. 9).

[90] Such a small change seems very unlikely to deliver the substantial range of benefits claimed in EPA (2002a).

too severe, but, on the other hand, that conclusion is contradicted by the rhetoric surrounding the rule, the health implications of lead exposure, and actions taken by various US states.

The ability to recycle CRT glass is limited at present (ICER, 2000; MFF, 2001), which indicates that diffusion of current technologies may not be a sound policy aim. Current limits, however, are driven in part due to the costs of transport and disassembly, as opposed to an inherent technological limitation. In Massachusetts, where CRTs are banned from landfills, the cost of CRT recycling fell by 60% in two years, partially due to infrastructure and secondary market development.[91] Though this cost decrease is a positive sign, local infrastructure development policies are difficult to legislate at the federal level. Nevertheless, an outright ban on landfilling CRTs, including CRTs from households, is a good example of a stringent regulation that should result in some innovation.[92] If for some reason the EPA was not comfortable with a national ban on the landfilling of CRTs, the Massachusetts example could provide the credible threat of regulation that could bring parties to negotiate in good faith.

The EPA should consider requiring the use of recycled CRT glass in CRT manufacturing, to give direct policy support to the nascent glass recycling industry it claims to be developing through the proposed rule, and to demonstrate a commitment toward closed loop recycling.[93] The EPA has recognized the importance of finding and developing markets for recycled materials, and it seems clear that this should be an integral part of the legislation (see EPA 1999). This requirement would also encourage innovation on the demand side of the CRT recycling market. If it turns out that lead cannot be replaced in CRT glass, it will be particularly important that the leaded glass has a market application.[94]

The idea that new niche markets can be a springboard for technological change is supported in the innovation literature (Kemp et al, 1998; Christensen, 2000).[95] Indeed, businesses are often finding and exploiting new and/or niche markets in the course of their normal activities. It has been pointed out (Ashford, 2000) that regulations can also create niche markets and hence encourage technological change and innovation. As currently envisioned, however, the new rule is not stringent enough to significantly change the incentives for actors involved, and will therefore not encourage innovation in CRT glass processing or production or in applications for recycled CRT glass.

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[91] See http://www.state.ma.us/dep/recycle/crt/crthome.htm for additional information.

[92] Any national policy along these would also have to ensure that thought is given to the final disposal of likely CRT replacements, such as flat panel displays, and the environmental impacts of any lead replacements in CRTs. It is assumed in this discussion that removal of lead from CRT glass is not possible because of the protection it offers from X-rays, but in principle, policies to reduce or eliminate the lead in CRTs would be possible, if a substitute were available that could also protect against X-rays.

[93] Alternatively, this could also be encouraged by less forceful policy interventions such as tax breaks or by R&D support in researching applications for recycled CRT glass.

[94] Or that the lead and de-leaded CRT glass can be used in other applications. Note that a reading of Utterback (1996, pp. 203-204) would suggest there is a good chance of an innovation in the processing of CRT glass coming from an established actor, because glass is a nonassembled product.

[95] Kemp et al (1998) define strategic niche management as "the creation, development and controlled phase-out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of 1) learning about the desirability of the new technology and 2) enhancing the further development and the rate of application of the new technology" (p. 186).

The MCE portion of the rule suffers from a similar set of problems.[96] While it is laudable to make the recycling of MCE easier, the rule is not structured in a way to make sure such recycling actually occurs. The proposed rule only ensures that destination facilities will probably receive more MCE, but they will most likely continue to handle it in the same way. At a minimum, any reduced handling provisions should be accompanied by specific final disposal requirements. Otherwise, it may simply be that more MCE is disposed of, as opposed to recycled. This would clearly obviate any environmental benefits from the MCE portion of the rule.[97]

If the goal of the rule is to increase the recycling rate for MCE, then this should be explicitly stated and required. If a substantial portion of mercury and metals can be recovered from MCE using current technology, then the rule should require recycling rates in line with the capabilities of that technology and thereby encourage diffusion. If only a small portion of the metals and mercury of the MCE is being recycled currently, then more stringent requirements should be included in the rule to encourage innovation.[98] As with the CRT rule, support for secondary markets may be required to complement a mandatory recycling provision. However, this is less likely because of the market value of metals and mercury.

Even relatively small changes in the proposed rule, such as those just outlined, could have a dramatic effect on the innovative response to the legislation. In addition, a revised rule would be much more likely to deliver on the benefits claimed in EPA (2002a). And even those benefits are narrowly construed within the confines of the CRT and MCE rules.

The proposed rule's limited scope masks the severity of the problem and hence of the innovative response that would truly be desired to address the problems associated with WEEE. The EPA should explicitly encourage, and probably require, the reuse, remanufacturing, recycling, and recovery of other components of WEEE aside from CRTs.[99] Plastics are an important part of WEEE, as are different types of metals. These should not be ignored in future rule making. Even if high recycling rates for CRTs are achieved, that leaves the bulk of WEEE untouched. A more holistic approach is required.

Toward that aim, the EPA could, perhaps in conjunction with the APC and others, assist in developing new technologies that would allow for more efficient recycling of plastics.[100] New approaches are needed for identification, sorting, and final use of recycled products. The EPA could also require, or seek voluntary agreements, that would address the primary obstacles to plastics recycling that were found in the APC study discussed above (coatings, labels, use of

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[96] The definition of MCE should also be more clearly specified in the rule.

[97] The proposed rule (EPA, 2002a) states that it will be less likely that MCE is improperly disposed of in municipal landfills or incinerators under the new rule, but there is not any information to show that this is currently a problem or that it would be fixed under the new legislation.

[98] It may also be that other materials fractions of the MCE should be recycled.

[99] These terms can be broadly defined as follows: Reuse—use by a second party and for the original purpose of whole EEE or its components without significant alteration to the equipment; Remanufacturing—use for the original purpose of whole EEE or its components that requires alteration beyond that which a user can do himself but not so much that the material is reprocessed; Recycling—reprocessing of waste materials for further uses, excluding energy recovery (i.e., incineration); Recovery—reprocessing of waste materials for further uses, including energy recovery.

[100] Plastics are specifically singled out because of the current difficulty in recycling them, though technological development may be necessary for other materials fractions as well. It is assumed here that ferrous and non-ferrous metals can be fairly well recycled using current technologies.

multiple types).[101] The APC has noted that plastics manufacturers are already taking many of these steps; the EPA need only encourage them to continue down the path.

Finding, developing, and perhaps initially supporting markets for recycled materials generated by WEEE management programs should be an integral part of any policy.[102] Note that markets for reusable and remanufactured products should also be supported.[103] Closed loop recycling should be encouraged and recycling standards, in terms of the final product and processing, should protect the environment and workers.[104] Ten WEEE recycling firms are responsible for processing 75% of the material, which makes this stage of the process an easy entry point for policy initiatives.

The US government itself can play a role and lead by example when making choices about purchasing and disposing of its own EEE. The US government is the nation's, and perhaps the world's, largest purchaser of EEE, spending around $5 billion on computers alone in 1996 (US Government MOU, 2001). It has been recognized that the government's size and buying power could be used to encourage "the design of environmentally preferable electronic equipment and the development of a cost-effective national reuse and recycling infrastructure for surplus electronic equipment" which would deliver a broad range of benefits (MOU, 2001).[105] In fact, the purchasing power of the US Government, if harnesses properly, could be a niche market in its own right, in the sense of Kemp et al (1998). Fulfilling the spirit of the MOU would demonstrate the efficacy of environmentally sound purchasing and management of EEE, reward those firms who innovate and reduce the environmental impacts of the EEE they produce, and help to develop the recycling infrastructure mentioned in the proposed rule.

The EPA could do much more in the early stages of EEE product design to prevent or mitigate later environmental problems. Efforts of this kind include designing out hazardous substances, standardization of materials types, use of recycled and recyclable materials, and other actions.[106] The EIA has also recommended these types of efforts and many of them have already been undertaken by private actors (EIA, 1998) in addition to being recognized and verbally encouraged by the EPA (EPA, 2000). Environmental groups such as the SVTC are also supportive of these types of measures. Given the broad support and progress that has been made

[101] The NSC (1999) spends some time in its report discussing the importance of recycling plastics from WEEE.
[102] Efforts to this effect should include incorporating recycled content into new products, and ensuring that the materials used in new products can be recycled at the end of the product's life.
[103] Ideally, WEEE should be used in these markets before it is recycled. Such markets need not be domestic, or even necessarily for profit (if one considers tax breaks associated with donation of EEE). Some initial efforts have occurred here (see EPA, 2000), but more could be done.
[104] SVTC and BAN (2002) cites a number of potential dangers associated with recycling operations that should be considered if recycling efforts are going to expand. At the moment, there are not any standards for exposure to hazardous substances during disassembly of EEE in the US (CGCAP, 2002, p. 18) or Europe (Mark and Lehner, 2000, p. 11).
[105] Government procurement policies could support the market for used or remanufactured computers, in addition to policies for purchasing environmentally preferable new EEE and policies to recycle WEEE.
[106] The EPA's own publication (EPA 2002d) recognizes that most of the environmental impacts from CRTs occur during manufacturing and use.

in these areas, it does not seem unreasonable for the EPA to encourage or require companies to keep up with the state of the art.[107]

Finally, an ongoing dialog is already in place through the National Electronics Product Stewardship Initiative (NEPSI) to begin working out the details of a WEEE recycling infrastructure. NEPSI includes members from industry, government, and NGOs, who have begun to "work toward the establishment of a financing system that will include the costs of managing used electronic products in the overall purchase price of new electronic products" (NEPSI, 2002). Members agreed that national legislation would be necessary and highlighted a number of challenges: how to make the system convenient; whether it can include product design incentives to reduce toxicity and increase recycled content; how to reduce the exports of WEEE; and how the costs and responsibilities for collection, reuse, and recycling will be shared by producers, retailers, consumers, and government.[108]

These are certainly valid areas of inquiry, though there is no indication, yet, that the EPA is thinking of developing any regulatory initiatives along these lines. Note, however, that the NEPSI dialog is working toward a voluntary national agreement, and it is still very unclear how their proposed system would work and what would be done with old EEE already in circulation. In addition, having industry, representing current actors and technologies, at the table early in the process may limit the possibility for regulations that would truly encourage innovation. The NEPSI process would almost certainly be made more robust and timely with a credible threat of comprehensive WEEE legislation from the EPA, should negotiations fail.

The EPA need not design such comprehensive legislation from the ground up. Many of the questions being discussed in the NEPSI process have been on the agenda in Europe for several years, and the European Commission has nearly finalized two directives for the management of WEEE. It is to these directives that we now turn.

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[107] The EIA Compendium of Design for Environment Efforts highlights a number of actions freely undertaken by EIA members that were, perhaps, at the leading edge several years ago. These include: Philips electronics has banned asbestos, cadmium, and mercury in all of its products; Sharp televisions reduced the number of plastics by 50% and the number of parts by 33%; the eight major plastic parts of IBM's 6893 IntelliStation E Pro system unit are made with 100% recycled plastic; and all plastic parts over 100 grams in Apple products are made from the same type of plastic (EIA, 1998). Given agreement on the value of undertaking such efforts and the obvious ability of companies to do so, it is not unrealistic to expect companies today to keep up with the state of the art from 1998.

[108] This approach in the US is indicative of "shared responsibility", as opposed to "extended producer responsibility" in Europe.

3 EU Policy

3.1 Background

The rationale for public policies to reduce WEEE in Europe arises from similar reasons as those cited in the US--the waste stream is rapidly growing; it contains hazardous materials; and, in a slight variation from the US, the environmental impacts from the production of WEEE are considered to be much higher than those arising from other types of MSW.

In 1998, 6 million tonnes (6.6 million tons) of WEEE were generated in the EC, which equates to 4% of municipal solid waste.[109] The growth of WEEE is around three times higher than the growth of typical MSW, or between 3-5% per year. At this rate, the amount of WEEE in MSW will have doubled by 2010 from what it was in 1998. (EC, 2000, p. 4)

The hazardous content of WEEE causes "major environmental problems" and a large proportion of the pollution found in municipal waste comes from WEEE (EC, 2000, p. 4). The EU is particularly concerned about the lead, cadmium, mercury, hexavalent chromium, and brominated flame retardants contained in EEE, in addition to pollution released during incineration of WEEE. For example, the incineration of WEEE contributes significantly to the 36 tonnes of mercury and 16 tonnes of cadmium emitted per year in the European Community, in addition to emissions of dioxins and furans (EC, 2000, p. 7). Disposing of WEEE in landfills is problematic because some of the hazardous substances, such as mercury, PCBs, cadmium, and lead, leach out or evaporate.[110]

Improved recycling of WEEE should have a disproportionately large effect on resource and energy conservation due to comparatively high environmental burden of EEE manufacturing and WEEE disposal.[111] (EC, 2000, p. 4)

The EC determined action was necessary in light of the above considerations and because individual nations or regions in Europe had WEEE management programs in place or had begun drafting legislation on WEEE. In addition, WEEE was specifically mentioned in the Fifth Environmental Action Programme, and regulatory action is viewed as a logical next step following on from other initiatives regarding chemicals, packaging, batteries, and automobiles. A European Directive would both protect the environment and harmonize standards across EU member countries.

The European Union has been deliberating on two pieces of legislation relevant to electronics waste—the WEEE and ROHS (Restriction of the use of certain Hazardous Substances) directives. In general, the main elements of the former are producer responsibility, separate

[109] In the US, the official (and disputed) figures are 2.3 million tons and 1% of municipal solid waste (EPA, 2001), bearing in mind that the EU and US definitions of WEEE differ.

[110] The Danes estimated in 2000 that 40% of all lead and 60% of all copper being dumped or incinerated in Denmark was from WEEE (ENS, 2000). Metals used in EEE account for 50% of the metals found in the waste stream (ICER, 2000, p. 10).

[111] ICER (2000, p. 9) states that the resources contained in the 6 million tonnes of WEEE include: 2.4 million tonnes of ferrous metal; 1.2 million tonnes of non-ferrous metal; 1.2 million tonnes of plastics; 336,000 tones of glass; 12,000 to 27,000 tonnes of lead; and 6-8 tonnes of mercury.

collection of WEEE, improved treatment and reuse/recycling of WEEE, and provision of information to users of EEE. ROHS seeks to reduce the content of hazardous substances in EEE, specifically lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenylethers (PBDEs). Both of these directives will be explained in more detail below.

3.2 Overview of WEEE[112]

The WEEE directive's stated first priority is the prevention of WEEE, and secondly to encourage reuse, recycling, and other forms of recovery.[113] EEE is defined as (Article 3)

> equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields falling under the categories set out in Annex IA and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current.

Specific examples of EEE, as defined in the WEEE directive, are listed in Figure 12 (note the similarity to Figure 2.

Figure 12 Categories and products of EEE, according to the WEEE directive

Consumer equipment	**Lighting equipment**	**Medical devices (with the exception of all implanted and infected products)**
Radio sets	Luminaires for fluorescent lamps with the exception of luminaires in households	Radiotherapy equipment
Television sets	Straight fluorescent lamps	Cardiology
Videocameras	Compact fluorescent lamps	Dialysis
Video recorders	High intensity discharge lamps, including pressure sodium lamps and metal halide lamps	Pulmonary ventilators
Hi-fi recorders	Low pressure sodium lamps	Nuclear medicine
Audio amplifiers	Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs	Laboratory equipment for in-vitro diagnosis
Musical instruments		Analysers
And other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications		Freezers
		Fertilisation tests
		Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability

[112] The information presented here is generally taken from the common position on WEEE (EC, 2001), unless indicated otherwise. The common position is not the final text of the directive.

[113] The following definitions are from EC (2001, Article 3). Prevention: "measures aimed at reducing the quantity and the harmfulness to the environment of WEEE and materials and substances contained therein"; Reuse: "any operation by which WEEE or components thereof are used for the same purpose for which they were conceived, including the continued use of the equipment or components thereof which are returned to collection points, distributors, recyclers or manufacturers"; Recycling: "the reprocessing in a production process of the waste materials for the original purpose or for other purposes, but excluding energy recovery which means the use of combustible waste as a means of generating energy through direct incineration with or without other waste but with recovery of the heat"; Recovery: "any of the applicable operations provided for in Annex IIB to Directive 75/442/EEC".

IT and telecommunications equipment	**Large household appliances**	**Small household appliances**
Centralised data processing: Mainframes, Minicomputers, Printer units	Large cooling appliances	Vacuum cleaners
Personal computing: Personal computers (CPU, mouse, screen and keyboard included), Lap-top computers (CPU, mouse, screen and keyboard included), Note-book computers, Note-pad computers, Printers	Refrigerators	Carpet sweepers
Copying equipment	Freezers	Other appliances for cleaning
Electrical and electronic typewriters	Other large appliances used for refrigeration, conservation and storage of food	Appliances used for sewing, knitting, weaving and other processing for textiles
Pocket and desk calculators	Washing machines	Irons and other appliances for ironing, mangling and other care of clothing
And other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means	Clothes dryers	Toasters
User terminals and systems	Dish washing machines	Fryers
Facsimile	Cooking	Grinders, coffee machines and equipment for opening or sealing containers or packages
Telex	Electric stoves	Electric knives
Telephones	Electric hot plates	Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances
Pay telephones	Microwaves	Clocks, watches and equipment for the purpose of measuring, indicating or registering time
Cordless telephones	Other large appliances used for cooking and other processing of food	Scales
Cellular telephones	Electric heating appliances Electric radiators	
Answering systems	Other large appliances for heating rooms, beds, seating furniture Electric fans	
And other products or equipment for transmitting sound, images or other information by telecommunications	Air conditioner appliances	
	Other fanning, exhaust ventilation and conditioning equipment	
Automatic dispensers	**Toys, leisure and sports equipment**	**Monitoring and control instruments**
Automatic dispensers for hot drinks	Electric trains or car racing sets	Smoke detector
Automatic dispensers for hot or cold bottles or cans	Hand-held video game consoles	Heating regulators
Automatic dispensers for solid products	Video games	Thermostats
Automatic dispensers for money	Computers for biking, diving, running, rowing, etc.	Measuring, weighing or adjusting appliances for household or as laboratory equipment
All appliances which deliver automatically all kind of products	Sports equipment with electric or electronic components	Other monitoring and control instruments used in industrial installations (e.g. in control panels)
	Coin slot machines	

Electrical and electronic tools (with the exception of large-scale stationary industrial tools)

Saws

Sewing machines

Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials

Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses

Tools for welding, soldering or similar use

Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means

Tools for mowing or other gardening activities

The directive applies to all EEE in the above categories from private households, unless the EEE is essential for national security.[114]

The directive sets out collection, recovery, and reuse/recycling targets for the different categories of WEEE, and discusses the financing mechanisms that will fund such efforts. The primary requirements of the directive, in order of implementation date, are as follows.

Within 18 months of the entry into force of the directive, EU member states will have in place the necessary laws, regulations, and administrative provisions to comply with the Directive (Article 15).

Within 30 months of the entry into force of the directive, producers will mark EEE with a symbol[115] indicating that WEEE should not be disposed of with household waste. In addition, users in private households will be given information about WEEE return and collection systems, their role in managing WEEE, and the meaning of the symbol. (Article 9)

Within 30 months of the entry into force of the directive (and from then onwards), producers will provide for the financing of the collection, treatment, recovery, and environmentally sound disposal of WEEE from private households[116] deposited at collection facilities. This may be done collectively or individually.[117] The cost of financing historic waste, i.e., WEEE that was on the market before the directive came into force, will be proportionally provided by all producers existing in the market when waste management costs are incurred.[118] Current producers in the market will also finance the cost of managing WEEE from producers that are no longer present or cannot be identified. This may be done with an arrangement similar to the one for financing historic waste. (Article 7) For WEEE from sources other than private households, users may be made partly or totally responsible for financing (Article 8).

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[114] WEEE from private households is "WEEE which comes from private households and from commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households" (EC, 2001, Article 3).

[115] The symbol is shown in Annex IV of EC, 2001. EP (2002) proposed, and EC (2002) accepted in principle, that the deadline be extended from the 24 months stated in EC (2001) to 30 months.

[116] The following definitions are from EC (2001, Article 3). Treatment: "any activity after the WEEE has been handed over to a facility for depollution, disassembly, shredding, recovery or preparation for disposal and any other operation carried out for the recovery and/or the disposal of the WEEE"; Disposal: "any of the applicable operations provided for in Annex IIA to Directive 75/442/EEC" (EC, 2001, Article 3).

[117] EC (2001, Article 2) allowed member states to exempt small independent manufacturers (less than EUR 2 million turnover and fewer than 10 employees) from financing requirements for up to five years. However, this provision was deleted in EP (2002) and EC (2002). EC (2002) accepted in principle an amendment in EP (2002) saying that financing should be provided on an individual basis through guarantees, unless this would involve disproportionately high costs, in which case, a collective financing scheme can be used after notification to the Commission. EC (2002) also accepted in principle an amendment in EP (2002) that the costs of collection, treatment, and disposal of future WEEE should be internalized within the product price.

[118] EP (2002) proposed, and the EC (2002) accepted in principle, that the costs will be divided by producers in the market "in proportion to their respective share of the market by type of equipment" (EP, 2002, amendment 42). EP (2002) proposed, and the EC (2002) also accepted in principle, that producers may show users, through a visible fee, the cost of collecting, treating, and disposing of historic WEEE. However, the visible fee may only be in place for the average life of the equipment, and in no case longer than 10 years.

Within 30 months of the entry into force of the directive, member states will ensure that final holders and distributors can return WEEE from private households free of charge.[119] When supplying new equipment, distributors (or third parties acting on their behalf) must ensure that similar waste equipment can be returned free of charge. Producers may set up and operate take back systems for their WEEE individually or collectively.[120] For WEEE from other sources (not households), producers, or third parties acting on their behalf, must provide for collection of WEEE. (Article 4)

Within 36 months of the entry into force of the directive, member states must achieve separate collection of WEEE equal to an average of 6 kg per inhabitant per year.[121]

Producers (or third parties acting on their behalf), either individually or collectively, must provide for the treatment of WEEE. At a minimum, this means that fluids must be removed and some WEEE will receive separate treatment.[122] (Article 5)

Producers (or third parties acting on their behalf), either individually or collectively, must provide for the recovery of WEEE, giving priority to the reuse of whole appliances. By December 31st, 2005,[123] the following targets will be in effect (Article 6):[124]

[119] This idea is generally known as a take back provision.
[120] For up to five years, member states may also set up or facilitate alternative free take-back systems.
[121] EC (2001) set the collection target at 4 kg per inhabitant per year. EP (2002) proposed 6kg, and EC (2002) said the 6 kg target was "very ambitious" but was "prepared to accept" it. According to EP (2002) and EC (2002) new targets for the years after 2008 will be set by the end of 2007, and these may be set as a percent of EEE sold to private households in preceding years. Greece and Ireland may apply for extensions of up to 24 months to meet the collection, recovery, and reuse/recycling targets (EC, 2001, Article 15).
[122] The following must be removed from collective WEEE and treated according to Article 4 of Directive 75/442/EEC: polychlorinated biphenyls (PCB) containing capacitors; mercury containing components; batteries; printed circuit boards of mobile phones generally, and of other devices if the surface of the printed circuit board is greater than 10 square centimeters; toner cartridges, liquid and pasty, as well as colour toner; plastic containing brominated flame retardants; asbestos waste; cathode ray tubes; chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC); gas discharge lamps; liquid crystal displays (together with their casing where appropriate) of a surface greater than 100 cm2 and all those back-lighted with gas discharge lamps; external electric cables; components containing refractory ceramic fibers; components containing radioactive substances with the exception of components that are below the exemption thresholds; electrolyte capacitors containing substances of concern.
[123] The deadline in EC (2001) was within 46 months of the entry into force of the Directive, but this was amended in EP (2002) and EC (2002).
[124] Recovery and reuse/recycling targets for whole appliances and for Medical devices (with the exception of all implanted and infected products) will be established in the future by the Commission for the years beyond 2008. Whole appliances do not count toward reaching the stated recovery or reuse/recycling targets.

Figure 13 Recovery and reuse/recycling targets for different categories of WEEE

Category of WEEE	Recovery target (by weight)[125]	Reuse/Recycling target (by weight)
Large household appliances, automatic dispensers[126]	80%	75%
IT and telecommunications equipment, Consumer equipment	75%	65%
Small household appliances, Lighting equipment, Electrical and electronic tools (with the exception of large-scale stationary industrial tools), Toys, leisure and sports equipment, Monitoring and control instruments	70%	50%
Gas discharge lamps[127]		80%

Producers are obligated to provide any information to treatment, reuse, and recycling facilities[128] that is necessary to comply with directive, including the location of dangerous substances in EEE. (Article 10)

To help reach these targets, member states should encourage the development of new recovery, recycling, and treatment technologies.[129] States are also required to give the EC annual reports on the quantities and categories of EEE put on their market, collected, reused, recycled, recovered, and exported[130] (by weight, or, if necessary, by number). (Articles 6 and 11)

There is a provision for effective, proportionate, and dissuasive penalties for breaches of the directive (Article 8).

3.2.1 Costs of WEEE

Extrapolating from a number of pilot projects that have been underway in the EU, the costs for the collection and reuse/recycling of household WEEE are estimated to be EUR 750-1350 million/yr, with commercial equipment costing approximately 20% more.[131] If all the costs were

[125] EP (2002) wanted to increase the targets for nearly all of the categories, but the EC (2002) would not agree to increases in targets unless both recovery and reuse/recycling targets for a product category were simultaneously increased. The EC (2002) argued that increasing only the recovery target might incentivize additional incineration, which may or may not be an environmentally preferable outcome.

[126] In EC (2001) automatic dispensers had a recovery target of 70% and a reuse/recycling target of 50%, but this was amended in EP (2002) and EC (2002).

[127] These are to be separately treated, see footnote 122.

[128] The latter two were added in EP (2002) and EC (2002).

[129] This provision was introduced into Article 6 by EP (2002) and EC (2002).

[130] The requirement to provide data on exports was proposed in EP (2002) and accepted in principle in EC (2002).

[131] EUR 750-1350 assumes 6kg of WEEE per person is collected each year and is based on the cost calculations in EC (2000), assuming a linear increase in costs as collection increases from 4 to 6 kg per person per year (and presumably calculated on the basis of current technology). There would also be expenditures, estimated at EUR 100 million in the first year, for PR, consulting fees, and overhead, but this amount is projected to decrease over time. The APC claims that commercial WEEE is easier to recycle because it generally has a higher value and is a more

passed on to consumers, the average price of EEE would increase 1%, though the increase could be as high as 2-3% for some refrigerators, TVs, and monitors.[132] (EC, 2000, p. 22)

However, these cost estimates are probably inflated because they do not account for economies of scale or disposal costs avoided.[133] The explanatory memorandum to the WEEE directive cites an example to bolster this point. The Dutch have had national WEEE legislation in effect since 1999, and the contracts between producers and recyclers there were agreed at half the cost projected by a pilot project. (EC, 2000)

If 6 kg per inhabitant per year were collected, this would yield 2.25 million tonnes (2.5 million tons) of WEEE. Average reported collection costs in pilot projects were EUR 200 to 400/tonne, which puts the cost for the 15 EU member states at EUR 450-900 million /yr.[134] Again, this would probably decrease over time as logistics and collection rates improved. (EC, 2000, p. 22)

Recycling costs can vary substantially for different types of EEE. For large household equipment, costs typically range from EUR 10 to 80/tonne, whereas for small household equipment costs are usually in the range of EUR 200 to 500/tonne.[135] Costs for recycling refrigerators and equipment containing monitors run from EUR 200 to 300/tonne and EUR 100 to 800/tonne respectively. Using data from pilot projects, and assuming a waste composition of 70% large household goods, 15% equipment containing monitors and 15% small household equipment, a first order estimate of EUR 300-450 million/yr has been calculated as an indication of recycling costs likely to be incurred in meeting the WEEE directive.[136] The general accuracy of that figure is confirmed by extrapolating the costs from the Dutch system.[137] (EC, 2000, p. 23)

The financial benefits of a directive like WEEE can be difficult to calculate. Cost savings from not having to produce virgin materials and tipping fees (landfill charges) avoided have not been included in these calculations.[138] Nor was any attempt made to monetize external benefits, such

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predictable waste stream, and it is not clear why EC (2000) assumes collecting and recycling commercial WEEE would cost an additional 20%.

[132] The economic impacts to producers due to changes in demand from increased prices are expected to be small because demand for EEE is generally inelastic or partially elastic (EC, 2000, p. 26). Note, however, that this statement was made in the draft with a 4 kg/person collection target. A price increase of 1-3% would mean that a computer that originally cost EUR 1500 would be EUR 1515-1545. ICER (2000) data indicates that a charge of £2-£3 per item of radio, TV, and audio equipment would make recycling of these items viable. A recycling charge of £3 would be 1% of a £300 TV, generally confirming the data in EC (2000). Also see footnote 82.

[133] Nor do they include learning effects or innovation.

[134] If 4 kg per inhabitant per year were collected, this would yield 1.5 million tonnes of WEEE at a cost of EUR 300-600 million /yr (EC, 2000). (Assumes linear extrapolation from 4-6 kg and current technology.)

[135] ICER (2000, p. 34) found the costs for recycling radio, TV, and audio equipment to be £100 per tonne, excluding transport costs, and based on current technology.

[136] If 4 kg per inhabitant per year were collected, the cost would be EUR 200-300. (Assumes linear extrapolation from 4-6 kg and current technology.)

[137] The costs in EC (2000), based on 4kg collected per person, were calculated to be EUR 200-300 million per year. The extrapolation from the Dutch system resulted in a figure of EUR 258 million/yr.

[138] At a cost of EUR 50/tonne, EUR 75 million would be saved in tipping fees if 6kg per person of WEEE is collected, and EUR 50 million would be saved in tipping fees if 4kg per person of WEEE is collected (EC, 2000, pp. 23-24). (Assumes linear extrapolation from 4-6 kg.)

as the future availability of resources, lower environmental impacts, improvements in human health, or knowledge spillovers gained from recycling experience.

3.3 Overview of ROHS[139]

The WEEE directive is intimately linked with the ROHS directive. Therefore, before moving on to analysis or discussion of WEEE, the basic points of the ROHS directive will be presented, and the two directives will be treated jointly thereafter.

The ROHS directive is portrayed as a logical next step in EC waste legislation and restrictions on the marketing of hazardous substances. ROHS specifically targets lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenylethers (PBDEs). ROHS is explicitly tied with WEEE because in spite of the improvements in reuse, recycling, and recovery that will come about as a result of the WEEE directive, WEEE and its byproducts will still need to be disposed of. WEEE includes each of the substances just mentioned, and they would continue to pose risks to health and the environment.[140] The EC argues that "substitution of those substances, which are most problematic in the waste management phase, is the most effective way of ensuring a significant reduction of risks to the health and the environment related to these substances" (EC, 2000, p. 12).

In addition to the environmental implications of the use of hazardous substances, some countries already have restrictions on one or more of these substances in place, which creates disparities within the EU common market. The EC therefore thought that it would be worthwhile to harmonize the policies across different countries.

The main provision of ROHS is that by January 1st, 2006, new EEE put on the market may not contain lead, mercury, cadmium, hexavalent chromium, PBB, or PBDEs.[141] ROHS applies to all of the product categories in the WEEE directive except for medical devices and monitoring and control instruments.[142] In addition, ROHS applies to electric light bulbs and luminaires in

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[139] The discussion here reflects the common position on ROHS (EC, 2001a) unless otherwise indicated. The common position is not the final text of the directive.

[140] The risks associated with each of the hazardous substances listed in the ROHS directive are detailed in EC (2000, pp. 12-15, 41-55).

[141] EC (2001a) had a deadline of January 1st, 2007, but this was amended in EP (2002a) and EC (2002a). Member countries are required to have all necessary laws, regulations, and administrative provisions in place within eighteen months of entry into force of the directive.

[142] Within two years after entry into force, the Commission is required to submit proposals for including medical devices and monitoring and control instruments under the scope of ROHS (EC, 2001a, Article 6). In addition, there are a number of exemptions already in place for applications of lead, mercury, cadmium, and hexavalent chromium. These are: mercury in compact fluorescent lamps not exceeding 5 mg per lamp; mercury in straight fluorescent lamps for general purposes not exceeding: halophosphate 10 mg, triphosphate with normal lifetime 5 mg, triphosphate with long lifetime 8 mg; mercury in straight fluorescent lamps for special purposes; mercury in other lamps not specifically mentioned; lead in glass of cathode ray tubes, electronic components and fluorescent tubes; lead as an alloying element in steel containing up to 0.35 % lead by weight, aluminium containing up to 0.4 % lead by weight and as a copper alloy containing up to 4 % lead by weight; lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85 % lead), lead in solders for servers, storage and storage array systems (exemption granted until 2010), lead in solders for network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications, lead in electronic ceramic parts (e.g. piezoelectronic devices); cadmium plating except for applications banned under Directive 91/338/EEC(1)

households. (Articles 2 and 4) There are exemptions allowing for the reuse of EEE and EEE components and for the production of spare parts.[143]

Exemptions from the directive's requirements should be granted if it is scientifically or technically impossible[144] to avoid the use of a substance, or if the alternative is more damaging to the environment, health, and/or consumer safety than the original material.[145] Similarly, exemptions can be rescinded if it becomes possible to eliminate or substitute for use of an exempted substance, provided the alternative is less damaging to the environment, health, and/or consumer safety than the original material.[146] (Article 5)

ROHS may be updated in light of scientific and technical progress. This may include establishing maximum concentration values of the regulated substances in specific materials and components of EEE, exempting materials and components of EEE from the legislation, and reviewing exemptions every four years to see if they remain necessary. The list of substances can also be updated, in light of new scientific evidence. (Articles 5 and 6)

There is a provision for effective, proportionate, and dissuasive penalties for breaches of the directive (Article 8).

3.3.1 Costs of ROHS

There is not very much information on the financial costs or environmental benefits of ROHS in the proposed directive. The EC notes that some manufacturers have already phased out lead, mercury, cadmium, hexavalent chromium, and halogenated flame retardants in some applications, which leads the EC to conclude that the costs of doing so are not prohibitive (EC, 2000, p. 23).

Lead solder is the primary application where industry claims they would bear substantial substitution costs. The EC estimates that substituting tin-based solders would cost industry EUR 150 million/yr. This would result in tiny increases in the prices of products: EUR 0.0006 to 0.003 per telephone, EUR 0.003 to 0.017 per calculator, and EUR 0.03 to 0.17 per television. In light of such low price increases, the EC claims the issue of replacing lead in solders is more an issue of fine-tuning alternative technologies than a cost question. (EC, 2000, p. 23)

The stated benefits of ROHS are broadly similar to those discussed under WEEE. These include a decrease use of virgin materials, savings on disposal costs, improved reuse and recycling

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amending Directive 76/769/EEC(2) relating to restrictions on the marketing and use of certain dangerous substances and preparations; hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators (EC, 2001a, Annex). Finally, the Commission will also evaluate the applications for: Octa BDE; Deca BDE; mercury in straight fluorescent lamps for special purposes; lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications (with a view to setting a specific time limit for this exemption); and light bulbs, to establish as soon as possible whether these items are to be exempted.

[143] These appear in EP (2002a) and were accepted in EC (2002a).

[144] EC (2001a) used the term "unavoidable", but this was changed in EP (2002a) and EC (2002a).

[145] EP (2002a) and EC (2002a) introduced the consumer safety aspect into EC (2001a).

[146] This phrasing is also from EP (2002a) and EC (2002a).

efficiencies, and lower impacts on the environment. The EC (2000) hints at decreased health impacts, but does not go into any detail. Estimations of the monetary benefits of ROHS are generally absent from EC (2000).

3.4 Analysis of WEEE and ROHS

Numerous organizations have provided comments about WEEE and ROHS throughout the various phases of their development. The EC solicited views from a number of stakeholders from industry and NGOs, who, according to the EC (2000, pp. 26-27), were generally supportive of the directives. However, while these stakeholders may have been in broad agreement with the overall objectives, a review of their submissions shows that many of them had a considerable number of comments to make on the specifics.[147] The intent here is not to review in detail all of the many comments submitted by various stakeholders at different stages of the WEEE and ROHS drafting process. Rather, their main objections and suggestions will be incorporated into a discussion of potential challenges with the current basis, scope, and intent of the directives.[148]

3.4.1 Basis for the directives

A few stakeholder submissions began by questioning the underlying basis for the directives. There was a clear divide between American and European stakeholders on this point, with the American comments being primarily directed at the underlying basis, while European submissions generally were silent on the fundamental need for the directives and instead offered numerous more detailed comments on specific provisions.[149]

In general, the directives were criticized for lacking sound science, cost-benefit analysis, risk assessment, or other objective evidence (AEA et al, 2001; Hunter et al, undated). Regarding ROHS, many of the submissions focused on the lack of comprehensive scientific studies or risk assessments that would make clear the costs, benefits, and risks of the substances being banned and any possible substitutes (AEA and EIA, 2000; NEMA, undated; AEA et al, 2001; Hunter et al, undated; ORGALIME et al, 2000; ORGALIME, 2000).[150] Specific critiques of the data used to justify bans on individual substances were also offered by Hunter et al (undated), while additional support was given in EEB (2001b).

WEEE was also cited as lacking a systematic analysis of the content of electronics, the hazards of suspect substances, and the risks of exposure to humans and the environment. Data on the contribution of WEEE to emissions was found wanting, and data from recycling pilot projects was questioned as to its applicability and accuracy. There was little information supporting the idea that recycling resulted in a net environmental benefit, and there was not much explanation

[147] Wavra (2000) indicates that the first three drafts of the directives met with industry disapproval.

[148] While every effort was made to obtain as many stakeholder submissions as possible, the submissions themselves are not accessible through any official European Commission, European Parliament, or European Council channels. Submissions were instead sought by contacting the stakeholders listed in EC (2000, pp. 26-27) and through searches on the internet and in journals. The submissions obtained are thought to be representative, though not exhaustive.

[149] One exception being the European Environmental Bureau, which was generally very supportive of the basis for the directives.

[150] Some information along these lines does appear in EC (2000, pp. 41-55), but it is not clear if this section of the document was available when early stakeholder comments were submitted.

of the benefits of the directive in general. Projections on the likely employment impacts of the directives also came under fire.[151] (NEMA, undated; Hunter et al, undated)

While many of these comments were written in response to drafts of the proposed directive that were circulated before official publication, many of these same criticisms could still be levied against the explanatory memorandum accompanying EC (2000). Though the text of the directives has been revised since then, the explanatory memorandum has not. It is almost certain that more data is available that could address some of the concerns outlined above and further support the claims made in the explanatory memorandum. Indeed, it is possible that some of the data upon which the explanatory memorandum and the stakeholder submissions are based are no longer accurate or current.[152] Failure to update the memorandum is unfortunate, as it is the document that sets the tone and provides the background and underlying basis for the directives.

The explanatory memorandum could particularly benefit from additional clarification in the following areas. First, it should provide more detail on which hazardous materials are found in which categories of EEE. Second, it should indicate how much WEEE contributes to emissions that are of concern.[153] Third, estimates should be provided of the emissions that will be prevented as a result of implementing the directives, taking into account the WEEE that is exempted from the directives. Fourth, the memorandum should be more thorough in its coverage and analysis of current recycling programs, with an eye toward setting realistic targets, and with an eye toward accurately estimating likely costs when using current technology. Fifth, the benefits of the directives need to be more fully articulated, especially in the area of human health.[154] Sixth, additional information on the availability and environmental impacts of likely substitutes for those substances subject to phase out under ROHS should be given.[155] Finally, it would be particularly helpful if data that contradicts the facts or conclusions of the directive were included in the memorandum, with some accompanying text indicating why the chosen approach was taken despite such data.

It is not the intent of these suggestions to require a full scale risk assessment or cost benefit analysis for any of the above points.[156] As noted in Chapter 1, both of these techniques are

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[151] Since the publication of the explanatory memorandum, a study prepared for the Commission found that the WEEE directive would increase both jobs and GDP across Europe as a whole (Vernon and George, 2001).

[152] For example, Hunter et al (undated) relies heavily on a report from the Nordic Council of Ministers from 1995.

[153] Unattributed statements such as WEEE "contributes significantly" to emissions are not adequate (EC, 2000, p. 8).

[154] It may also be worthwhile to estimate the financial value of the benefits provided, though this is notoriously difficult in the areas of environmental and health benefits. It is odd that the EC has made some effort at indicating costs quantitatively, while there is little effort to do the same for the environmental benefits, even in terms of pollution prevented, let alone the financial value of that pollution.

[155] For example, the memorandum currently only states, without any supporting evidence, that "substitutes of these hazardous substances already exist for most applications" and that and that they "have a less hazardous profile" (EC, 2000, pp. 53-54).

[156] For an American reader, the lack of elaborate cost-benefit calculations in the explanatory memorandum is almost refreshing. Unlike in the US, there is not a general guideline in European Community law that requires cost benefit analysis of risk management measures. The concept of proportionality is used to check the necessity of a measure to reach the policy goal, and the costs inform the choice or design of the measures (but not whether to adopt them) (see Christoforou, 2002, p. 32). Thus, many of the arguments put forward by the AEA are clearly approaching the issue from an American perspective on what is required. It has also been argued that it would be legally inappropriate and even wrong to require scientific certainty before allowing action to be taken to protect health or the environment (Christoforou, 2002).

probably not able to provide the answers that are being sought under the circumstances, and they are not able to account for the innovation that may occur as a result of the directives. What is known is that recycling will increase and less WEEE will be disposed of, probably resulting in some environmental benefits.[157] What is also very probable, if not known, is that the costs of recycling will be less than calculations based on current technology would indicate. Nevertheless, it is crucial that pertinent facts be presented clearly, concisely, logically, fairly, and with full bibliographic information, so that stakeholders reading the explanatory memorandum can arrive at their own conclusions about the necessity of the directives.

3.4.2 An additional note on costs

It is particularly important that the costs estimated in the explanatory memorandum be as accurate as possible.[158] The criticisms contained in Hunter et al (undated) and ORGALIME (2000) citing substantially higher recycling costs for WEEE are particularly damaging to the credibility of the memorandum, in no small part because Hunter et al sometimes cite the same studies as the memorandum. This gives the analysis in the memorandum the appearance of being selective in its use of data. At a minimum, all relevant cost estimates from recycling pilot projects should be provided with the accompanying analysis and final estimates.[159] Data on price increases in EEE resulting from the directive and possible corresponding loss of sales due to elastic demand should be attributed to specific sources.[160]

The memorandum has similar problems when estimating the substitution costs of ROHS. For all substances covered in ROHS other than lead, the memorandum does not provide any substitution costs at all. The data provided in the text for overall substitution costs for lead and for the resulting incremental cost increases in specific products are not attributed to a particular source, and are therefore unverifiable (EC, 2000, p. 23). In contrast, it is quite easy to find a number of industry studies citing substantially higher costs than those given in EC (2000). The memorandum states that annual investment costs are thought to be relatively low, while industry claims they would total tens of billions (Hunter et al, undated).[161] For the lay reader, it is not possible to ascertain which of the estimates is more credible, particularly if one of them is from an unknown source. In addition, EC (2000) makes a number of largely unsupported statements to the effect that costs are overestimated and will probably come down over time. If there is data

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[157] Christoforou (2002) has argued that the precautionary principle could oblige regulators to err on the side of caution when this is necessary to achieve the chosen level of health or environmental protection in situations of scientific uncertainty.

[158] Though even Wavra (2000) concedes that exact costs are "near impossible" to determine.

[159] It was not reassuring that the author was unable to replicate the calculated recycling cost ranges appearing in EC (2000) when using the information provided (see EC, 2000, p. 23).

[160] The memorandum draws a distinction between general price increases and the increases for refrigerators and TVs, and it is assumed there is some reference that can support that distinction.

[161] Wavra (2000) states that additional materials costs in the US due to ROHS would be $140 to $900 million, with additional infrastructure costs likely running into tens of billions. Wavra (2000) also cites the consultations done by the EC with European businesses regarding WEEE as showing: average compliance costs would be between EUR 6,000 to 6 million per year per EEE producer; average compliance costs would be between EUR 12,000 to 180,000 per year for recyclers; and the directive is considered administratively burdensome because it would require more than 4 hours per month of time. On the other hand, ICER (2000) found that in the UK shredders and specialist recyclers currently have spare capacity, which would allow for increased recycling of WEEE with only additional variable costs, until, and if, new investment were necessary.

from actual recycling programs to support this type of inference, that data should be consistently provided.

Again, any discussion about costs assumes at the outset that they can be reliably calculated and will be indicative of some future situation. In the case of WEEE and ROHS, where an innovative response is likely, cost calculations based on current technologies are certain to be incorrect. The very fact that industry estimates of costs are so high indicates that they will probably embark on a search for better solutions to the recycling of WEEE and the use of chemicals covered in ROHS. That is precisely the point of the directive.

Partially as a result of poor referencing in the explanatory memorandum, it was not possible in this paper to come to any conclusion about the accuracy of the environmental benefits or estimated financial costs associated with the WEEE and ROHS directives. It should be obvious that any regulatory initiative that will incur an estimated hundreds of millions of euros in costs will come under intense scrutiny on both of those points. It is therefore critical that the underlying basis of any such directive be comprehensive in its coverage and thoroughly documented. The discussion from this point will assume that the directives are warranted and concentrate on the efficacy of the proposed provisions.

3.4.3 WEEE definition

Before getting into additional detailed commentary, it might be helpful to have an abbreviated timeline to refer to during the following discussion. That timeline is presented in Figure 14.

Figure 14 Timeline of WEEE and ROHS development[162]

Date	Event
Early 1998	1st drafts of WEEE and ROHS circulated for comment
July, 1998	2nd draft
July, 1999	3rd draft
May, 2000	4th draft
June, 2000	EC officially proposes directives (EC, 2000)
May, 2001	EP first readings and Commission responses
June, 2001	EC amends proposed directives
December, 2001	Common positions adopted (EC, 2001; EC, 2001a)
April, 2002	EP second readings and Commission responses (EP, 2002; EC, 2002; EP, 2002a; EC, 2002a)
June, 2002	Commission responses to EP second reading sent to EP and Council

As with so many legislative initiatives, early problems come in agreeing the precise definitions of terms. Before the first proposal for the directives was officially published, industry had already suggested that the definition of WEEE begin with large household appliances and

[162] This is based on Wavra (2000) and on the information found in the PreLex database, which is available on-line http://europa.eu.int/prelex/detail_dossier_real.cfm?CL=en&DosId=158020#319172.

expand over time (ORGALIME et al, 2000). The debate soon shifted, however, to whether spare and replacement parts, cables, and consumables should be considered WEEE. The European Environmental Bureau (EEB) was in favor of this (EEB, 2000; EEB, 2002), while some industry groups were against it (ORGALIME, 2001; EICTA et al, 2001). In the end, it appears spare parts and consumables are considered WEEE, though they are exempt from ROHS.[163] This may be an appropriate compromise, as spare parts and consumables could be a considerable fraction of WEEE and should therefore fall under the legislation. However, spare parts should still be available for equipment produced before ROHS, which makes the exemption appropriate.

The apparent shift in the debate overlooked the question of whether the definition of WEEE may simply be too inclusive. The directives cover everything from computers to microwaves to sewing machines to pulmonary ventilators. The incredibly broad scope of the directives may make recycling more difficult, as the waste stream will be more varied. In addition, the number of EEE manufacturers subject to the directives increases dramatically as the number of products and product categories increases, which adds to the regulatory and bureaucratic burden associated with the directives.[164]

The Industry Council for Electronic Equipment Recycling (ICER) actually conducted a study of the recycling of WEEE (as defined in the directive) in the UK (ICER, 2000). Large household appliances accounted for 43%, IT equipment for 39%, and consumer equipment for 8% of WEEE collected (by weight). Thus, these three categories of WEEE comprise 90% of the total.[165] Based on the ICER study, it is not at all clear why the other categories of WEEE should be included, given the concentrated nature of the waste stream. In addition, the category of small household appliances leaves out some obvious pieces of equipment, such as blenders and kettles, that, if included, would increase the amount of WEEE in that category around 30%.

There is not any indication of how the categories or products of WEEE were chosen. Perhaps the definition of WEEE could be narrowed if certain aspects of EEE were of particular concern. Those products or categories with the most hazardous substances, for example, or that take up the most landfill space, or that result in higher environmental impacts when disposed of.[166] This might serve to reduce the number of products or categories of WEEE while still achieving most of the desired benefits. There is no indication that discussions along these lines ever occurred, and it is not possible to discern how WEEE products or categories were chosen.[167]

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[163] Industry might have influenced this outcome, as several groups appeared to change their negotiating tactic starting late in 2001 (EICTA et al, 2001a) to focus on exemptions for spare parts and consumables from ROHS. This was also picked up in ORGALIME et al (2002).

[164] There are thousands of EEE companies in the EU (EC, undated). The EEB (2001b) wanted to expand the definition of EEE still further to be "An electronic product is a unit containing active and passive components that serve to create, process and/or pass on electrical signals or to create mechanical, acoustic or electrical effects, including parts and components for such a unit" (p. 51).

[165] In the ICER study, small household appliances were 3%, tools 3%, and other four categories 1% each of the total. Note that the ICER categories do not correspond exactly to the current categories as defined in WEEE, and the WEEE collected in the UK may not be representative of the EU.

[166] Similar ideas were supported in NEMA (undated). For differences in composition of typical EEE, see p. 10 of the Electronic Consumer Goods Case Report, http://www.leidenuniv.nl/interfac/cml/chainet/ECG-22.pdf.

[167] The data provided in the explanatory memorandum are also not fine enough to allow for a more nuanced analysis.

3.4.4 Collection target

The amount of WEEE collected is the crucial starting point in any effort to manage waste from EEE. Throughout the development of the directives, industry groups were strangely silent about the collection targets, while the EEB and the European Consumers Organization (BEUC) claimed they were too low (BEUC, 2000; EEB, 2000; EEB, 2001; EEB, 2002). The EEB pushed to have the target increased to 6 kg/person/year, to be achieved by January 1, 2006, with revised targets starting in 2007 (EEB, 2000). Both the EEB and the BEUC pointed out that WEEE generation is expected to soon reach 20 kg/person/year (EEB, 2001b; BEUC, 2000), of which 12 kg would be from the consumer sector, 5 kg from the industrial sector, and 3 kg from cables (EEB, 2001b, p. 24).[168] This would mean the original 4 kg target would only collect one third of the total consumer WEEE.[169] Pilot projects in member states had already achieved collection rates of up to 8 kg/person/year (EEB, 2001b). The BEUC pointed out that higher collection rates would mean recycling would be cheaper per unit (BEUC, 2000). This may explain why the debate on required collection rates themselves did not receive much attention from industry (in addition to an implicit assumption that producers would not finance collection).

The first published draft of WEEE set the target at 4 kg/person/year, and it stayed at that level, despite the suggestion of the EP on its first reading to increase the target to 6 kg. The EP proposed this change again at its second reading, and this time the change was accepted by the EC, although it was viewed as "very ambitious" (EC, 20002). This is to be achieved within 36 months of the directive entering into force, with revised collection targets for future years possibly being set as a percent of EEE sold. These portions of the directives could be the result of sustained pressure by the EEB throughout their development.

While the arguments the EEB and BEUC make for increasing the target to 6kg/person/year seem valid, it would be preferable if there were more explanation in the text of the directives showing how these targets were chosen. A 50% increase in the collection target is not insignificant. This will result in considerably more expense for local authorities, who will finance the collection, and for producers, who finance the treatment of WEEE. It will generate half again as much recycled material and generate increased environmental benefits. But there is no effort to demonstrate why the chosen target is preferable than any alternative target, whether the increased costs are affordable, the environmental benefits substantial, or the recycled materials marketable.

On the face of it, an initial 6kg per person per year target appears ambitious but not unreachable. This is precisely the type of target that could lead to organizational and institutional innovation on the part of the local authorities who will be collecting WEEE.[170] Though it is implicitly assumed that any revised targets based on sales in previous years would be higher than 6 kg per person, this is not stated in the common position. Local authorities should be given some advance indication of increases in targets so they will be able to adjust their collection systems if necessary.

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[168] In Denmark, 20kg/person/year of WEEE are already being generated (ENS, 2000).
[169] EC (2000, p. 20) calculates 4kg as being 25% of the overall annual generation of WEEE.
[170] It is assumed here that collection will not require technological innovation.

3.4.5 Recycling target

Unlike the choice of the collection target, the recovery and reuse/recycling targets have generated considerable controversy. Starting with the early drafts of the directives, industry groups have consistently stated that recycling targets were unrealistic (ORGALIME et al, 2000; AEA and EIA, 2000; ORGALIME, 2001; ORGALIME et al, 2001; CECED, 2001).[171] Industrial stakeholders appear to have had some early success, as the targets in the initial proposed directive are generally lower than in previous consultation drafts (see EEB, 2001b, p. 28).[172]

The EEB has been equally strong in their desire to have recycling targets increased (EEB, 2000; EEB 2001; EEB, 2001a; EEB, 2002).[173] In the time between the original proposed directives and the current common position, targets have generally increased. The EEB cites a number of studies indicating that quite high recovery and reuse/recycle rates have been achieved in pilot projects: 90% recovery of PCs, 90% recycling of large household appliances, 70% recycling of small WEEE, 70% recycling of WEEE containing CRTs (EEB, 2000). By these standards, few of the targets proposed in various drafts of the directive are very ambitious.[174]

[171] Of all the stakeholder submissions reviewed, only NEMA (undated) points out that the costs and benefits of particular recycling targets for categories of WEEE were not available. Note that the same organization can have dramatically different responses to very similar recycling initiatives. In the case of the EIA, they are cited as fighting hard against EU directives (CGCAP, 2002; AEA et al, 2001b), and yet also claim to "strongly encourage recycling as the best option" for WEEE (EIA, 2001) and to be working toward a "cost-effective, efficient, and convenient national recycling program" in the US (NEPSI, 2002).

[172] The EEB (2001b, p. 31) claims that recycling targets "were only lowered for reasons of political compromise". As late as the 4th draft of WEEE, dated May, 2000, the targets were consistently higher. The 4th draft of the directive is avaible on-line http://www.svtc.org/cleancc/weee/euweee/directive/weee4th.htm.

[173] The EEB (2000) also stated that WEEE could be seen as a tool for innovation.

[174] NEMA (undated) suggests that targets be set after experience has been gained, but this appears to overlook the data that has already been gathered in numerous local, regional, and national recycling programs.

Figure 15 Changes in WEEE recovery and reuse/recycle targets

WEEE Category	Proposed Directive (EC, 2000)	EP 1st Reading (EP, 2001)	Common position (EC, 2001)	EEB proposed targets (EEB, 2001b)[175]
1	80/75	90/85	80/75	95/90
2	60/50	70/60	70/50	80/70
3	75/65	85/70	75/65	95/90
4	60/50	85/70	75/65	80/70
5		70/60	70/50	70/50
6	60/50	70/60	70/50	80/70
7	60/50	70/60	70/50	80/70
8				70/50
9		70/60	70/50	70/50
10		90/85	70/50[176]	95/90
Gas discharge lamps	80 (reuse/recycle)	85 (reuse/recycle)	80 (reuse/recycle)	90 (reuse/recycle)
WEEE with CRT[177]	75/70	80/75	n/a	75/70

WEEE categories

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools
7. Toys
8. Medical equipment systems
9. Monitoring and control instruments
10. Automatic dispensers

A study for the UK Department of Trade and Industry also showed that reuse/recycle rates are already achievable (and presumably profitable) for some items of WEEE.[178] The study found recycling rates shown in Figure 16 (EC, 2000, p. 25).[179]

[175] These targets would include reuse of whole appliances and would take effect December 31, 2007. In their submission of March, 2001 (EEB, 2001b), the EEB supported the targets in the proposed directive up until December 31, 2007.

[176] In EP (2002) and EC (2002) this was increased to 80/75. The EC (2002) did not agree to any of the other amendments in EP (2002) regarding recycling targets, which generally suggested increasing them and putting WEEE with CRTs into a separate category.

[177] WEEE containing CRTs is not included in categories 2,3,4,6, and 7 under the proposed directive; the same categories plus category 9 in the EP first reading; in the common position no exceptions are made for WEEE with CRTs; in the EEB proposed targets, CRTs were not included in categories 2,3,4,6, and 7.

[178] ICER (2000) found that recycling IT and telecommunications equipment and large household appliances is generally profitable.

[179] ICER (2000) also agreed with the data for washing machines and refrigerators, and said the current weighted average of the recycling rate for large household appliances is around 68%. Note that the WEEE recycling targets are calculated by percentage recycled by average weight per appliance.

Figure 16 Comparison of current recycling rates and WEEE targets

Item	Recycle rate in study	WEEE target
washing machines	62%	75%
Refrigerators	60%	75%
personal computers	60%	65%
Telephones	62%	65%
Televisions	42%	65%
Kettles	58%	??

Benchmarking against these data, the targets in the WEEE directive seem reachable using current technology, except possibly for refrigerators and televisions.[180]

It should be noted that the current common position does not count reuse of whole EEE toward the targets, at least for the first five years, and the original proposed directive was unclear on this point. The EP first reading also does not count reuse of whole EEE toward the targets, which is significant, considering how much the EP raised many of the targets in that reading.181 Generally speaking, the EEB would have preferred targets higher than those put forward in the EP first reading (to start December 31, 2007); however, reuse of whole appliance would have counted toward the targets.182 Thus, numbers put forward by the EEB (2001b) are not strictly comparable to the others in Figure 15.

Deadlines for reaching the targets have also been discussed in various stakeholder submissions, and the current agreement based on EC (2002) and EP (2002) of December 31st, 2005, is more in line with the EEB than with industry.[183]

It is surprising that the argument put forward by ORGALIME (2000) that targets should be progressive did not appear in future stakeholder submissions. This would allow a gradual phasing in of recycling requirements, and this approach was used in the End of Life Vehicle directive. There is a provision in the common position to review the targets, especially for whole appliances, in five years time. Presumably this will result in an increase in the targets, particularly if reuse of whole appliances begins to count toward them. However, there is no indication of how large the increase in the targets might be. Giving indications now of future likely targets would allow actors to plan ahead and determine their best technological options in light of more certain future conditions. In addition, recycling operations might be constructed or operated differently if credit is going to be given for reuse of entire pieces of equipment. A

[180] However, both EEB (2000) and ICER (2000) have data showing large household appliance recycling rates approaching 90%. On the other hand, these targets might look ambitious if we consider that, on average, WEEE is 47% ferrous metals, 22% plastics, 6% glass, 4% non-ferrous metals, and 21% miscellaneous by weight (ICER, 2000, p. 22). If plastics and miscellaneous material are generally not recyclable, then only around 60% of WEEE, on average, is even capable of being reused/recycled or recovered.

[181] Reuse and remanufacturing are not insignificant in the EU. The remanufacturing of inkjet and toner cartridges alone in Europe comprises some 1,400 remanufacturers in a market worth around EUR 1 billion (Remanufactured, 2002).

[182] The most recent submission from the EEB (2002) essentially asked for the EP (2001) targets.

[183] Of all the stakeholder submissions reviewed, only the EEB (2001a) appeared to be against the extended deadlines that Greece and Ireland could apply for.

change of the rules in five years time may introduce unnecessary adjustment costs. Given the importance of reuse in the waste hierarchy, it is not at all clear why reuse and refurbishment of WEEE does not count toward the targets. Advanced notification of an increase in targets would encourage the development of new recycling technologies, provided the new targets are beyond the reach of current technological capability.

On balance, the WEEE directive looks like it will encourage technological diffusion and perhaps incremental innovation, but not disruptive innovation. The targets in WEEE are generally the same, or slightly above, the targets that are already being reached in pilot programs across Europe and can therefore most likely be reached with current technology.[184] The only possibility for disruptive innovation to occur is if it is simply too expensive to reach the targets with current technology.

The fact that the current targets will induce diffusion or incremental innovation lends further support to the argument that future targets should be set farther in advance, to encourage and allow time for the development of radical or disruptive innovations.

Stakeholder submissions did not mention the possibility of technology forcing regulations, and nor do the explanatory memorandum or text of the directive make such a reference.[185] However, the innovative response of industry is very dependant on what the reuse/recycling and recover targets are, and the targets, in some cases, have undergone considerable change in different drafts of the directives. Such changes could be significant if, for example, the increase in the reuse/recycling target for consumer equipment from 50% to 65% would mean that an entirely new materials fraction would have to be at least partially reused/recycled in order to meet the higher target. Not only is the process by which the targets are chosen opaque to outside observers, but the impact on technological development and innovation resulting from different targets appears not to have been considered.[186]

It should also be pointed out that targets for broad categories of WEEE may have very different impacts on specific pieces of equipment or on specific individual actors. What the directive is really attempting to do is encourage recycling, not of pieces of equipment, but of the different distinct materials that comprise that equipment.[187] One wonders if it would be possible or advisable to require different reuse/recycling and recovery rates for different materials fractions such as ferrous metals, non-ferrous metals, glass, plastics, etc. Theoretically, these could be structured so that the overall targets currently in place were reached when the targets for the materials fractions of different equipment types were summed. The point is not to recycle refrigerators, toasters, and computers, but to reuse/recycle and recover the metal, glass, and

[184] This reading of the data is confirmed by several communications with staff of the EEB and EC Environment Directorate.
[185] Some industry submissions did characterize the targets as unreachable, but did not make the leap to technology forcing regulations. In any case, assessments reaching that conclusion do not look entirely credible in light of the available data. NGO submissions tended to argue for high recycling targets based on limited experience with pilot programs and moral suasion, but not from the standpoint of technological development.
[186] Of course changes in targets also indicate differences in costs, environmental benefits, and the amount of material available for use in secondary markets.
[187] This is assuming the equipment cannot be reused.

plastics that are contained therein. Structuring the targets along those lines might allow for better fine-tuning of recycling efforts and technologies.

3.4.6 Financing of household collection

Another major point of contention in the WEEE directive is who shall bear the collection cost of household WEEE. Industry was initially against any financial or organizational responsibility of producers for household collection (ORGALIME et al, 2000). More recently, their objections have been targeted only at financial responsibility for collection of WEEE from households. Industry groups presented a very consistent and united front on this question (ORGALIME, 2000; CECED, 2001; OGALIME et al, 2001; CECED, 2001a; EICTA et al, 2001a; ORGALIME, 2001). The EEB argued the opposite side in several of its submissions, saying that producers should finance the collection of WEEE from households (EEB, 2000; EEB, 2001b). Aside from an early comment by ORGALIME et al (2000) the question of organizational responsibility appears to be moot, with local authorities having this responsibility.

This discussion point has been inflamed somewhat by unclear language in the initial proposal and in the common position, which states "producers provide at least for the financing of the collection, the treatment, recovery and environmentally sound disposal of WEEE from private households deposited at collection facilities" (EC, 2001, Article 7). The question is whether the producer's financial responsibility starts with collecting WEEE from households, or whether it starts from the collection facility. There seems to be some agreement that producers' financial responsibility starts from the collection facility (even the EEB (2001b) concedes this point), but it isn't perfectly clear from the text of the directive.

Industry argues that they should not bear collection costs because those costs are out of their control, and the costs would be passed on to consumers who would then be double charged for collection services. In addition, local authorities have traditionally handled collection of waste from households and they are still in the best position to do so. The EEB argues that extended producer responsibility includes all waste management costs, including collection from homes. This is a necessary step in waste handling, and can be as much as 50% of total costs (EEB, 2001b, p. 9). The general public should not have to bear those costs.[188]

Having producers pay for collection from households makes sense for a number of reasons. It is consistent with extended producer responsibility and with the polluter pays principle. The costs of collection would be added to the price of EEE, which means that those people who purchase and benefit from EEE would pay the costs of collection, rather than society at large. It may not be the case that local authorities will be best positioned, in the financial sense, to handle the growing WEEE waste stream, as it will be difficult for them to acquire the additional funds that might be needed to increase their waste handling capacity.[189] Collection costs could easily be put under the control of producers, who would then have an incentive to be as efficient as

[188] EEB (2002) appears to concede somewhat on these points, as it introduces language requiring member states to establish a network of reuse installations.

[189] EP (2002) and EC (2002) agreed to language that would require WEEE to be collected separately, which could significantly increase collection costs.

possible in their collection activities. In the simplest case, producers could simply subcontract the collection responsibilities to local authorities, who would be paid for their efforts.

On the other hand, the logistical and financial arrangements necessary to make a separate WEEE collection system work could get very complicated. It would be difficult to apportion the costs of collection across all EEE producers. Indeed, it would even be challenging to agree how such costs would be determined. For example, should it be by weight, volume, or number of items? Setting up such a system for WEEE could also set a precedent for other waste streams. Why not do something similar for other recyclables, such as glass bottles, cans, or newspaper? Though these items may not be as environmentally damaging as WEEE during disposal, that wouldn't mean the producers of such items shouldn't pay for their collection.

There is, of course, some middle ground between these two extremes, and that may be where some realistic solution could be found. Perhaps producers should subsidize the cost of WEEE collection from households. The subsidy could just be a surcharge, above the cost of WEEE treatment, which is hypothecated to local authorities. Alternatively, the subsidy could be a one time investment in necessary infrastructure for local authorities. In any case, having society bear the full costs of collection of WEEE from households does not seem to be in keeping with the broader aims of the directive. Have producers share the costs would have the additional benefit of bringing their instincts for cost effectiveness and innovation to bear on the problem of collection.

3.4.7 Financing of historic WEEE

Another financial question that was raised in a number of stakeholder submissions, but which was less contentious than the financing of household collection, was who should bear the costs of managing WEEE that is already on the market (historic WEEE).

Industry positions before the publication of the proposed directive were that the financing of historic waste should be borne by society (ORGALIME et al, 2000; AEA and EIA, 2000; NEMA, undated). Though industry continued to decry retroactive legislation, it appears this position was not sustainable, as their statements began to soften soon after the directives were published. The endgame on the question of historic WEEE is that producers will share the costs of treatment of historic WEEE, dividing the costs in proportion to market share at the time the costs are incurred, and that the costs will be offset by a visible fee on the price of new EEE that is sold. The visible fee will be allowed for up to ten years. Variations on this proposal appear in a number of industry submissions (ORGALIME et al, 2000; ORGALIME, 2000; ORGALIME et al, 2001; CECED, 2001; CECED, 2001a; EICTA et al, 2001a; CECED 2001b; ORGALIME, 2001; ORGALIME et al, 2002), were generally supported by BEUC (2000) and the EEB (EEB, 2000; 2001b; 2002), and the ideas were put forward in EP (2002) and accepted in principle by the EC (2002).

The only part of this solution that raised some eyebrows was the use of a visible fee. BEUC (2000) is opposed to any price increase due to treatment costs, and the EEB (2001b) is also unsure about the use of a visible fee for historic waste, fearing it would be viewed as an extra

charge or tax.[190] However, if additional efforts are being undertaken to properly treat historic WEEE, a commensurate increase in cost should be expected. That cost, visible or not, will almost certainly be passed on to consumers, and hence will increase the price of EEE.[191] This is sometimes the unfortunate side effect of internalizing costs. Internalization of costs does not necessarily mean invisibility of costs, it only means that the additional costs of treatment are included in the product price. It would seem reasonable to be transparent about what is driving cost increases in this case, rather than to hide them.[192]

The agreement on the financing of historic waste also does not entirely conform to extended producer responsibility. Since costs are divided according to today's market share, the financial responsibility of each producer is essentially determined by their ability to pay today.[193] Thus, a producer whose market share has increased over time will end up paying the treatment costs of other producers' historic WEEE. Conversely, a producer who put many products on the market in the past but has since lost market share would probably only pay for the treatment of a fraction of his historic WEEE. Under a strict reading of producer responsibility, each producer would pay to treat his historic WEEE regardless of the change in fortune they experience between when products were put on the market and when historic WEEE treatments costs are incurred. It is easy to see why a strict reading of producer responsibility would not necessarily be palatable to producers, but it is surprising that this point was not raised in the stakeholder submissions.

In addition, cost allocation by market share will obviously lead to intense disputes about the delineations of markets for categories of WEEE. Is everything under the category of IT and telecommunications equipment in the same market, or should computers be separated from fax machines and telephones? Should desktop computers be separate from laptop computers? It is also unclear how the share of the market will be determined, and this is not specified in EC (2001), EP (2002), or EC (2002). For example, market delineations could be done by sales revenue, number of units sold, or weight of units sold. The latter alternative is nearest in spirit to the overall aims of the directives, and seems to be the working assumption of many

[190] Both the EEB (2000; 2001b) and BEUC (2000) preferred a deposit-refund system instead of a visible fee for historic waste, especially for smaller appliances. The issue for them was how to increase collection for small appliances that could be discarded with household trash relatively easily. A refund, receivable when returning small appliances, could be workable, but only provided it 1) was internalized within the product price and 2) was an additional charge on top of financing for historic WEEE, free riders, and future WEEE. The deposit would have to be additional because it is an incentive to return the product and is not meant to cover treatment costs. Consumers who return small appliances would get the refund, and producers would retain (or perhaps be obligated to share with local authorities) the deposits that went uncollected.

[191] One wonders if the ideas of producer responsibility or polluter pays truly hold, at least in the financial sense, if all additional costs are passed on to consumers.

[192] Any costs associated with the management of future WEEE, as opposed to historic WEEE, must be internalized within the product price (EP, 2002; EC, 2002). This seems reasonable as the costs associated with future WEEE are within the producer's control, whereas costs for historic WEEE are not. Treatment of future WEEE is simply just one of many costs of production of new EEE.

[193] This assumes that higher market share means higher profits, which may not be the case. It is difficult to determine the effect this arrangement would have on the prices of comparable products made by different manufacturers. For example, would a produce with a larger market share, who has to finance more of the treatment costs for historic WEEE but is able to spread those costs out across more units, be at an advantage or a disadvantage relative to a producer with fewer units and a smaller portion of the historic WEEE treatment costs?

stakeholders.[194] Simply decreasing the weight of EEE on the market does not necessarily mean that the WEEE arising will be easier to reuse/recycle or recover. In addition, measuring market share by weight downplays the assumed link to willingness to pay for historic WEEE. Ideally, the metric used to determine market share would be linked to the treatment costs of historic WEEE. Developing such a metric, say something that could measure the recyclability of each producer's EEE products currently on the market, would work in theory but could be difficult to implement in practice.[195] Yet doing so would provide a much better connection between the final aims of this portion of the directive and the yardstick that will decide the costs, in addition to avoiding the moral hazard of making recovery and reuse/recycling more difficult when lightweighting EEE.

3.4.8 Financing of free riders

The discussion in different stakeholder submissions on how to finance WEEE from free riders is a bit more complicated than the question of financing historic waste. Free riders in this context have been taken to mean WEEE from producers who are no longer on the market, WEEE from producers who have deliberately circumvented the directive, and WEEE from producers who have sold products via e-commerce.

At first, industry simply suggested that free rider problems should be avoided (ORGALIME et al, 2000), and then proposed that this could be achieved by all producers, including those selling via e-commerce, putting up financial guarantees (ORGALIME et al, 2001; CECED, 2001b; ORGALIME et al, 2002). Note that there was not agreement that industry should in fact pay for free riders, should any be found, but only that guarantees should avoid the problem (CECED, 2001; CECED, 2001a; EICTA et al, 2001a; CECED, 2001b). After the common position was published (EC, 2001), which included a possible five year exemption for small businesses from financing requirements, both industry and the EEB came out against the proposed exemption (CECED, 2001b; EEB, 2002; ORGALIME et al, 2002). Requirements that products be clearly marked and that a register of producers be created were also proposed by industry (CECED, 2001) and supported by the EEB (EEB, 2002). Both industry and the EEB were broadly in favor of individual producers being responsible for financing the treatment of their own WEEE, unless this proved to be unduly burdensome (EEB, 2000; BEUC, 2000; ORGALIME et al, 2001; CECED, 2001; EEB, 2001a; CECED, 2001a; EICTA et al, 2001a; CECED, 2001b; EEB, 2002; ORGALIME et al, 2002).[196] There was similar agreement that the logistics of WEEE treatment could be organized individually or collectively.

What is interesting about the free rider question is that neither industry nor environmental groups want free riding. Industry does not want to have to pay for the treatment of other parties' WEEE, and environmental groups do not want any WEEE to go untreated. The only question is how this can best be achieved. The current draft of WEEE reflects much of the discussion and agreement

[194] However, the justification of amendment 42 in EP (2002), which was accepted in principle by the EC (2002), says that costs should be allocated "according to market shares by volume". This language appears in the justification for the amendment, not in the proposed text itself, and is still unclear as to whether it refers to volume as in sales or volume as in m^3. It is also not in agreement with the provision in Article 11 that prefers data to be in terms of weight.

[195] For some initial work on this type of idea, see Huisman et al (2001).

[196] Though NEMA (undated) proposed that industry not be solely liable even for future WEEE.

in the stakeholder submissions. That is to say, financing for future WEEE is to be provided individually, unless that is unduly burdensome; producers must provide financial guarantees;[197] products must be clearly marked; a registry of producers will be created; and all producers, including those selling by e-commerce and small businesses, are subject to the same requirements.[198]

However, the current draft also states that the costs of financing orphan WEEE will be borne by producers (EC, 2001, Article 7). Industry has argued that this will encourage free riding and that it is not fair to honest producers because they would be punished twice for their honesty. Not only will they have to bear additional treatment costs associated with orphan WEEE, but they will have also included the costs of treating their own future WEEE in the price of current products, which their unscrupulous competitors will not have done.[199] These arguments, however, are not persuasive.

It is not at all clear that having producers pay for the treatment of orphan WEEE would encourage more free riding than having orphan WEEE go untreated or having society pay for its treatment. In practice, it is unlikely that orphan WEEE will go untreated, because it would be very difficult to separate out WEEE from unknown producers before or during treatment. Whether society pays or producers pay, free riding producers still receive the benefit of not including treatment costs in the price of their product.[200] The only additional incentive to free ride if producers pay is that honest producers will bear the additional cost of treating orphan WEEE. However, it seems unlikely that such a large amount of orphan WEEE would be treated that the price of honest producers' products would noticeably increase, as treatment costs would be spread across all other producers in the market. In the absence of a definitive increase in honest producers' prices from the treatment of orphan WEEE, there is no additional incentive to free ride if producers pay.

On the other hand, if producers pay for the treatment of orphan WEEE, there is an incentive for producers to ensure that those costs are minimized. Producers will be incentivized to make sure there are not any free riders, or to find out who is free riding. Internal policing schemes capable

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[197] The details on how the financial guarantees for future WEEE will be set are not known. This could certainly be problematic, as a flat fee by WEEE category may not be representative of treatment costs in different countries (or in general), but the experience needed to accurately predict an individual producer's treatments costs is generally not available. There have already been two instances of flat fees resulting in overcharging consumers for treatment costs (EEB, 2001b, p. 19).

[198] This reading of the proposed directive is based on EC (2001), including amendments proposed by EP (2002) and accepted in whole or in principle by the EC (2002).

[199] This assumes that a company is being unscrupulous, as opposed to having simply gone out of business. Though the latter situation is less clear cut, the same arguments presented in this section could apply to failed enterprises.

[200] That is to say, a determined free rider will receive the benefit of not having to include WEEE treatment costs in his product's price, regardless of who pays those costs on his behalf. Thus the only point of discussion is the incremental additional incentive to free ride, if it is known that other producers will pay the treatment costs of the free rider. This discussion leaves aside the question of whether avoided treatment costs would be such that a free rider's products would be noticeably cheaper than an honest producer's, as estimates on that score vary widely. EC (2000) claims the directives will result in a 1-3% price increase, the EEC (2001b) claims costs of recycling systems rarely exceed 5% of product price, and ORGALIME (2000) claims that collection and recovery of used appliances costs 5-15% of manufacturing costs.

of doing this could be created within existing industry associations.[201] Producers also have the incentive to ensure that their treatment program, when taken in its entirety, is as efficient as possible. If society pays for the treatment of orphan WEEE, there is not incentive for other producers to root out free riders or to assist in doing so, and it would be very difficult for public agencies to locate the culprit.

There are also strong arguments to support producers paying for free riders on a more theoretical level. If the costs were borne by society, everyone would help finance free riders, whether he had purchased EEE or not. If costs are borne by producers, they, and the customers who purchase their products, finance the treatment of free riders in the industry. Costs are thus allocated to those who receive the benefits of producing and using EEE. Allocating costs to producers (and their consumers) also has the benefit of encouraging enforcement among peers as discussed above.

In light of these points, it seems perfectly reasonable that producers should be responsible for financing orphan WEEE, as is set out in EC (2001). It should also be kept in mind that the problem of free riders is, at present, only theoretical, and its potential should be minimized by the requirement to provide financial guarantees. More could be done in this regard, however. For example, producers could be required to be officially registered and to provide guarantees before they are allowed to sell WEEE in the market.[202] Whatever method of dealing with free riders is finally agreed upon, it should also apply if the guarantees that have been provided are not enough to cover WEEE treatment costs. The common position (EC, 2001) allows member states to finance orphan WEEE in the same way that historic WEEE is financed, which may bring some of the challenges discussed in the previous section.[203]

3.4.9 ROHS timeline

There was some discussion in stakeholder submissions regarding the time the ROHS directive would come into effect. Industry was very keen to have a fixed phase out date, i.e., a date from which ROHS would take effect (EICTA et al, 2001; CECED, 2001a; ORGALIME et al, 2002). Comments on this point were in response to changes in language between the initial proposed directive and the common position. In EC (2000), ROHS went into effect "from January 1, 2008", whereas in EC (2001), ROHS went into effect "by January 1, 2007 at the latest". The language in EC (2001) would theoretically allow individual countries to require phase-outs earlier than January 1, 2007, which could create problems in the market.

Industry was also in favor of a later phase out date, certainly after 2006 (ORGALIME et al, 2002), perhaps around 2008 (ORGALIME et al, 2001; EICTA et al, 2001) and preferably 2010 (EICTA et al, 2001). The EEB consistently wanted the date to be January 1, 2006 (EEB, 2000; EEB, 2002), while the BEUC wanted it to be as soon as possible (BEUC, 2000). The original proposed directive had the date in 2008, the common position moved it forward to 2007, and the

[201] Though trade association monitoring and enforcement can be weak (see Ashford, 2002).
[202] Perhaps guarantees should be linked to metrics that producers will want to maximize and have publicly known, such as number of units sold.
[203] If financing of orphan WEEE is going to be organized along the lines of financing of historic WEEE, the same metric should be used for both. A balance must be found between the ability of a producer to pay, recouping treatment costs, and the convenience of the financial arrangement.

agreed amendments have now fixed the date at "from January 1, 2006" (EP, 2002a; EC, 2002a). Thus, industry got its definite date, and the EEB got its preferred date.

Assuming the ROHS directive enters into force by January 1, 2003 (which admittedly seems rather optimistic), this would only leave three years for producers to phase out use of lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE in EEE. Clearly, this appears to be a stringent, innovation inducing regulation.

3.4.10 ROHS scope

Though ROHS is meant to apply to all the EEE defined in the WEEE directive, there are a number of exemptions, and these have had much ink spilled over them in the stakeholder submissions. Different industry groups argued for a number of specific exemptions, including lead in high temperature solders; lead in glass in electronic components; lead in glass in light bulbs; lead used in high performance or high reliability servers, storage and storage array systems, voice and data, transmission, and networking equipment; lead in piezoelectric devices; mercury (up to 10 mg) in straight fluorescent lamps; and a general exemption for repair and maintenance of equipment put on the market before ROHS to cover spare parts and consumables (ORGALIME et al, 2001; EICTA et al, 2001; ORGALIME et al, 2002). After a suggestion for an exemption to 2010 for lead in servers and storage and storage array systems had been tabled, EICTA et al (2001) specifically suggested the exemption be granted indefinitely.

In general, the EEB was silent on the specific exemptions suggested by industry, but proposed changes to ROHS that would make it easier to include substances under the scope of ROHS, including substances currently exempted, while also making it more difficult to create new exemptions. The EEB did not want any exemptions for lead in servers and storage and storage array systems, lead in light bulbs, or for Octa BDE and Deca BDE (two other halogenated flame retardants) (EEB, 2002). The BEUC (2000) was supportive of ROHS coverage of PBB and PBDE, while the EEB wanted ROHS to extend to all halogenated flame retardants, PVC, and HFCs (EEB, 2000; EEB, 2001b).

It should be noted that many exemptions to ROHS were included in the original proposal (EC, 2000) and were uncontroversially carried directly through to the common position (EC, 2001a). The amendments to the common position proposed and agreed in EP (2001a) and EC (2001a) were broadly supportive of the language proposed by the EEB on additions and deletions to the annex of exemptions.

On the specific exemptions, however, the common position is much more reflective of industry positions.[204] ROHS was not expanded to include halogenated flame retardants besides PBB and PBDE, and a general exemption was granted for spare parts and consumables. In line with industry preferences, exemptions were also granted for lead in high temperature solders; lead in glass in electronic components; lead in solder in servers, storage and storage array systems (though the exemption is limited to the year 2010); lead in solders in network infrastructure equipment; lead in piezoelectric devices; and mercury in various kinds of lamps. Nearly all of

[204] There are also other exemptions that were clarified, added, or deleted in the common position that are not discussed in stakeholder submissions.

these are additions or clarifications from the original directive. In addition, ROHS requires the Commission to specifically evaluation applications for exemptions for lead in glass in light bulbs, and for Octa BDE, and Deca BDE. The only specific point aligned with the EEB's submissions is that the Commission is also required to consider specific time limits for the exemptions given to lead in solder in servers, storage and storage array systems and lead in solders in network infrastructure equipment.

With the possible exception of the exemptions granted for lead solder and lead in electronic components, it isn't the specific substances that draw attention, but rather the number and scope of the exemptions that have been granted. No rationale for granting or refusing an exemption is given. There is, therefore, no easy way to determine the effect the exemptions will have on future emissions or costs. If lead and mercury are substances of primary concern, it might be wise to determine how much lead and mercury will still be disposed of in the environment due to the exemptions given in ROHS, and to see if those exemptions are still worthwhile.[205] This does not appear to have been done, however, and a reader of the directives is left to conclude that exemptions were granted or refused due to the influence of different stakeholders, rather than on a more rational process.

There is surprisingly little discussion in the stakeholder submissions on the requirements that must be met for additional exemptions to be granted. There are two possible ways to create exemptions. One is "if the use of the substances [lead, mercury, cadmium, hexavalent chromium, PBB, PBDE]... in those materials and components is technically or scientifically impossible", and the other is if "the negative environmental, health and/or consumer safety impacts caused by substitution are likely to outweigh the environmental, health and/or consumer safety benefits".[206]

It is easy to see that each of these statements will result in intense factual disputes. There are probably many applications where it is not possible to find exact substitutes for the current uses of particular substances. Indeed, this has already been argued in reference to lead solder (EICTA et al, 2001). Would this qualify as a ROHS exemption? It is unclear to what extent product or process alterations or redesign must be attempted before granting an exemption. It is also not clear how much cost this could entail, as there is nothing in the provision that refers to the financial implications of materials substitution. If it is technical and scientifically possible, but incredibly expensive, to remove a substance from EEE, would that be covered under the ROHS exemptions? The ROHS directive could be made more robust if, at the minimum, some dispute resolution procedures on this point were included in its provisions, or if more precise definitions of terms were provided.

Efforts will also be undertaken to demonstrate that the environment, health, and/or consumer safety impacts of a substitute are greater than the benefits, and therefore the original substance should be exempt. There is nothing in the directive that indicates how impacts and benefits along these lines are to be assessed, who should assess them, or whether any attempts to do so would be subject to third party verification. It would not be very difficult for interested parties to

[205] Hunter et al (undated) point out that the main uses of mercury in electronics are exempt from ROHS and that use of PBB and PBDE has already been phased out in Europe. The EEB (2001b) agrees with the latter point.
[206] This language is based on EP (2002a) and EC (2002a).

commission studies that would consistently favor their position on a particular substitute. Again, some dispute resolution mechanism will be necessary to resolve these differences.

The list of exemptions in ROHS is perhaps the clearest example of the influence of stakeholder submissions over the development of the directives because it is very easy to see the specific additions to the exemptions that have occurred and determine who proposed them. This result should not be surprising, in light of the background presented in Chapter 1.

ROHS is obviously relatively stringent and should therefore induce some innovation in response. Given the nature of the chemicals involved, a stringent regulation is probably the appropriate policy initiative, both from an environmental and health protection perspective and an innovation perspective. However, the long list of exemptions curtails the innovative potential and other benefits of ROHS, as does the already occurring phase out of PBB and PBDE.

What is particularly odd is that there are not any requirements for the exempted equipment, though it contains the same substances. Perhaps, in some circumstances, it simply is not possible for certain equipment to meet the ROHS deadline. In that case, the deadline should be extended, or a decreasing allowable limit of the substance could be put in place, or research into replacements could be conducted. ROHS could also be more proactive regarding the likely PBB and PBDE substitutes. For example, the leading substitutes may not be brominated flame retardants, but they could have other negative environmental impacts. Rather than allow the next generation of marginally better substances on the market, why not require a dramatic improvement? At present ROHS seems to be very black and white, either demanding radical or disruptive innovation in the search for substitutes, or requiring nothing.[207]

3.4.11 The question of plastics[208]

Plastics are a particular sticking point in WEEE because they are comparatively difficult to recycle and incineration can cause hazardous emissions. Yet plastics are bound to play a key role in fulfilling the directives, partially because of concerns about halogenated flame retardants, and partially because the reuse/recycling requirements are high enough that the plastics fraction of WEEE probably cannot be ignored.[209]

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[207] Note that the innovation in terms of technology or the substitute's mechanical or chemical properties may be radical or disruptive, but the environmental improvement could still only be marginal.

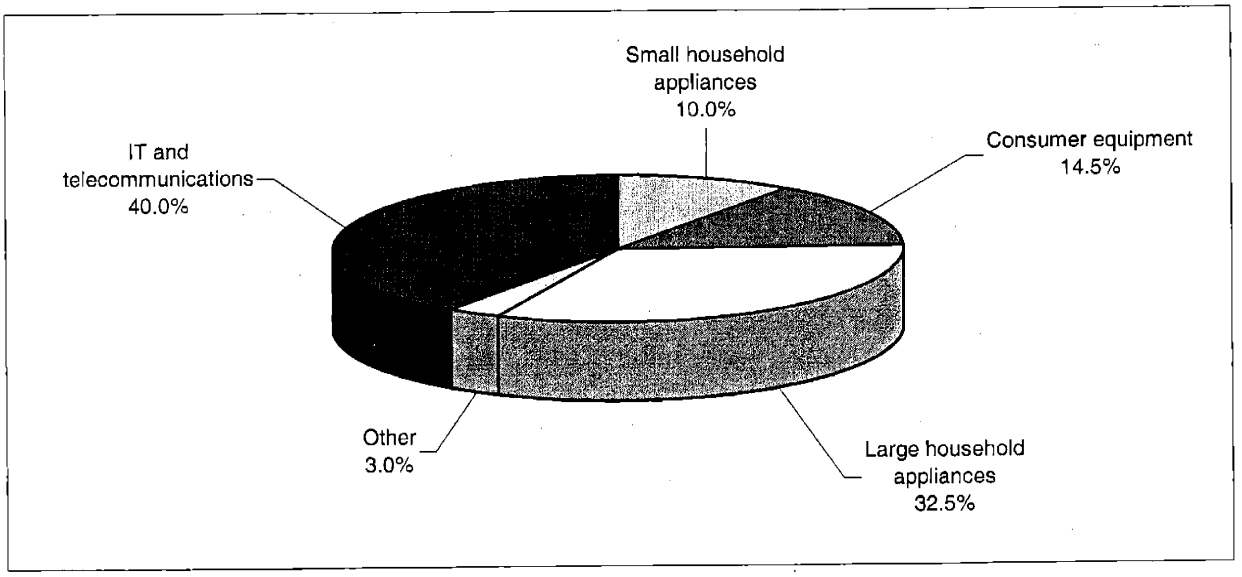
[208] As with the chapter on US policy, the information in this section is largely from industry sources due to a lack of academic research on plastics recycling and associated secondary markets (Boks and Stevels, 2001). This may be beginning to change, perhaps due to the WEEE directive (see Goodship et al, 2002).

[209] On average, plastics are 20% by weight of EEE (APME, 2001, p. 1; ICER, 2000). Assuming this average applies to large household appliances and plastics are not at all reused/recycled or recovered, then 94% of the remaining material in large household appliances would have to be reused/recycled to meet the WEEE target, and 100% of the remaining material would have to be recovered. Under the same assumptions, 81% of the remaining weight of IT equipment would have to be reused/recycled, and 94% recovered. APME (2001, p. 4) estimates that IT equipment is actually 26% plastic, which would make achieving the targets even more difficult. ICER (2000, pp. 21, 32) data show that the plastic content of telephones, small household appliances, radio/TV equipment, and computers is 74%, 49%, 31%, and 27% respectively, in which case it would literally be impossible to meet the recycle/reuse targets for these items without making use of the plastics fraction.

The total consumption of plastics resins by EEE industries in Western Europe was nearly 1.9 million tonnes in 1995 (NSC, 1999, p. 10) and 2.6 million tonnes in 2000 (APME, 2001, p. 2). If plastic is 20% of EEE on average (APME, 2001, p. 2), then 1.8 million tonnes of plastic will be collected as part of WEEE.

Though there is a trend for greater numbers of plastic resins to be used in EEE, the resins ABS, PS, and PP together account for 70% of plastics use in EEE (over 1 million tonnes) (APME, 2001, p. 2).[210] Use of plastics is also heavily concentrated within the EEE categories of large household appliances, IT and telecommunications equipment, and consumer equipment, which together account for 85% of the plastics used in EEE as shown in Figure 17 (APME, 2001).[211]

Figure 17 Plastics use in EEE



The conclusion that can be drawn from the discussion so far is that plastics are concentrated in only a few categories of EEE, and three types of plastic comprise the vast majority of plastics used in EEE. Both of these facts bode well for the possibility of future plastics reuse/recycling, which may be necessary to reach existing targets, and will almost certainly become necessary should those targets increase.[212]

The plastics in WEEE that is projected to be collected follows a similar pattern as that just discussed regarding plastics consumption, with IT and telecommunications, large household equipment, and consumer equipment accounting for nearly 90% of the plastic in WEEE, as shown in Figure 18 (APME, 2001).

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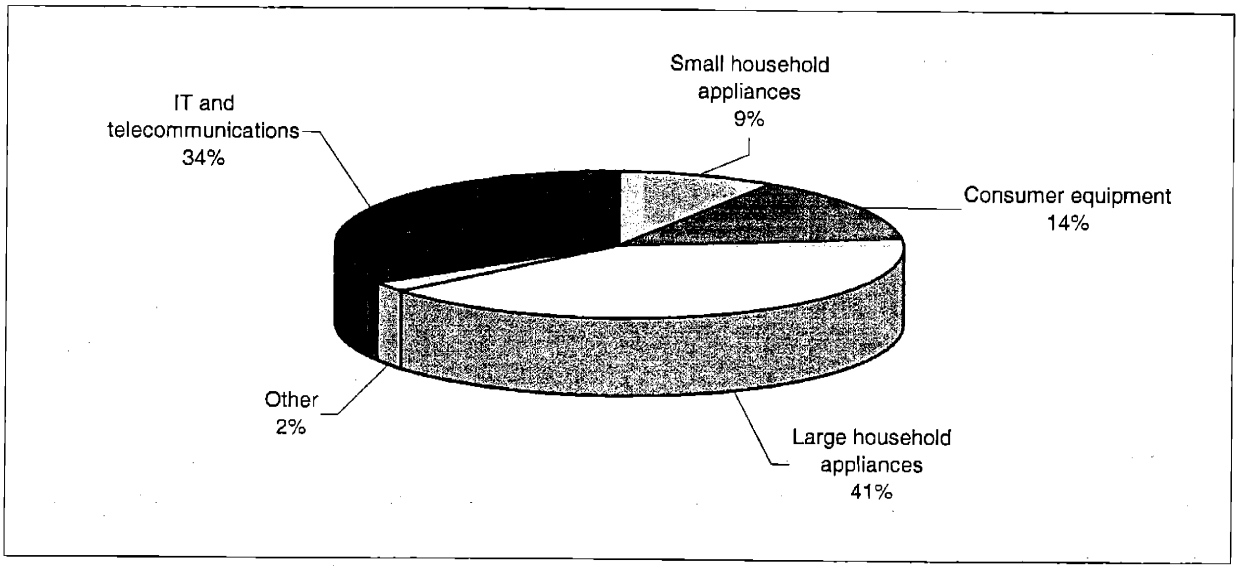
[210] ABS acrylonitrile butadiene styrene; PS polystyrene; PP polypropylene. ICER (2000) also includes PVC, PC, and HDPE in the list of "primary polymers" used in EEE, but it is not clear what the basis was for selecting the polymers.

[211] Recall that these same EEE categories are the ones that comprise 90% of WEEE.

[212] Boks and Stevels (2001, p. 520) state that "technology as such is not perceived as an obstacle for end-of-life plastics processing" and their scenario analysis found that in most cases an increase in plastics recovery would be necessary to reach WEEE targets. Their analysis also found that increases in economies of scale and in the use of high value plastics in EEE would have the most positive impacts on overall costs, followed by mandatory targets.

Figure 18 Projected plastics from WEEE



Flame retardants are only used in about 12% of the plastics in EEE, and then predominantly in IT and telecommunications equipment (PCs, monitors, printers, copiers) and consumer equipment (TVs) (APME, 2001, p. 6). Based on the WEEE directive, it is not certain what should be done with plastics coated with flame retardants. Though the explanatory memorandum highlights a number of environmental issues associated with the incineration of flame retardants, there is no provision in WEEE for special treatment of plastics coated with them. It may be quite difficult to separate out plastics with flame retardants from those without.[213] It should be pointed out that incineration of plastics coated with flame retardants does not necessarily lead to the creation of toxic byproducts.[214]

APME states that for "effective and economic recycling there is a need for clearly defined, high quality waste streams" (2001, p. 8). Their own data and statements indicate that the plastics in WEEE are concentrated by type and WEEE category; therefore recycling operations should indeed be possible. However, this may mean that plastics from other sources, especially if existing in small quantities or co-mingled, may not be eligible for recycling operations.[215] In that case, it might be better to recover the plastic fraction rather than send it to landfill.[216] Some of the barriers to plastics recycling, such as use of labels, bonded materials, and multiple types of plastic, could be addressed at the design stage or through improved recycling technology. The

[213] Boks and Stevels (2001) rightly point out that manufacturers could facilitate the development of plastics recycling if the plastic parts used in EEE did not contain contamination that would decrease recyclability.
[214] Provided combustion is at a high enough temperature and in the absence of oxygen.
[215] On the other hand, given the likely necessity of recovering plastics to meet the WEEE targets, having to handle complex plastics streams might encourage innovation in light of the high costs associated with doing so using current technology. (see Arola and Biddle, 2001)
[216] See Mark and Lehner (2000) for an account of using PC scrap in a smelting plant, with no significant change in environmental impacts. Note, also, that France has set a target of 75% for recycling of plastics waste (http://star.eea.eu.int/showResult.asp?selection=1377&themeID=8&class=inst&instr=Intiative).

problem of identification and separation, on the other hand, is almost exclusively a technological issue.[217]

As the need to utilize the plastics fraction in order to meet recovery and reuse/recycling targets increases, more specific thought on these questions might be warranted, in order to ensure environmentally preferable outcomes.[218] At present, the possibility of addressing specific waste fractions is not built into the WEEE directive.

If it is possible to reach the WEEE targets using current technologies and ignoring the plastics fraction, industrial actors will probably do so. If plastics recycling is truly going to occur, that fraction of the materials must be specifically addressed, or the targets for categories of WEEE must be deliberately set high enough so that the plastics must be dealt with.[219]

Yet even if some plastic must be recycled to meet the targets, that may not require innovation in plastics recycling technology. Producers could first reduce the number of different plastics used and reduce the use of coatings, labels, etc. In other words, to change the things that are directly under their control. Technologies for identifying, sorting, and actually recycling plastics are farther from EEE producers' area of expertise, and hence it will require stronger incentives for producers to seriously consider those options. Those incentives could come in the form of the revised targets, to take effect five years after entry into force of the directive.

3.4.12 Recycled content

In early, pre-publication drafts of the directives, there was a provision that producers use at least 5% recycled plastics content in new EEE (Snowdon et al, 2000; SVTC, undated).[220] However, any provision to this effect was removed before the publication of the proposed directive (EC, 2000). There is a statement in Recital 15 of EC (2001) stating that "producers should be encouraged to integrate recycled material in new equipment". This is not, however, a legally binding requirement; nor does it receive any elaboration in the Articles. There is also not any indication that a discussion ever took place to mandate the inclusion of a certain amount of recyclable material in WEEE. This would be particularly relevant for plastics, and would give some assurance to recyclers of a guaranteed stream of material to input into their processes. For all the rhetoric about recycling surrounding the WEEE directive, it is particularly surprising that there is not a requirement to use recycled or recyclable content in new EEE. It is also surprising that the stakeholder submissions do not raise this point.

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[217] ICER (2000) highlighted these barriers to plastics recycling.

[218] Some early modeling work along these lines is in Mayne and Fisch (2002).

[219] EEB (2002) specifically wanted a requirement that 5% of the plastic components of WEEE be recycled.

[220] The second draft had a provision for 5% recycled plastics content, which was replaced in the third draft by a target to reduce the number of different plastics used in EEE (Snowdon et al, 2000). The fourth draft required the marking of all plastic parts weighing more than 50 grams. None of these provisions appear in the official published draft. The SVTC claims this change is the result of industry lobbying, including US industry. The original explanatory memorandum also had a reference to closed loop recycling of CRT glass, which has also been removed (see EEB, 2001b, p. 28). For the full text of the second draft of WEEE, see http://www.svtc.org/cleancc/weee/euweee/directive/weee2nd.htm; for the fourth draft (including the explanatory memorandum), see http://www.svtc.org/cleancc/weee/euweee/directive/weee4th.htm. Glass, and especially plastics, have presumably been singled out because of limited recycling and smaller markets, in comparison to metals.

Well over 50% of all the WEEE collected must be reused or recycled, or over 1 million tonnes per year. It is crucial that these recycled materials have viable markets where they can be used, or many of the benefits of WEEE and ROHS will not be realized. Markets may already exist for these materials, but may not be able to absorb such a sudden and dramatic increase in supply. Requiring recycled or recyclable content through regulation, or through public sector purchasing, can create the niche market that will help begin the transformation to a new technology. The definite existence of a market eliminates some of the uncertainty that attends innovation and product development, and will encourage those who have early success to forge ahead. The environmental benefits of the directives would be strengthened considerably if closed loop recycling were more rigorously required.

3.5 Summary of policy recommendations

Overall, WEEE and ROHS are quite comprehensive in their approach when taken together, and many of the above comments are on the form, rather than the substance, of the directives. Nevertheless, there are some concerns about the basis, scope, intent, and innovative potential of WEEE and ROHS. The directives could be improved in a number of ways, which are summarized below.

The explanatory memorandum accompanying the directives should be updated, with relevant new information added and major criticisms from stakeholders addressed. Specifically, more complete information should be provided on which hazardous materials are found in which categories of EEE, how much WEEE contributes to emissions that are of concern, and how much pollution will be prevented as a result of implementing the directives (taking into account the WEEE that is exempted). Health benefits could also be more specifically addressed. A more thorough analysis of existing household collection programs could also be presented, to determine an ambitious yet reasonable collection rate and to provide a range of the expected costs for WEEE collection and recycling based on current methods and technology. Additional information on the availability and environmental impacts of likely substitutes for those substances subject to phase out under ROHS should be given. The objective should not be to provide a risk assessment or cost benefit analysis, but rather to present the pertinent facts clearly, concisely, logically, and with full bibliographic information, so that stakeholders reading the explanatory memorandum can arrive at their own conclusions about the necessity of the directives.

The definition of WEEE is very broad. Large household appliances, IT equipment, and consumer equipment together comprise around 90% of WEEE, by weight. Perhaps the definition of WEEE could be narrowed if certain aspects of EEE were of particular concern, such as hazardous substances, landfill space, or overall environmental impacts upon disposal. This might serve to reduce the number of products or categories of WEEE while still achieving most of the desired benefits and reducing financial, administrative, and bureaucratic burdens.

The 6kg per person per year target appears ambitious but not unreachable. This is precisely the type of target that could lead to organizational and institutional innovation on the part of the local authorities who will be collecting WEEE. A deposit-refund system should be considered for small appliances in order to increase collection rates for that category of WEEE and to help

defray costs.[221] Local authorities should be given some advance indication of increases in collection targets so they will be able to adjust their collection systems if necessary. Changes in the collection target should consider whether the increased costs are affordable, the environmental benefits substantial, and the recycled materials marketable.

The recovery and reuse/recycling targets can probably be met with current technology, and hence are likely to encourage diffusion or incremental innovation. The targets in WEEE are generally the same, or slightly above, the targets that are already being reached in pilot programs across Europe and can therefore most likely be reached with current technology. The only possibility for disruptive innovation to occur is if it is simply too expensive to reach the targets with current technology. Higher future targets should be specified well in advance, to encourage and allow time for the development of radical or disruptive innovations in recycling technology, assuming the new targets are beyond the reach of current technological capability. Reuse of whole pieces of equipment should count toward the targets to emphasize the importance of reuse in the waste hierarchy. Waiting to introduce reuse into the targets creates unnecessary adjustment costs.

Consideration should be given to requiring different reuse/recycling and recovery rates for different materials fractions such as ferrous metals, non-ferrous metals, glass, plastics, etc., rather than for entire pieces of equipment. Materials fractions targets could be structured so that the overall targets currently in place were reached. The point is to reuse/recycle and recover the metal, glass, and plastics that are contained in EEE, not the EEE itself. Structuring the targets along those lines might allow for better fine-tuning of recycling efforts and technologies.

Such an approach would be particularly useful for the recycling of plastics. If it is possible to reach the WEEE targets using current technologies and ignoring the plastics fraction, industrial actors will probably do so. If plastics recycling is truly going to occur, that fraction of the materials must be specifically addressed, or the targets for categories of WEEE must be deliberately set high enough so that the plastics must be dealt with.

Plastic is a sizable fraction of WEEE, and the need to utilize the plastics fraction in order to meet recovery and reuse/recycling targets will increase as those targets are revised upward, though more specific analysis of this might be required in order to ensure environmentally preferable outcomes. Plastics are concentrated both by type (3 kinds account for over 70% of plastic in EEE) and by WEEE category (85% of plastic is in the same three categories that comprise 90% of WEEE by weight). This bodes well for recycling efforts.

Yet even if some plastic must be recycled to meet the targets, that may not require innovation in plastics recycling technology. Producers could first reduce the number of different plastics used and reduce the use of coatings, labels, multiple types, etc. Technologies for identifying, sorting, and actually recycling plastics are farther from EEE producers' area of expertise, and hence it will require stronger incentives for producers to seriously consider those options. Those incentives could come in the form of the revised targets.[222] EU governments could also facilitate

[221] See footnote 190 for details.

[222] Since plastic is a nonassembled product, Utterback (1996) would suggest that an industry insider still has a good chance of successfully developing a disruptive innovation. This would probably apply to ROHS substitutes as well. Disruptive innovations in the EEE itself, i.e., in assembled products, is very likely to come from industry outsiders.

the development of plastics recycling technologies through joint research or demonstration projects.

Producers should at least partially subsidize the cost of collecting WEEE from households. Extended producer responsibility should extend to all costs resulting from waste management of products, and having society bear collection costs is not in keeping with the broader aims of the directives. Local authorities will almost certainly require additional financing to separately collect WEEE, and there is no reason why the necessary funds should not come, in part, from producers, as they and their customers are the people who purchase and benefit from EEE. Collection costs could easily be put under the control of producers, who would then have an incentive to be diligent about efficient collection. In the simplest case, producers could simply subcontract the collection responsibilities to local authorities, who would be paid for their efforts. Alternatively, collection could be subsidized through a surcharge, above the cost of WEEE treatment, which is hypothecated to local authorities. Alternatively, the subsidy could be a one-time investment in necessary infrastructure for local authorities.

A strict reading of producer responsibility would also require each producer to pay for treatment of his historic WEEE regardless of the change in fortune they experience between when products were put on the market and when historic WEEE treatments costs are incurred. However, the compromise on this point, where financing of historic WEEE is based on current market share, is acceptable. The method of determining market share should be carefully considered. Market share by weight seems to be the likely metric, but this is not necessarily linked to treatment costs and it downplays the assumed link to willingness to pay. It also introduces the possibility that EEE would become lighter but more difficult to manage at the end of its life. A metric that is more reflective of treatment costs would be preferable, as would one that is not likely to be underestimated. There is nothing wrong with a visible fee charged to consumers for the treatment of historic WEEE, provided that said fee reflects the costs of treatment. Consumers should be aware that their past choices have environmental consequences.

Producers should be responsible for financing the treatment of free riders. Contrary to industry arguments, there is no additional incentive to free ride if producers pay, as opposed to a situation where free riders are financed by society. In addition, financing by producers creates additional incentives to locate free riders and maximize the efficiency of the producer's individual and collective treatment systems.

At the same time, the problem of free riders should be minimized by producers being obligated to provide financial guarantees. The method used to determine the level of the guarantees should be carefully considered. Metrics that producers will want to maximize and have publicly known, such as number of units sold, may be a useful approach. However, consistency between the metric used to determine the guarantee and for determining the financing of historic and orphan WEEE might be desirable. Whatever method of dealing with free riders is finally agreed upon, it should also apply if the guarantees that have been provided are not enough to cover WEEE treatment costs.

The exemptions already built in to ROHS are a bit troubling. It is unclear what process was used to determine the exemptions from ROHS and it is not possible to determine the effect the

exemptions will have on future emissions or costs. It appears industry has had a substantial influence in determining the ROHS exemptions. If lead and mercury are substances of primary concern, it might be wise to determine how much lead and mercury will still be disposed of in the environment due to the exemptions given, and to see if those exemptions are still worthwhile. It is also unclear to what extent product or process alterations or redesign must be attempted before granting additional exemptions, or how much expense can be incurred in order to find a substitute for a material.

In addition, any exemptions limit the incentive for innovation that the substance bans in ROHS would otherwise encourage. Rather than granting full exemptions via an opaque process, ROHS should instead consider extending deadlines, decreasing the allowable limit of substances in certain types of equipment, or conducting research into substitutes. ROHS could also be more proactive regarding the likely PBB and PBDE substitutes, since these are widely considered to be exiting the market already. Oddly, through banning substances ROHS requires a radical or disruptive technical innovation, while in the process only requiring a marginal environmental improvement. ROHS then sets itself up for future disputes on whether the environmental impacts of the substitute are such that they should be banned as well.

The ROHS directive should consider creating tighter definitions of terms to avoid extended disputes about exemptions. Dispute resolution procedures should make clear how questions of scientific or technical impossibility and environmental, health, and consumer impacts will be assessed. At a minimum, any such assessments should be conducted by a competent body and subject to outside scrutiny, yet even these basic ideas are not included in the directive.

Finally, the WEEE directive should reinstate requirements to use recycled content in new EEE and/or to add a requirement to use recyclable content. This is necessary to close the loop on the recycling question. Markets may already exist for the recycled materials derived from WEEE, but existing markets may not be able to absorb such a sudden and dramatic increase in supply. Requiring recycled or recyclable content through regulation, or through public sector purchasing, can create the niche market that will help begin the transformation to a new technology. The definite existence of a market eliminates some of the uncertainty that attends the innovation and product development processes, and will encourage those who have early success to continue. The environmental benefits of the directives would be strengthened considerably if closed loop recycling were more rigorously required.

In summary, the WEEE and ROHS directives could be significantly more innovation-oriented by requiring higher reuse/recycling and recovery targets, by granting fewer outright exemptions from ROHS, and by creating markets for recycled materials.

Some observers were already quite alarmed by the provisions contained in the two directives as they were being drafted, let alone any new provisions that may be included to make them more innovation-oriented. In an effort to proactively organize against the directives, several organizations began assembling critiques of WEEE and ROHS and their legality under World Trade Organization (WTO) rules. Their arguments, and the counter arguments offered in return, are analyzed in the next chapter along with relevant WTO rules and cases, to see if the more controversial provisions of the directives would survive a WTO challenge.

4 EU Policy and the World Trade Organization

Though the WEEE and ROHS directives have not yet been passed into law, various organizations have already been establishing their positions on whether portions of the directives would withstand challenge in the World Trade Organization (WTO).[223] This chapter will assess the *prima facie* case of each side's claim in this regard, and highlight the precedence and case law most relevant to analyzing any future disputes brought to the WTO. It is important to note that, in general, WEEE has not been viewed as contradicting the WTO. Nearly all of the discussion has focused on ROHS, and on early requirements for recycled plastics content and export of WEEE for treatment in other countries.[224]

4.1 WTO background

The WTO incorporates the agreements and principles of the General Agreement on Tariffs and Trade (GATT) and is the premier international organization dealing with the global rules of trade between nations. For the purposes of this discussion, there are a few key provisions of the GATT that should be highlighted.[225] These will be quoted so that the exact language of the Agreement can inform the discussion that follows.

Article 1 of the GATT establishes the principle of Most Favored Nation treatment, or, in the language of the Agreement itself (GATT, 1986)

> ...any advantage, favour, privilege or immunity granted by any contracting party to any product originating in or destined for any other country shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other contracting parties.

[223] The organizations are the American Electronics Association (AEA, 1999), the Silicon Valley Toxics Coalition (SVTC, 1999), and also Hunter and Lopes-Torrez (1999). All three have close ties with the US. Very few European stakeholder submissions in the drafting process referred directly to WTO compatibility, though a few made similar arguments. The actual arguments put forward in these documents are based on early drafts of WEEE and ROHS and therefore are not necessarily directly applicable to the current texts. However, their broad lines would remain the same. It is also important to bear in mind that only governments of WTO member countries can actually bring suit in a WTO dispute, which means that none of these three organizations would have standing in the WTO. However, the AEA et al (2001) have already been in touch with the US Trade Representative, so it is entirely possible that a suit could be brought by the US or another WTO member. Indeed, the USTR seemed to respond favorably to the letter from AEA et al (see Zoellick, 2001). Finally, any suit brought to the WTO would assess the specific circumstances of the implementation of WEEE and ROHS in a particular country, which means that this discussion is necessarily general.

[224] These latter two provisions no longer appear in WEEE or ROHS, but recycled plastics content will be analyzed in light of the policy recommendations made in Chapter 3.

[225] These have been chosen because they were specifically incorporated into the AEA and SVTC critiques of ROHS and GATT. Other provisions of WTO agreements may also be relevant, but will not be considered here. For example, Article 2.8 of the TBT states that wherever appropriate, technical regulations should be based on product requirements in terms of performance rather than design or descriptive characteristics. It could be argued that ROHS is descriptive, rather than performance based, and hence possibly in violation. But this was not brought up in any stakeholder critiques of ROHS.

Article III of the GATT establishes the principle of national treatment, which ensures that there will not be discrimination against imported products. In the language of Article III(4) (GATT, 1986)

> The products of the territory of any contracting party imported into the territory of any other contracting party shall be accorded treatment no less favourable than that accorded to like products of national origin in respect of all laws, regulations and requirements affecting their internal sale, offering for sale, purchase, transportation, distribution or use.

Finally, Article XI of the GATT governs the behavior of members' use of quantitative restrictions in trade, and specifically Article XI(1) states that (GATT, 1986)

> No prohibitions or restrictions other than duties, taxes or other charges, whether made effective through quotas, import or export licences or other measures, shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party or on the exportation or sale for export of any product destined for the territory of any other contracting party.

It is possible to implement policies that would appear to contravene one of the above Articles, if such a policy fell under one of the exceptions listed in Article XX. The introductory clause of Article XX (the chapeau) sets the general tone for the allowable exceptions, and then follows up with a list of ten specific exceptions. The chapeau and the two exceptions relevant to the discussion here are (GATT, 1986)

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures:
>
> (b) necessary to protect human, animal or plant life or health;
>
> (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.

Arguments about the legality of measures contained in WEEE and ROHS have also been based on the text of the Agreement on Technical Barriers to Trade (TBT), which is part of the GATT.[226] The TBT attempts to ensure that regulations and standards are applied equally to imported and domestic products, and that they do not create unnecessary barriers to international trade. The preamble to the TBT states, in part,

> that technical regulations and standards, including packaging, marking and labelling requirements, and procedures for assessment of conformity with technical regulations and standards do not create unnecessary obstacles to international trade;

[226] The text of the TBT is technically in Annex 1 of the agreement establishing the WTO and is available on-line http://www.wto.org/english/docs_e/legal_e/final_e.htm.

and

> that no country should be prevented from taking measures necessary to ensure the quality of its exports, or for the protection of human, animal or plant life or health, of the environment, or for the prevention of deceptive practices, at the levels it considers appropriate, subject to the requirement that they are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail or a disguised restriction on international trade, and are otherwise in accordance with the provisions of this Agreement;

Article 2.2 of the TBT states that

> Members shall ensure that technical regulations are not prepared, adopted or applied with a view to or with the effect of creating unnecessary obstacles to international trade. For this purpose, technical regulations shall not be more trade-restrictive than necessary to fulfil a legitimate objective, taking account of the risks non-fulfilment would create. Such legitimate objectives are, *inter alia*: national security requirements; the prevention of deceptive practices; protection of human health or safety, animal or plant life or health, or the environment. In assessing such risks, relevant elements of consideration are, *inter alia*: available scientific and technical information, related processing technology or intended end-uses of products.

With these salient points of the GATT now in mind, we can turn to the debate on whether portions of the WEEE and ROHS directives would contravene the GATT or the TBT and whether they would qualify as allowable exceptions.[227]

4.2 ROHS and GATT XX(b)

It has been argued (AEA, 1999; Hunter and Lopez-Torres, 1999)[228] that ROHS would violate Article XI(1) of the GATT and not qualify for an exception under Article XX(b) because:

- no evidence has been provided that use of ROHS substances in EEE poses a threat to human health or the environment, or that alternatives (if available) could eliminate such risks[229]

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[227] There are a number of larger WTO issues that will not be covered here. For example, this discussion assumes any challenge would be directed toward an individual country, after WEEE and ROHS have been transposed into national law. However, the EC is a member of the WTO and in theory could be brought before a Dispute Settlement Body in reference to WEEE or ROHS. In addition, the fact that different national governments have agreed to WEEE and ROHS could be taken to mean they are fulfilling obligations under a Multilateral Environmental Agreement (MEA). The relationship between the rules of MEAs and the WTO is not clear, particularly if the requirements of the MEA affect trade with nations who are not party to the MEA. Any suit brought against an individual country in the EU by an outside country could encounter this area of law under the WTO, but this also will not be considered here.

[228] Hunter and Lopez-Torres (1999) have also been cited as being affiliated with the AEA (see CGCAP, 2002), and the arguments made in AEA (1999) and Hunter and Lopez-Torres (1999) are indeed very similar.

[229] The AEA (1999) and Hunter and Lopez-Torres (1999) cite specifically a lack of risk assessment, lack of evidence that WEEE presents higher or differential risks from other types of waste, and weak scientific evidence provided in

- a ban of the substances used specifically in EEE, without the backing of a scientific risk assessment, does not appear to be part of a policy designed to protect health and the environment
- ROHS is not necessary to fulfill environmental protection objectives
- a measure may not be justified under XX(b) if an alternative measure which could be reasonably employed and is not inconsistent with other GATT provisions is available, and, when that is not possible, the measure used must be the least inconsistent with GATT provisions[230]
- ROHS fails these criteria because other policies such as selective landfill bans, eco-taxes, technical requirements for landfills and incinerators, etc. are available, have not been used, and the failure to use them has not been justified.

Offering counterpoint to the above, the SVTC (1999) argues that ROHS may not contravene Article XI(1) in the first place.[231] Assuming ROHS did contravene Article XI(1):

- ROHS is certainly a measure designed to protect human, animal or plant life or health
- nations are free to set their own environmental policy objectives, so this cannot be questioned
- XX(b) does not require a valid risk assessment be performed
- the so-called necessity test applies to the necessity of the measure to reach the environmental goal, not the necessity of the measure in terms of the least restrictive in trade
- other measures cannot achieve the same level of environmental protection as ROHS.

It is possible that ROHS would be viewed as counter to Article XI(1), as it would put a restriction on importing EEE that contained the substances banned under the directive.[232] However, it is more likely that ROHS could be found to be in violation of Article III(4), following the reasoning of the Panel in *Asbestos*.[233] Whether ROHS was deemed to be a violation of either, the directive could still be allowable under Article XX(b).

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the explanatory memorandum accompanying the directives. Their case is more difficult to make in light of the data now provided in EC (2000). In a slight surprise, both papers also suggest that any restrictions on the use of substances should apply to all consumer and industrial products, rather than only to EEE. They also seem to overlook that exemptions can be granted under ROHS if the substitute is more damaging to the environment, health, and/or consumer safety than the original material.

[230] These statements are based on GATT (1990 at 74-75; hereinafter *Cigarettes*). There is some rationale for why other measures are not suitable in EC (2000).

[231] In support, the SVTC (1999) cites the EC submission to WTO (2000; herinafter *Asbestos*) and *Cigarettes* (at 77): "A non-discriminatory regulation implemented on a national treatment basis in accordance with Article III(4) requiring complete disclosure of ingredients, coupled with a ban on unhealthy substances, would be an alternative consistent with the General Agreement."

[232] The *Cigarettes* citation in footnote 231 refers to Article III(4), not article XI(1), and the EC submission in *Asbestos* was not necessarily persuasive to the Panel.

[233] *Asbestos* was not publicly available at the time the AEA, SVTC, and Hunter and Lopez-Torres comments were written. *Asbestos* determined that a measure that applies to an imported product and the like domestic product and is enforced at the time or point of importation would fall afoul of Article III (at 8.88 of *Asbestos*). It is not yet known how exactly ROHS would be implemented, i.e., if imported EEE would somehow be screened for the banned substances, and therefore it is not possible to determine with precision if any violations of Article III or Article XI would occur.

In order to make a case for an exception under Article XX(b) it must be shown (WTO, 1996, at 6.20; hereinafter *Gasoline*)

(1) that the *policy* in respect of the measures for which the provision was invoked fell within the range of policies designed to protect human, animal or plant life or health;
(2) that the inconsistent measures for which the exception was being invoked were *necessary* to fulfil the policy objective; and
(3) that the measures were applied in conformity with the requirements of the *introductory clause* of Article XX.

4.2.1 XX(b): the range of policies

The Panel in *Asbestos* (at 8.170) interprets clause (1) above to require a determination of whether there is a risk to human, animal, or plant life or health, while keeping in mind that the necessity of the policy goal should not be examined (*Gasoline*, at 6.22). In principle, a policy that seeks to reduce exposure to a risk should fall within the range of policies designed to protect human life or health, insofar as a risk exists (*Asbestos*, at 8.186).

The Panel in *Asbestos* was able to conclude that the measure in question posed a risk to human health because the evidence "tends to show" (at 8.193) such a risk. The discretion of the Panel in making this determination was upheld by the Appellate Body, and, furthermore, the Appellate Body also held that there is no requirement under Article XX(b) that risks must be quantified (WTO, 2001, at 167; hereinafter *Asbestos II*).[234] The most recent case law as embodied in the Asbestos decision lends strong support to the general arguments made by the SVTC in regards to ROHS and Article XX(b).[235] Given the clear link between reducing use of hazardous materials and protection of human, animal, or plant life or health, the current version of ROHS could probably satisfy this clause of Article XX(b).

4.2.2 XX(b): necessity

The precise requirements for meeting the burden of proof for clause (2) above have been the subject of some controversy. *Cigarettes* quotes an earlier Panel decision in saying

> a contracting party cannot justify a measure inconsistent with other GATT provisions as 'necessary' in terms of Article XX(d) if an alternative measure which it could reasonably

[234] The findings in *Asbestos* and *Asbestos II* improve the chances that the current explanatory memorandum, including the memorandum on scientific evaluation contained therein, would be useful in a XX(b) case (see EC, 2000).
[235] ROHS (EC, 2001a) also contains a number of statements that would buttress any claim to an exception under Article XX(b) of the GATT, including that the substances "pose risks to health or the environment" (Recital 5); "the most effective way of ensuring the significant reduction of risks to health and the environment" (Recital 6); "The substances covered by this Directive are scientifically well researched and evaluated" (Recital 7); "The measures provided for in this Directive...are based on an assessment of available scientific and technical information" (Recital 8); "The purpose of this Directive is to ... contribute to the protection of human health" (Article 1).

> be expected to employ and which is not inconsistent with other GATT provisions is available to it (*Cigarettes*, at 74).

This same idea was held to apply to Article XX(b) and led the Panel in *Cigarettes* to conclude

> that the import restrictions imposed by Thailand could be considered to be 'necessary' in terms of Article XX(b) only if there were no alternative measure consistent with the General Agreement, or less inconsistent with it, which Thailand could reasonably be expected to employ to achieve its health policy objectives (at 75).

The phrasing of the Panel's ruling in *Cigarettes* has led to some considerable discussion about the meaning of "reasonably be expected to employ". However, this particular standard is not absolute. In *Asbestos*, the most recent WTO environmental case dealing with Article XX(b), the Panel found that "the determination of the existence of other measures consistent or less inconsistent with the GATT largely depends on a scientific assessment of the [health] risk" (at 8.183).[236]

In addition, one recent case has approached the question of necessity in a slightly different way. In *Gasoline*, the Panel considered the relevant question to be whether the GATT-inconsistent measures were necessary to achieve the policy goal, as opposed to necessary in terms of their effect on trade (at 6.22).

Thus, the ability of ROHS to withstand WTO challenge would depend in part on how the concept of "necessity" is interpreted. The Recitals in ROHS claim that "the most effective way of ensuring the significant reduction of risks to health and the environment ... is the substitution of those substances" in EEE (Recital 6) and "the measures are necessary to achieve the chosen level of protection" (Recital 8). However, the stated objective in Article 1 of ROHS is only to "contribute to the protection of human health" (EC, 2001a).

If the goal is considered to be only to contribute to the protection of human health, then it is possible that (1) a less trade restrictive measure could reasonably be employed to achieve this aim;[237] (2) the risk from the substances may not be great enough to justify a ban;[238] or (3) a ban may not be necessary to achieve the stated aim.[239] In any of these three cases, the overall aim of

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[236] If ROHS were found to be in violation of Article III(4), the health effects of the chemicals being banned and their possible substitutes might also be considered by the dispute panel in determining if they are "like products" (though the health risks would not be considered as a separate criterion) (see *Asbestos II*, at 113).

[237] EC (2000) does provide some rationale for why other policy options would not achieve the "significant reduction of risks to the health and the environment" sought by the directives (see p. 12).

[238] In *Asbestos*, the extent of the health problem was found to have a bearing on the necessity of the measure, and if the health effects were less than alleged, less vigorous measures might be justified (at 8.176). The Panel in *Asbestos* stressed that there was no threshold or duration below which exposure to chrysotile asbestos would have no effect (at 8.202). The Appellate Body in *Asbestos II* (at 172) found that "In this case, the objective pursued by the measure is the preservation of human life and health through the elimination, or reduction, of the well-known, and life-threatening, health risks posed by asbestos fibres. The value pursued is both vital and important in the highest degree. The remaining question, then, is whether there is an alternative measure that would achieve the same end and that is less restrictive of trade than a prohibition." Thus, in the asbestos cases, the fact that the health effects of asbestos were well known and severe was an important factor in the legal arguments. Other substances may not enjoy that advantage.

[239] In *Asbestos*, France's stated aim was to "halt" the spread of asbestos-related health risks; if anything, the reasoning in that case makes it appear that a stricter stated aim (more than "significant reduction" in Article 6 of

ROHS to significantly reduce risks or contribute to the protection of human health may not be interpreted as requiring a ban of substances in EEE.[240]

Note that the existence of any possible risks attending the use of a substitute need not be considered under the necessity clause of XX(b) (*Asbestos II*, at 168). In the Panel decision in Asbestos (at 8.221) it was determined that

> to make the adoption of health measures concerning a definite risk depend upon establishing with certainty a risk already assessed as being lower than that created by chrysotile would have the effect of preventing any possibility of legislating in the field of public health. In fact, it would mean waiting until scientific certainty, which is often difficult to achieve, had been established over the whole of a particular field before public health measures could be implemented.

However, it seems unwise not to require some showing that the likely substitutes are less harmful than the original substance. This need not take the form of a full quantitative risk assessment, but replacing a substance with a more hazardous material would surely defeat the aims of any policy designed to protect health. *Asbestos II* found that it is "perfectly legitimate for a Member to seek to halt the spread of a highly risky product while allowing the use of a less risky product in its place" (at 168), but this implicitly assumes the substitute is, in fact, less risky. Perhaps in the case of asbestos, this is accepted as common knowledge. This would not necessarily be true for other substances, however, and it seems human health protection would be better served by making a showing, perhaps through a comparative risk assessment, that human health would indeed be improved by the measure in question.[241]

The findings in all the recent cases point to the importance of clearly stating the risks that the stated policy is trying to address, and the severity of those risks. Even if a full quantitative risk assessment is not required, the WEEE and ROHS directives would be more robust to WTO challenge if the "Memorandum on Scientific Evaluation" contained in EC (2000) were strengthened and updated.[242] In addition, the findings in the recent *Asbestos* cases seem to create

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ROHS) would help the directive survive a WTO challenge. The Appellate Body in *Asbestos II* (at 174) held that "France could not reasonably be expected to employ *any* alternative measure if that measure would involve a continuation of the very risk that the [measure] seeks to 'halt'. Such an alternative measure would, in effect, prevent France from achieving its chosen level of health protection." In addition, Canada's arguments that workers could safely handle chrysotile-containing products was found not to be persuasive.

[240] In contrast, earlier drafts of WEEE talked about "minimizing", "minimizing as far as possible", or "minimizing to the maximum extent possible". See the second draft of WEEE (http://www.svtc.org/cleancc/weee/euweee/directive/weee2nd.htm) and the fourth draft (http://www.svtc.org/cleancc/weee/euweee/directive/weee4th.htm). The current explanatory memorandum (EC, 2000, p. 5) mentions minimizing risks and impacts to the environment, but this phrasing does not appear in the Recitals or Articles of WEEE or ROHS. It is entirely possible that other policy measures, such as eco-taxes or landfill bans or standards, would not be as effective as the ban in ROHS. But the key question is whether the other policy measures would be capable of achieving the stated aim of ROHS.

[241] ROHS addresses this by requiring the substitutes be less harmful in Article 5.

[242] Additional information would open up the possibility, for example, of conducting a comparative risk assessment. If exposure to substances in WEEE is the concern, and those substances are replaced with safer substitutes, then only the comparative safety of the substitutes need be shown, rather than a full quantitative assessment of exposure routes, ingestion rates, dose-response, etc.

an incentive to set very high policy targets. In light of those findings, it is not at all clear why the stronger language in the text of the actual directives has been toned down from earlier drafts.

4.2.3 XX(b): requirements of the chapeau

Finally, any exception to GATT allowable under Article XX(b), even if found to be necessary and within the range of policies designed to protect human, animal or plant life, must meet the requirements of the chapeau. The chapeau is designed to prevent the abuse of the exceptions allowed under Article XX. The requirements of the chapeau, as set forth in WTO (1996a; page 21; hereinafter *Gasoline II*), prohibit application of a measure that would constitute

(a) "arbitrary discrimination" (between countries where the same conditions prevail);
(b) "unjustifiable discrimination" (with the same qualifier); or
(c) "disguised restriction" on international trade.[243]

Discrimination includes discrimination between products from different supplier countries and discrimination between domestic and imported products (*Asbestos* at 8.227). On the face of it, ROHS would not discriminate on either of these counts, because the ban is comprehensive. However, it is possible that ROHS could be accused of discriminating among categories or products of EEE, in light of the exemptions already granted in the Annex of the directive. This would be particularly true if the existing exemptions correlated to particular producers or countries.[244] The importance of having some justification for the exemptions takes on additional significance, in light of possible WTO scrutiny.

Note that any analysis of ROHS at this stage in terms of the chapeau is rather difficult because the determining factor is the application of the measure, and the ROHS directive has not yet been finalized, let alone transposed into law in an EU member country.[245] For example, *Asbestos* (at 8.236) specifically states that the design, architecture, and revealing structure of the measure can shed light on whether the measures is a disguised restriction.

At this stage, all that can be said is that the way individual countries incorporate ROHS into national law will have a major impact on its GATT viability.[246]

There a few things which are worth mentioning in this regard. One is that even if ROHS is inextricably linked to WEEE, any problems ROHS may have with GATT will not automatically affect WEEE (see *Gasoline II*). This is significant, because the current version of WEEE does not contain any provisions that have been critiqued by stakeholders as to their GATT

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[243] WTO (1998, at 150; hereinafter *Shrimp*) explains the burden for meeting points (a) and (b) as: the application of the measure must result in discrimination, the discrimination must be arbitrary or unjustifiable, and the discrimination must occur between countries where the same conditions prevail.
[244] Given the apparent influence producers had in including specific exemptions, this is a possibility.
[245] *Gasoline II*, *Asbestos*, and *Shrimp* all stress the importance of how the measure is applied. *Shrimp* notes (at 160) that discrimination can also exist in the detailed operating requirements of the measure, but these are also not yet available for ROHS.
[246] EC (2000, p. 18) does state that "all measures in the proposed Directive have been designed in such a way so as to meet international obligations and to minimise potential trade impacts. The need to avoid unnecessary obstacles to trade has been duly taken into account."

compatibility. Thus, even if ROHS is deemed in violation of the GATT, WEEE could still be implemented.

Another important point to keep in mind is that a measure that inadvertently favors domestic producers is not necessarily in violation of the chapeau. No doubt some parties will try to make a case that ROHS will provide undue benefit to EU producers of ROHS substitutes or EEE. However, in the *Asbestos* case, the Panel found that while "there is always the possibility that measures such as those contained in the Decree might have the effect of favouring the domestic substitute product manufacturers", "this is a natural consequence of prohibiting a given product and in itself cannot justify the conclusion that the measure has a protectionist aim, as long as it remains within certain limits" (*Asbestos*, at 8.239).

Another argument that could arise in reference to the chapeau is a claim that ROHS would force other WTO member countries to adopt particular regulatory programs. This was clearly found to be in violation of the GATT in *Shrimp* (at 164):

> However, it is not acceptable, in international trade relations, for one WTO Member to use an economic embargo to *require* other Members to adopt essentially the same comprehensive regulatory program, to achieve a certain policy goal, as that in force within that Member's territory, *without* taking into consideration different conditions which may occur in the territories of those other Members.

However, promulgation of ROHS in the EU would not require any other WTO member country to change any of its laws or regulations, because the substances banned by ROHS could still be used in EEE that was sold in other markets and used in other products. Individual producers need only change the EEE being marketed to the EU.[247] Similarly, national governments would not have to adopt any policies managing the substances covered by ROHS, or work toward the reduction of risks to health and the environment that ROHS is designed to accomplish.

The importance of attempting bilateral or multilateral negotiations on topics of concern before going ahead with measures that may conflict with GATT has also been stressed by a number of Panel reports and Appellate Bodies (see, for example, *Shrimp* at 166). It is not clear from the current text of WEEE and ROHS (EC, 2000; EC, 2001; EC, 2001a) if any negotiations were attempted with other WTO member countries during their development. The absence of any negotiating efforts would damage any efforts made toward being granted an exception under Article XX of the GATT.[248]

It is likely that ROHS would fall afoul of Article III(4), or perhaps Article XI(1), of the GATT. In terms of the clauses of Article XX(b), ROHS, in its current draft, appears to fall within the range of policies necessary to protect human, animal or plant life or health. A claim about the

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[247] In the case of the US, though, the EU is the top export market and manufacturing investment location, with cash flows amounting to $50 billion and $33 billion, respectively, in 1999 (AEA et al, 2001).

[248] The point of multilateral negotiations is raised elsewhere in reference to the legality of WEEE and ROHS. An argument could be made that the directives are already multilateral by virtue of the fact that they have been enacted by the agreement of the distinct national governments that comprise the European Community. Any argument along these lines is of course overcome if an action is brought against the EC as single WTO member. In any case, this line of inquiry will not be developed further here, and instead the directives will be viewed as unilateral actions.

necessity of the measures within ROHS to achieve the stated policy goals would be helped by a clearer articulation of the severity of the human health risks and by stating a higher goal in the text of the directive, such as minimization of those risks. In reference to abiding by the terms of the chapeau to Article XX of the GATT, the ROHS directive would be served by more clearly delineating the basis for granting exemptions. In addition, the EC may wish to consider actively pursuing multilateral negotiations on the provisions of ROHS before proceeding with the directive. Finally, it is critical the member countries carefully consider how ROHS is applied, and its precise requirements, when transposing the EC directive into national law, as the application and requirements of ROHS will come under intense scrutiny when compliance with the chapeau is being determined.

4.3 ROHS and GATT XX(g)

It is also possible that if ROHS is found in violation of Article XI(1) or Article III(4), it could be granted an exception under Article XX(g). Article XX(g), as mentioned above, is the exception for measures relating to the conservation of exhaustible natural resources.

Hunter and Lopez-Torres (1999) argue that ROHS would not qualify for the exception offered under XX(g) because:

- ROHS is not primarily aimed at the conservation of exhaustible natural resources[249]
- ROHS has an extraterritorial effect because EEE is produced elsewhere and the natural resources would be preserved at the location of materials extraction
- extraterritoriality can only be justified under exceptional circumstances, for which ROHS does not qualify[250]
- ROHS would require other members to adopt the same regulatory program as the one in the EU, and this is not acceptable (*Shrimp*, at 164)
- no evidence has been offered that less restrictive measures are not reasonably available[251]
- no evidence has been offered of attempts to engage in multilateral negotiations.

The SVTC presents a different reading of the case law regarding the applicability of XX(g) to ROHS. The SVTC argues:

- ROHS is clearly within the range of measures relating to the conservation of exhaustible natural resources because any measure with that aim, applied in conjunction with restrictions on domestic production or consumption, may be justified under XX(g)
- clean air, and presumably clean soil and water, are natural resources and therefore ROHS is primarily aimed at the conservation of natural resources[252]

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[249] The requirement that the policy be primarily aimed at conservation of resources is from GATT (1988, at 4.6; hereinafter *Herring*).

[250] The exceptional circumstances are delineated only in a submission to the *Shrimp* dispute, and are therefore not official findings of any dispute resolution procedure in the WTO.

[251] Some counterarguments are presented in EC (2000).

[252] The idea that clean air is an exhaustible natural resource was put forward in *Gasoline* (at 6.37): "a policy to reduce the depletion of clean air was a policy to conserve a natural resource within the meaning of Article XX(g)".

- policies need not be primarily aimed at conservation of resources to be allowable under XX(g), as indicated in *Gasoline II*[253]
- extraterritoriality has no bearing on the matter because countries would not be required to adopt any particular regulatory program to comply with ROHS
- any claims about extraterritoriality would have to be examined afresh, in light of lack of controlling precedent in that area, and there is some indication that extraterritoriality may be acceptable in some circumstances (as found in *Shrimp*).[254]

Both sides of the above dispute are in agreement on the burden of proof that must be met to demonstrate the acceptability of a measure under XX(g), which is taken from *Gasoline* at 6.35:

(1) that the *policy* in respect of the measures for which the provision was invoked fell within the range of polices related to the conservation of exhaustible natural resources;
(2) that the measures for which the exception was being invoked - that is the particular trade measures inconsistent with the General Agreement - were *related to* the conservation of exhaustible natural resources;
(3) that the measures for which the exception was being invoked were made effective *in conjunction* with restrictions on domestic production or consumption; and
(4) that the measures were applied in conformity with the requirements of the *introductory clause* of Article XX.

4.3.1 XX(g): the range of policies

Note that for clause (1) above, the question is whether the policy in general, not any specific measure, is within the range of polices related to the conservation of exhaustible natural resources. If we take the reasoning from *Gasoline*, then it could be assumed that ROHS is generally designed to conserve clean air, water, and soil. However, there is nothing in the text of ROHS (EC, 2001a) to support the idea that it is generally intended to conserve natural resources. In face, the word "resource" does not appear once in the text.[255] Any claim that ROHS is within the range of policies designed to conserve natural resources will be very difficult to make in the absence of any language in the directive itself so stating.

4.3.2 XX(g): measures are related to conservation

This portion of XX(g), clause (2) above, begins to deal specifically with the measures that are in violation of an Article of the GATT. That the measures themselves must be related to the conservation of natural resources is obvious from the language of XX(g) and has been confirmed

[253] *Gasoline II* found that "the phrase 'primarily aimed at' is not itself treaty language and was not designed as a simple litmus test for inclusion or exclusion from Article XX(g)" (page 17).
[254] See *Shrimp* at 133 ("We do not pass upon the question of whether there is an implied jurisdictional limitation in Article XX(g), and if so, the nature or extent of that limitation.")
[255] According to EC (2000, p. 6) the objectives of WEEE and ROHS include an intent to "protect soil, water, and air from pollution" and to "preserve valuable resources", but these are not restated in ROHS (EC, 2001a). EC (2000, p. 10) also refers to preserving "disposal capacities, particularly landfill" but it is not as clear if this would be considered a natural resource within the meaning of XX(g). Note that any references in the directives to conserving the natural resource inputs, as opposed to clean air, soil, or water, could lend credence to the argument put forward about extraterritorial effects.

in *Gasoline II*. This provision requires the examination of the relationship between the measure and the "legitimate policy of conserving exhaustible natural resources" (*Shrimp*, at 135). *Herring* found that the measure "did not have to be necessary or essential to the conservation of an exhaustible natural resource" but did have to be "primarily aimed at the conservation of an exhaustible natural resource to be considered as 'relating to' conservation within the meaning of Article XX(g)" (at 4.6). This approach has gone largely unchallenged, even in *Gasoline II*, which made the observation that "primarily aimed at" is not treaty language, but did not go on to revise the *Herring* approach to this clause in XX(g).

ROHS again has trouble meeting the standard of proof with this clause of XX(g). In the first place it is difficult to prove that the overall policy is designed to conserve natural resources. ROHS only has one key measure, the banning of substances, which lies at its heart. The measure in question is therefore essential to the fulfillment of the overall policy of ROHS. However, if it cannot be proved that the overall policy was designed to conserve natural resources, it follows that the one and only key provision within that policy would have similar difficulty. While "primarily aimed at" may not be the standard, total silence on this question will almost certainly not be enough to withstand challenge.[256]

The question of extraterritoriality is more easily dealt with, along the lines outlined above. ROHS would not require other countries to adopt any particular regulatory program and the directive would only affect EEE, and even then only EEE destined for the EU market, and countries would be free to regulate ROHS substances in all other arenas as they saw fit. If conservation benefits are experienced in other countries due to ROHS, that hardly meets the standard set in *Shrimp* (at 164). Further, the EC could rightfully claim the conservation benefits experienced within the EC as territorial benefits of ROHS, assuming those benefits could somehow be determined. Finally, the Appellate Body in Shrimp specifically stated that "We do not pass upon the question of whether there is an implied jurisdictional limitation in Article XX(g), and if so, the nature or extent of that limitation" (at 133).

4.3.3 XX(g): measures made effective in conjunction

The requirements to meet clause (3) from above have been interpreted in *Herring* as follows: "A trade measure could therefore in the view of the Panel only be considered to be made effective 'in conjunction with' production restrictions if it was primarily aimed at rendering effective these restrictions" (at 4.6). Thus, according to *Herring*, the measure would have be primarily aimed at the conservation of an exhaustible natural resource and at rendering effective the restrictions on domestic production or consumption.

Gasoline II had a slightly different interpretation, saying "the clause is a requirement of even-handedness in the imposition of restrictions, in the name of conservation, upon the production or consumption of exhaustible natural resources" (page 19). *Gasoline II* went on to say that the clause does not require identical treatment of domestic and imported products,[257] nor does it

[256] This assumes an argument that the environment generally is an exhaustible natural resource could not be made.
[257] Indeed, *Gasoline II* stated that real equality of treatment would probably mean the measure was not in violation of GATT Article III(4) in the first place. Assuming ROHS resulted in real equality of treatment, this could bode well for any challenge to the directive in reference to Article III(4).

establish an empirical "effects test" for the availability of the Article XX(g) exception (pages 19-20). This latter point appears to refer to the causation between the measure and any change in natural resource levels.

Clause (3) would pose less of a challenge to ROHS than meeting the burden of proof for the first two clauses of XX(g). ROHS applies to all producers, both foreign and domestic, and would therefore operate in conjunction with domestic restrictions. This should be enough to meet the burden of the clause (3), according to *Herring*. The universal applicability of ROHS would also imply even-handedness, if not identical treatment, which would satisfy the conditions put forward in *Gasoline II*. Any arguments about needing to show a causal link between ROHS and natural resources, for example, cleaner air or soil, could also be rebutted using the findings of *Gasoline II*.

4.3.4 Difficulty of an exception under XX(g)

To be allowable under XX(g), ROHS would also have to meet the requirements of the chapeau to Article XX in clause (4) above. A discussion on meeting the requirements of the chapeau was presented in Section 4.2.3 and will not be repeated here, though the same suggestions would apply equally to XX(g). Given the difficulty ROHS has in establishing a claim that it is primarily aimed at conserving natural resources, it seems more likely that any exception would be sought under XX(b). If ROHS were to be made more robust to counterarguments against an exception granted under XX(g), the main improvement would be to incorporate more language referring to the conservation of natural resources as a primary aim underlying the directive. Being unable to support that claim, it is unlikely ROHS would be granted an exception under XX(g).

4.4 ROHS and Technical Barriers to Trade

Arguments have also been put forward on both sides on whether ROHS is a Technical Barrier to Trade, and if so, whether any exceptions would justify it.[258] The TBT Agreement attempts to ensure that regulations and standards are applied equally to imported and domestic products, and that they do not create unnecessary barriers to international trade. The relevant clauses in the TBT preamble and in Article 2.2 appear at the beginning of this chapter.

AEA (1999), AEA et al (2001) and Hunter and Lopez-Torres (1999) argue that ROHS is a technical regulation within the TBT and would not be eligible for any of the allowable exceptions. Their arguments can be summarized as:[259]

- ROHS does not fulfill a legitimate objective because evidence has not been provided showing the impacts of the substances on health or the environment
- ROHS is more restrictive than necessary[260]
- there is no evidence of attempted multilateral negotiations

[258] At the time AEA (1999), SVTC (1999), and Hunter and Lopez-Torres (1999) were written, the major case dealing with environmental issues and TBT (*Asbestos*), and its appeal (*Asbestos II*) were not yet publicly available.
[259] These are generally based on TBT Article 2.2.
[260] Some counterarguments for the first two points do now appear in EC (2000).

- ROHS is disproportional to the policy objectives and does not take into account the risks that non-fulfillment would create.[261]

To rebut the above, the SVTC (1999) offers the following counterarguments:

- ROHS may not be a technical barrier to trade within the meaning of the TBT
- Article 2.2 of the TBT does not require evidence to be presented before the adoption of a technical regulation, it only requires that technical regulations fulfill a legitimate objective[262]
- necessity under the TBT need not be interpreted in the same way as necessity under GATT Article XX[263]
- the TBT does not require that evidence on the risks of non-fulfillment, or any type of study, be prepared or provided before technical regulations are prepared, adopted, or applied.[264]

In the absence of any precedent, the two parties could interpret the preamble, Article 2.2, and the definitions of the TBT in the manner that best suited their case. Now that *Asbestos* and *Asbestos II* have been decided, some aspects of the relationship between ROHS and TBT can be more clearly assessed.

4.4.1 Definition of technical regulation

The first question that must be answered is whether ROHS is a technical regulation within the meaning of the TBT. Annex 1 to the TBT defines a technical regulation as a:

> Document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method.

The application of this definition was carefully scrutinized in *Asbestos* and *Asbestos II*. It is important to note that practically the entire approach, and many of the findings, from *Asbestos* related to the definition of technical regulation within the TBT were overturned. It is equally important to note that both the Panel in *Asbestos* and the Appellate Body in *Asbestos II* emphasized that their rulings on the applicability of the definition of a technical regulation only applied to the particular circumstances that were before them in those individual cases.

Asbestos II found that the heart of the definition of technical regulation is that a document set forth, stipulate, or provide product characteristics, which can include any features, qualities,

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[261] EC (2000, p. 12) explicitly states that the measures are not disproportionate, but little supporting evidence is provided.
[262] Article 2.2 does actually have several other requirements
[263] The SVTC also claims that the AEA interpretation of necessity under GATT Article XX is incorrect.
[264] However, some evidence regarding the risks of non-fulfillment must be available to survive a WTO challenge.

attributes, or other distinguishing mark of a product.[265] A technical regulation may include applicable administrative provisions for products that have certain characteristics. A technical regulation must regulate the characteristics of a products in a binding or compulsory fashion. Product characteristics maybe be prescribed or imposed positively (the product must possess) or negatively (the product must not possess). A technical regulation must also be applicable to an identifiable product or group of products. (*Asbestos II*, at 67-70)

In light of the explication and clarification of "technical regulation" within the TBT provided by *Asbestos II*, it is hard to see how ROHS would not be considered a technical regulation.[266]

4.4.2 Future disputes under the TBT

Though there is now some clarification on what constitutes a technical regulation, neither of the two asbestos cases went on to analyze the claims of the parties under the TBT.[267] Therefore, the application of the TBT in any environmentally oriented dispute still has yet to occur. Furthermore, *Asbestos II* (at 80) indicates that the TBT is a specialized legal regime that applies solely to a limited class of measures and imposes obligations on members that are different from, and additional to, obligations under GATT. One cannot assume that any reasoning applicable to Articles of the GATT, including Article XX, would necessarily apply to the TBT.

Looking at the preamble of the TBT, it is possible to deduce at least one key point. On the one hand, "technical regulations should not create unnecessary obstacles to international trade", and on the other, "no country should be prevented from taking measures necessary for ... the protection of human, animal or plant life or health, of the environment, or for ... at the levels it considers appropriate". A potentially significant difference in the wording of the preamble to the TBT from the wording of GATT Article XX is that measures necessary for the protection of the environment *per se* are allowable under the TBT. This could make ROHS much more amenable to an exception under the TBT than under GATT Article XX(g), for example.[268] Though, of course, this would also depend on how the necessity for environmental protection was interpreted.

The phrases "arbitrary or unjustifiable discrimination" and "disguised restriction on international trade" from the preamble of the TBT are identical to those in the chapeau of Article XX, and stress the manner in which the measure is applied. Without sufficient detail on the application of ROHS

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[265] Characteristics might relate to, *inter alia*, "a product's composition, size, shape, colour, texture, hardness, tensile strength, flammability, conductivity, density, or viscosity" (*Asbestos II*, at 67).

[266] The SVTC (1999) relied on the EC submission to the *Asbestos* Panel to inform their arguments.

[267] Vogel (2001) claims this is due to political considerations. *Asbestos* found that the ban was not a technical regulation in the meaning of the TBT, and hence did not examine any claims regarding the ban under the TBT. *Asbestos II* reversed the Panel's finding that the ban was not a technical regulation, but did not go on to examine any claims under the TBT due to lack of an adequate basis for doing so (at 81-83). (In the spirit of appellate decisions in general, the appellate body may reverse on errors of law, if fatal. However, the appellate bodies do not substitute their judgment on questions of fact because traditionally those questions may not be raised anew at the appellate level.) Thus, any attempt to determine if ROHS, which may be a ban similar to the one is *Asbestos*, would be allowable under the TBT is going into virgin territory.

[268] The phrases "environmentally sound recovery" from Article 1 of ROHS (EC, 2001a), "protect soil, water, and air from pollution" EC (2000, p. 6), and "poses risks to ... the environment" (EC, 2000, p. 12) could potentially lend support to a TBT argument that could not be lent to arguments under XX(b) or XX(g). Support for a human health claim is the same as under XX(b).

in practice, and without any precedent on the application of TBT to environmental exceptions, this part of the TBT cannot yet be analyzed with any certainty.

Keeping in line with the preamble of the TBT, Article 2.2 reiterates protection of the environment as a legitimate objective. However, in language that appears stronger than that in GATT Article XX, Article 2.2 of the TBT requires that "technical regulations shall not be more trade-restrictive than necessary to fulfil a legitimate objective, taking account of the risks non-fulfilment would create". The focus of the necessity of a regulation would seem to be on its trade restrictiveness, i.e., more in keeping with the findings of *Cigarettes* than *Asbestos* or *Gasoline* in reference to necessity under XX(b) (though the reasoning in these cases may not apply to TBT). However, the apparent focus on trade may be tempered by the phrase on the risks of non-fulfillment. Those risks would presumably be health or environmental risks already existing in the current situation that would go unaddressed in the absence of the technical regulation.[269]

In assessing the risks of non-fulfillment the "relevant elements of consideration are, *inter alia*: available scientific and technical information, related processing technology or intended end-uses of products" (Article 2.2). This would appear to indicate that existing science-based studies should be used to assess risks, but that studies particular to the measure in question need not be conducted, and that such studies could consider health and environmental impacts as part of the scientific and technical information.[270] In the case of ROHS, considering related process technology may include the availability and viability of substitutes.

The arguments of the AEA and the SVTC presented above can both find support in the text of the TBT preamble and Article 2.2. It seems very likely that ROHS would be considered a technical regulation within the meaning of the TBT. To the extent ROHS is aimed at protecting the environment or human health, a claim for an exception to Article 2.2 would be strengthened. However, the necessity of the technical regulation(s) in ROHS in terms of their effect on trade would almost certainly be examined. That examination would probably be tempered by consideration of the environmental and health impacts that would occur in the absence of ROHS.[271] In addition, related process technology, perhaps meaning available substitutes, would also be taken into account. As with other provisions in the GATT, the precise application of the technical regulation(s) will shed considerable light on their possible violation of TBT articles and their possible necessity to reach legitimate policy objectives. Any legal statements about the application of the TBT to ROHS are uncertain. However, the analysis of ROHS under the TBT buttresses the conclusions made above about the advisability of updating and revising the explanatory memorandum and text of ROHS.

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[269] It would not make sense to address the trade risks of non-fulfillment. The AEA's arguments derive a concept of proportionality from these clauses that may not, in fact, be present.

[270] The phrasing of assessing risks is a potentially significant difference between the TBT and Article XX. It is not clear if a full quantitative risk assessment would be required or if a comparative risk assessment would be sufficient. EC (2000) states that the strategy underlying ROHS is based on the most current scientific knowledge, which, on its face, seems in line with the requirements of Article 2.2.

[271] This could be any entry point for the application of the precautionary principle into WTO law. Notice, however, that the asbestos case was bolstered by the fact that asbestos is a known carcinogen. The health or environmental effects of other substances may not be so clear cut.

4.5 Making ROHS more robust to WTO a challenge

Any claim that ROHS is not in compliance with WTO rules could come under a number of GATT Articles, particularly III, XI, or the TBT. Similarly, defenses could be offered under Articles XX(b), XX(g) or the TBT. Even in the face of these several possibilities, there are still some actions that could be taken to improve ROHS' chances of surviving a WTO challenge.

In the actual Recitals and Articles of ROHS where the objectives of the directive are stated, language more in line with XX(b), XX(g), and the TBT preamble and Article 2.2 should be included.[272] Though some language along these lines appears in the explanatory memorandum, it would send a much stronger message in the text of ROHS itself. The text of ROHS would also be helped substantially if the stated goal in Article 1 ("contribute to the protection") were made stronger. Other language in the Recitals and in the explanatory memorandum is stronger than that, but presumably the goal in the directive itself will carry the most weight. There may well be other policy options that could "contribute to the protection" of health. This is particularly important since the drafting history of ROHS would show that, if anything, the aims of the directive have gotten less stringent as time has gone on, while the key measure has stayed the same. (See footnote 240.)

Complementary cosmetic alterations to the explanatory memorandum (EC, 2000) should also be made to keep it in line with the updated text of ROHS. The stated overall aims of the directive should be more in line with the language used in XX(b), XX(g) and in the TBT preamble and Article 2.2. The policy goal should also be strengthened, to be in line with the new goal in the text of ROHS.

A number of more substantial changes could be included in EC (2000), or perhaps the information should just be on hand in the event of a WTO challenge to the directive. Information about the risks of the ROHS substances' health effects and their environmental impacts should be updated and some indication of the expected beneficial effects of the directive shown. This should also include ongoing health and environmental impacts that would occur if the directive did not come into force and some information on the availability and impacts of ROHS substitutes. Some work should be done to show, rather than to merely claim (as in EC, 2000), that other policy options would not achieve the stated goals of the directive. An explanation of how exemptions have been granted would help prove that discrimination in that regard has not occurred, and that the availability and health and environmental impacts of substitutes are taken seriously. Finally, any data showing that EU producers of ROHS substitutes or EEE would not be favored by the directive would also be useful.

Outside of the information included in the directive and the explanatory memorandum, it must be emphasized that the details of how ROHS is implemented in member countries will have a dramatic effect on the directive's WTO compatibility. Obviously, care should be taken in that regard, as a finding against ROHS due to careless implementation could be quite damaging. Efforts at multilateral negotiations on ROHS should be considered, as this will be looked at by a

[272] In the common position on WEEE (EC, 2001), several of the recitals include language that is obviously in line with WTO requirements.

WTO Panel. In addition, the credible threat of the ROHS directive coming into force may encourage parties to put in a good faith effort at the negotiating table.

4.6 Recycled content, Article XX, and the TBT

It has already been pointed out that the documents arguing the acceptability of ROHS under the WTO were written when WEEE and ROHS were still being drafted and before the two *Asbestos* cases. In fact, the substances bans in ROHS are the only measures remaining in either directive that were critiqued in said documents. However, earlier drafts of WEEE did include a provision for recycled content,[273] and that was also one of the recommendations made in the previous chapter on how WEEE could be improved. Therefore, an analysis of the WTO compatibility of such a requirement will now be conducted, based in part on earlier documents, and bearing in mind the review of WTO jurisprudence above.[274]

The arguments offered against a recycled content rule in the WEEE directive proceed much as they did for ROHS, as outlined in AEA (1999). The AEA claims the recycled content rule would be a violation of Article XI(1) and would not be justified under XX(b) because:

(1) it is not part of a policy to protect health[275]
(2) it has an extraterritorial effect[276]
(3) it is not necessary to fulfill the policy objective
(4) it unjustifiably discriminates among third countries and favor European producers
(5) multilateral negotiations have not been attempted.

The arguments against an exception under XX(g) claim first that the recycled content rule would not fall within the range of policies and that the measures are not primarily aimed at conservation of exhaustible natural resources, and then repeats points 2, 4, and 5 above. The burden of proof that would have to be met under Articles XX(b) and XX(g) and counter arguments to the AEA's claims are presented below.

The starting point in the discussion is whether a recycled content rule would be against any of the Articles in the GATT in the first place. Assuming a recycled content rule would require all EEE from domestic and foreign producers to have a certain percentage of recycled plastic content, and assuming, in the case of imported products, that the rule would be enforced at the time or point of

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[273] Article 7(5) in the second draft of WEEE (http://www.svtc.org/cleancc/weee/euweee/directive/weee2nd.htm) required that "Member States shall ensure that the share of recycled plastic in new electrical and electronic equipment amounts at least to five percent of the total plastic content by 1 January 2004". The current common position (EC, 2001), Recital 15, states that "producers should be encouraged to integrate recycled material in new equipment".

[274] The originally proposed recycled content rule required 5% of the plastics by weight in EEE to be recycled plastics. This is distinct from requiring material in EEE to be recyclable, an idea that was proposed in the previous chapter, and which will be picked up on below.

[275] AEA (1999) argues that evidence has not been provided showing that the use of new plastics in EEE poses a threat to human health or the environment, and, without a scientific risk assessment, the recycled content rule is therefore not part of a policy calculated to protect human, animal or plant health.

[276] EC (2000, p. 11) does specifically mention the environmental impacts at the site of extraction, particularly due to mining.

importation, a recycled content provision would be in violation of GATT Article III (following the reasoning in *Asbestos*).

4.6.1 Does WEEE fall under Article XX allowable exceptions

For the purposes of this discussion, let us assume that a recycled content provision is found to be in violation of GATT. In order to be granted an exception under Article XX(b) or XX(g), WEEE would have to be necessary to protect human, animal or plant life or health, or related to the conservation of exhaustible natural resources.

There are a number of statements in the explanatory memorandum (EC, 2000) and the common position on WEEE (EC, 2001) that could support either or both claims. Claims under XX(b) are supported by the following statements (all emphases added):

> The objectives of the Community's environment policy are, in particular, to preserve, protect and improve the quality of the environment, *protect human health* and utilise natural resources prudently and rationally. (EC, 2001, Recital 1)

> Various *health and environmental problems* linked to the current management of WEEE could be reduced by means of a diversion of these wastes away from landfills and incinerators. (EC, 2000, p. 12).

Claims under XX(g) find direct support in the following two passages,

> ... need for promoting waste recovery with a view to ... *saving natural resources*, in particular by reuse, recycling, composting and recovering energy from waste... (EC, 2001, Recital 4)

> It seeks to *preserve valuable resources*, in particular energy. (EC, 2000, p. 6)

and indirect support in two additional quotes:

> The objectives of the Community's environment policy are, in particular, to preserve, protect and improve the quality of the environment, protect human health and *utilise natural resources prudently and rationally.* (EC, 2001, Recital 1)

> One of the main objectives of the present initiative is to increase the recycling of WEEE. In general, increased *recycling preserves resources and disposal capacities*, in particular landfill. (EC, 2000, p. 10).

Note that there is nothing in Article 1 of the WEEE common position that is particularly helpful in terms of supporting claims under XX(b) or XX(g). Interestingly, the statements contained in the common position on ROHS generally have more to contribute to a discussion regarding XX(b) and XX(g). The shortcoming of WEEE is that, while there is a lot of verbiage about increasing collection, reuse, recycling, and recovery, there is not very much explanation of why all these activities should be undertaken. They should almost certainly be undertaken, not for their own sake, but to protect human health and/or natural resources. However, this is not very clearly stated in the text of the directive. Having said that, on balance, claims that WEEE is aiming for policies

legitimated under XX(g) look to be better supported in the current common position and explanatory memorandum.

Obviously, claims under both exceptions would be much better supported if the language in the Articles and Recitals of the common position, and the language in the explanatory memorandum, was brought more in line with Article XX.

4.6.1.1 XX(b): necessity

The second step under XX(b) is to show that a recycled content provision is necessary to fulfill the policy objectives relating to human, animal, or plant life or health. The lack of specificity about the precise level of human health protection sought in WEEE makes any assessment of necessity difficult. This is in contrast even to ROHS, which at least stated the aim of achieving a "significant reduction" in health risks.

As noted in the Section 4.2.2 above, the reasoning behind the necessity of the measure could be based on the effects on trade, the health risk, or the necessity to achieve the policy goal. Most likely, a recycled content provision would ban EEE that did not have the requisite recycled plastic content from being sold in the EU. In light of the severity of banning in terms of trade, the lack of data provided in the explanatory memorandum on the nature or severity of the health risks associated with use and disposal of plastics, and the vagueness of the health protection being sought by WEEE, it is difficult to make a case that a recycled content provision would be necessary in the meaning of XX(b). Most likely, some data indicating the difference in possible health impacts between disposal and recycling of virgin vs. recycled plastics would have to be provided. It isn't clear if that difference would be substantial enough to meet the necessity standard. With additional health related data or more clarity on the goal of the directive, the case under XX(b) might be improved. The requirements necessary to meet the burden of proof regarding the chapeau will be discussed below, since they are common to both XX(b) and XX(g).

4.6.1.2 XX(g): measures are related to conservation

The second step under XX(g) is to show that the measure, i.e., a recycled content provision, is related to the conservation of exhaustible natural resources. Notwithstanding the finding in *Gasoline II*, this would probably require that the recycled content provision be shown to be primarily aimed at the conservation of resources, following *Herring*.

Any arguments about the natural resources in question being the initial inputs to plastics may have trouble with the extraterritoriality issue (see Section 4.6.1.4). Therefore, the natural resources to consider might be clean air, water, and land. The question then becomes, is there a significant difference in the environmental impacts of recycling or disposing of virgin vs. recycled plastic, and can the likely resource conservation effects on air, water, or land be shown? In short, are recycled plastics easier to reuse, recycle, recover, or dispose of? Answering this question would require more data than is currently available in EC (2000) and EC (2001). In addition, the resulting conservation of natural resources would have to be shown to be the primary aim of the recycled content requirement. This clause of XX(g) would pose quite a challenge to a recycled content provision.

4.6.1.3 XX(g): measures made effective in conjunction

Assuming any recycled content requirement applies equally to domestic and foreign producers of EEE, this clause of XX(g) should be relatively easy to satisfy. In this case, the recycled content provision would clearly be made effective in conjunction with restrictions on domestic production or consumption. It is worth bearing in mind that this clause's meaning is more along the lines of "even-handedness" than "proven to be effective" (see *Gasoline II*). In comparison to the other clauses of XX(g), it is much easier to meet the burden for this clause.

4.6.1.4 XX(b) and XX(g): extraterritoriality arguments

The AEA (1999) put forward extraterritoriality arguments in reference to XX(b) and XX(g) similar to the ones used above in reference to ROHS and based on the findings in *Shrimp* (at 164). However, the AEA's claims that some of the benefits of a recycled content provision might occur outside the EU, and that any such provision is therefore in violation of Article XX, does not seem to be within the finding of *Shrimp*. On the contrary, other countries would not be forced to adjust their environmental, health, or safety policies to comply with a recycled content provision in WEEE. That incidental health benefits or conservation of natural resources might accrue in countries outside the EU because of their use of recycled plastics in EEE destined for the EU market does not take away from the fact that other countries would not be forced to adopt any particular "comprehensive regulatory program" as found in *Shrimp*.[277]

4.6.1.5 Article XX chapeau

If a recycled content provision passes muster under the clauses of XX(b) or XX(g), it would also have to meet the requirements of the chapeau of Article XX, which forbids any measures resulting in arbitrary or unjustified discrimination, and disguised restrictions on international trade (*Gasoline II*, p. 21).

As explained in Section 4.2.3, the key indicators in determining if a measure is in line with the chapeau are only discernable if that measure has been put into practice. At first blush, a recycled content provision would not result in arbitrary or unjustified discrimination because it would apply equally to all products, foreign and domestic. Presumably, the vast majority of EEE does not contain any recycled plastics, and no particular producers are already using recycled plastics on a large scale in EEE products. The measure would therefore not discriminate among producers, EEE products, or countries.

The AEA (1999) claims a recycled content rule would unjustifiably discriminate because producers outside the EU might not have access to recycled plastics of the necessary quality. Furthermore, the recycled content rule would encourage local production of recycled plastics, and, due to the population density of Europe, collection and recycling would be easier in the EU, giving them an unfair advantage.

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[277] *Shrimp* also stated that "We do not pass upon the question of whether there is an implied jurisdictional limitation in Article XX(g), and if so, the nature or extent of that limitation" (at 133). Thus, not only would other countries not be forced to adopt any particular regulatory program, but the mere existence of extraterritorial effects is not enough to draw any conclusions about the WTO compatibility of the measure. Of course, the EU could claim the territorial health and environmental benefits of ROHS and/or a recycled content provision, if they could be determined.

A few points can be raised that contrast with AEA arguments. It is difficult to judge whether EEE producers outside, or even inside, the EU would have access to recycled plastics for use in EEE. Information is not readily available on the extent to which recycled plastic is available in different countries. Producers of EEE outside the EU are most likely located in other advanced industrialized countries and would therefore not necessarily be at any immediate disadvantage. Even producers inside the EU would only have to incorporate recycled plastics into the EEE they are selling on the internal market.

The typical computer (see Chapter 2) would only require 0.7 lbs (0.3 kg) of recycled plastic to satisfy the provision. Note that recycled plastics would not necessarily have to come from WEEE, they could be from any source. In addition, the plastic destined for recycling would not have to be collected from households, so population density need not enter into the discussion. EEE is often produced and assembled at different locations. Given the global supply chains of many EEE producers, the recycled plastic need not even be from the producer's country of origin. Finally, any inadvertent discrimination that should occur could be justifiable under the findings of *Asbestos* (at 8.239).

4.6.2 Conclusions regarding Article XX

The Figures below show a summary of and a comparison between the ease of a recycled content provision being granted an exception under Articles XX(b) and XX(g).

Figure 19 Summary of recycled content provision and XX(b)

Clauses in XX(b)	Current support in WEEE	How to improve
Policy protects human health	Mentioned once directly in Recital 1 and once indirectly in explanatory memorandum	Include phrasing in WEEE Recitals, Articles (especially Article 1), and explanatory memorandum that refers to health protection
Measures are necessary	Very poor	Clearly state the health protection goal and make the goal ambitious; provide information data on health impacts of disposal of virgin and recycled plastics
Not violate chapeau	Poor	Careful implementation; develop information showing won't discriminate due to unavailability of recycled plastics in some countries

Figure 20 Summary of recycled content provision and XX(g)

Clauses in XX(g)	Current support in WEEE	How to improve
Policy conserves natural resources	Mentioned once directly in Recital 4 and in explanatory memorandum; mentioned once indirectly in both sources	Include phrasing in WEEE Recitals, Articles (especially Article 1), and explanatory memorandum that refers to conservation
Measure conserves natural resources	Poor	Articulate which resources are being conserved; provide information to that effect; and indicate how the measures is aimed at conserving said resources
Measure made effective in conjunction with restrictions on domestic production or consumption	Satisfactory because applies equally to foreign and domestic producers	Careful implementation; available information on trade effects showing no favoritism
Not violate chapeau	Poor	Careful implementation; develop information showing won't discriminate due to unavailability of recycled plastics in some countries

A few interesting points have come out of even this brief analysis of WTO compatibility of a recycled content provision. The first is that WEEE itself is surprisingly vulnerable to the initial clauses about the aim of the policy under XX(b) and XX(g), because WEEE does not make solid explicit links in the text of the directive to health or resources.

The second point is that a recycled content provision would have considerabe difficulty in being granted an exception under XX(b) and XX(g). On balance, the burden under XX(g) appears easier to meet, but in both cases considerably more information would have to be developed or made available to prove a case. This is particularly true under the necessity clause of XX(b), under the measure conserves natural resources clause of XX(g), and under the chapeau generally.

4.6.3 Recycled content and TBT

A recycled content provision in WEEE could also be a technical regulation and fall under the scope of the TBT. In that case, there would be a different burden of proof in order to be granted an exception. Given the definition of a technical regulation as expounded upon in *Asbestos II*, it is likely that a recycled content provision, which would specify a product characteristic, be mandatory, and have associated administrative provisions, would be found to a be a technical regulation within the meaning of the TBT.

Arguments have been put forward by the AEA (1999) claiming that a recycled content provision would fall afoul of Article 2.2 of the TBT and would not be allowable because such a provision would:

- not fulfill a legitimate objective
- have extraterritorial effects
- be more restrictive than necessary
- not be proportional to the objectives pursued by policy
- adversely effect developing countries.

Recall that in a significant difference from Article XX, both the preamble to the TBT and Article 2.2 allow technical regulations for the protection of the environment as an exception (with certain caveats). However, while WEEE in general might be able to support a claim that it is aimed at protection of the environment,[278] a recycled content provision would have to be carefully worded to substantiate the same claim. Similar suggestions to those made above in reference to Article XX would apply, that is, information about the added EU environmental protection associated with using recycled plastics would have to be provided. Any ancillary extraterritorial environmental protection benefits would not help the case under the TBT,[279] though, again, this is quite different from requiring other countries to adopt a particular regulatory program.

The TBT also includes the concept of necessity, in terms of the trade impact, of a measure to fulfill the policy objectives, while also taking into account the risks of non-fulfillment of those objectives. The objectives as included in the text of WEEE are not clear, though the explanatory memorandum does mention minimizing impacts to the environment (EC, 2000, p. 5). Similar to the arguments made above, a clearly stated ambitious objective would serve to make the necessity of the measure a bit stronger. In this case, however, requiring only 5% recycled plastics content could perhaps be achieved by other, less trade restrictive measures.

Under the TBT, scientific and technical information and related processing technology should be considered when assessing the risks of non-fulfillment. For the recycled content provision, this could include information on the environmental benefits of using recycled plastics and on the current technological capability of recycling plastic. These two requirements would probably help and hurt, respectively, any arguments aimed at getting an exception under the TBT. To the extent that is true, an improvement in plastics recycling technology would make any argument for an exception stronger.

The AEA also argues that a recycled content provision would run against Articles 12.2 and 12.3 of the TBT because recycled plastic may not available in developing countries, as outlined above. Article 12.3 of the TBT states that countries shall

[278] See EC (2001), Recitals 1,4,12,14, and EC (2000) pp. 4-9,12,20.

[279] Thus, while it would be easier to make a case under the TBT for the purely environmental benefits of recycled plastics, say, by having avoided the environmental impacts associated with plastics disposal, there is still the question of whether those benefits have occurred in the EU. The question of extraterritoriality is largely unexplored in WTO jurisprudence, including under the TBT.

> take account of the special development, financial and trade needs of developing country Members, with a view to ensuring that such technical regulations, standards and conformity assessment procedures do not create unnecessary obstacles to exports from developing country Members.

In principle, the exact requirements of a recycled content provision could be structured so that the special needs of developing countries were taken into account.[280] It is not clear how necessary a variance for developing countries would be, as it assumes that recycled plastics are less available in developing countries, and, indeed, that they would even have to be available in those countries for the production of EEE destined for the EU market.

The lack of jurisprudence regarding environmental issues and the TBT, in addition to the fact that WEEE has not yet been implemented, makes an analysis of claims under the TBT rather uncertain. This preliminary analysis shows, however, that while a broader environmental exception does exist under the TBT, many of the same challenges that confront a recycled content provision under the GATT Article XX exceptions would also present themselves under the TBT. In addition, the TBT can also take into account a discussion of plastics recycling technology and impacts on developing countries, which would further complicate any case for an exception.

4.7 Ways forward for recycled content in light of the WTO

A recycled content provision in WEEE appears to face considerable challenge under Article XX(b), XX(g) and the TBT as to its WTO compatibility. In the case of Article XX, even the initial supposition that WEEE directive is a policy to protect health or conserve natural resources is up for debate. Regarding XX(g) and the TBT, the recycled content provision itself would also have to be shown to be preserving natural resources or protecting human health or the environment. All three routes to an exception for a recycled content provision would face some similar problems: lack of a clearly defined, ambitious goal; need for additional information on the territorial benefits of requiring recycled content; need to show that other policy options cannot achieve 5% recycled content in EEE; and need to show that countries outside the EU would not be unreasonably disadvantaged by the provision. There is also no indication that multilateral negotiations have been attempted on the recycled content provision, and this would figure in to any WTO inquiry. Any one of these areas could prove to be a difficult hurdle to get over.

It seems a recycled content provision would also be quite hard to handle administratively. Careful thought would have to be given as to how all the different categories and products of EEE could be verified to be in conformity with the provision. Five percent recycled plastic in a computer is only 0.3 kg, and for many other types of EEE it would be less. Indeed, it is possible that a 5% recycled content provision for something like a smoke detector might not make economic or technological sense at all.[281] It is already known that 85% of the plastics used in EEE are used in large household appliances, IT and telecommunications equipment, and

[280] For example, recall the applications for extensions that Greece and Ireland could make use of in meeting some of the other requirements of WEEE.

[281] This could be because the total amount of plastic used is small enough that it would be easier to use 100% recycled plastic, or because it is incredibly uneconomic to incorporate a small amount of recycled plastic, or because it is technically incredibly difficult to incorporate recycled plastic.

consumer equipment (APME, 2001). Perhaps any initiative to increase recycled plastics content should be targeted at these three categories of EEE.

There are also other ways that the EU could begin to move toward recycling and recyclability that would be more readily WTO compatible or would avoid the WTO question altogether. For example, the EU could simply require their own producers of EEE to use 5% recycled plastic. The arguments put forward in the explanatory memorandum imply that the costs of doing so would not be too great, and at the same time a market for some of the recycled plastic that will be coming from WEEE would be developed. The EU could also require 5% recycled content but pair it with a consequence less severe than a ban on EEE products that do not comply.

To approach the problem from a slightly different angle, the EU could instead require that 5% of all the plastic in EEE by recyclable. Such an effort might have to be buttressed by a provision in EU waste law that the recycle plastic fraction of WEEE was, in fact, recycled. Nevertheless, the health protection, natural resource conservation, and environmental protection arguments would be much easier to make for a recyclability requirement because the treatment of the material would take place in the EU.

4.8 Conclusion

Both ROHS and a recycled content provision in WEEE would face a considerable challenge in obtaining an exception from WTO rules.[282]

ROHS would probably be found to be a violation of GATT Article III(4). Under the exception available in Article XX(b), ROHS could be found to be within the range of policies to protect human health. The possibility of doing so would be strengthened by improving the language to that effect in the Articles of the directive. On the necessity of the measure, ROHS would benefit from setting a more ambitious and firmer target for the protection of human health, in addition to a strengthening and updating of the explanatory memorandum's recounting of the health impacts of the banned substances.[283] These improvements will help avoid a conclusion that (1) a less trade restrictive measure could reasonably be employed to achieve the aim; (2) the risk from the substances may not be great enough to justify a ban; or (3) a ban may not be necessary to achieve the stated aim. The details of national implementation will be particularly important in defending ROHS under the terms of the chapeau to Article XX. That the ban applies to foreign and domestic products does bode well, but the exemptions should be more clearly justified to avoid any appearance of discrimination.[284] Finally, the WTO will almost certainly inquire about

[282] As indicated above, this assumes the directives cannot be considered Multilateral Environmental Agreements, in themselves, under the WTO rules.

[283] This suggestion is mostly to ensure information on the health effects of the banned substances and their substitutes is available, in case such information is asked for along the lines of *Asbestos II*. A full risk quantitative assessment does not appear to be necessary, in light of the *Asbestos* (at 8.221) and *Asbestos II* (at 167, 168, and 178) findings, but it would be advisable to have information on hand for a comparative risk assessment, should that be required.

[284] Recall that limited inadvertent discrimination, on its own, is not a problem under the chapeau (*Asbestos*, at 8.239).

any attempt to negotiate an agreement on ROHS, yet no such attempt appears to have occurred or be forthcoming.[285]

An application for an exception under XX(g) looks, if anything, even more daunting. The support for ROHS being aimed at protecting natural resources is quite weak, and there is nothing in the text of the directive itself to support such a claim.[286] The key provision, i.e., the substance ban, has the same trouble with that particular aspect of XX(g). ROHS is made effective in conjunction with domestic policies, since the ban applies equally regardless of the origin of the EEE. This is the strongest point in ROHS' favor under XX(g). Regarding the chapeau, the same concerns mentioned under XX(b) would apply here as well, though the most important details would be how the directive is implemented in national law.

ROHS would also probably be found to be a technical regulation in the meaning of the TBT. The jurisprudence under the TBT is much less tested, and any conclusions about the granting of exceptions therefore even more uncertain.[287] ROHS does benefit under the TBT because environmental protection policies are a basis for allowing exceptions and there is better support in the text of the directive for that aim (though the language could still be improved). Furthermore, the health and environmental impacts of non-fulfillment of the policy can be considered, and there is some data in the explanatory memorandum in that regard.[288] Under the TBT, processing technology can also be considered, which may mean that ROHS will have to do a better job of proving the availability and viability of substitutes. The trade restrictiveness of the measure is also considered under the TBT, in which case a better showing of the unreasonableness of using alternative measures to reach the same goal may be necessary.[289] Though discrimination doesn't figure in directly under the TBT, the necessity of the technical regulation in terms of its trade impacts does have to be justified. ROHS would need more support in that regard, probably in a similar fashion to the clause in XX(b) and the chapeau to XX.

A recycled content provision in WEEE would probably be against Article III(4) of the GATT and is also rather difficult to legitimate under Article XX and the TBT. The text of WEEE does very little to support a claim that the policy is aimed at the protection of human health or the conservation of natural resources, though the latter is better supported. This is a major stumbling block, as it is the first question that would be addressed in considering an exception. Language to this effect would have to be added to WEEE along with the recycled content provision.

The provision would also have a major challenge in demonstrating its necessity to achieve health protection (in the case of XX(b)) or its conservation of natural resources (in XX(g)). Though the

[285] Recall that in all analyses here the working assumption has been that the directives are assumed not to have been negotiated, in the sense of the WTO requirements, even though they have been jointly developed and agreed by European nations through the European Parliament and the European Commission.
[286] While clean air, and presumably water and soil, may be considered natural resources, this is problematic in terms of which resources are being protected (not stated in ROHS) and their territoriality (though that aspect of WTO jurisprudence is still uncertain).
[287] The TBT is viewed as imposing different and additional obligations to WTO members from those in the GATT, but exactly what those obligations are has not been determined.
[288] Though this, too, could be improved along the lines of footnote 283. Data would have to be available on the environmental impacts of non-fulfillment.
[289] This also assumes the goal is clearly identified, and, preferably, ambitious enough to warrant a ban.

arguments presented about the extraterritoriality of the provision are easily overcome, that does not itself mean that the health or conservation benefits achieved territorially justify the provision.[290] Such justification is only available by showing the difference in health or resource conservation between the treatment of recycled versus virgin plastics, and that does not appear in the explanatory memorandum or WEEE at present.[291] Finally, it would have to be shown that there would not be any discrimination as a result of the provision in order to satisfy the chapeau.

A recycled content provision fares better under the TBT, where it would probably be found to be a technical regulation. The overall WEEE directive does much better here, because the environmental protection aspects of WEEE can be considered under the TBT. However, the environmental protection aspects of the recycled content provision would also have to be demonstrated, and this is difficult. It is difficult partially because the aims in the text of WEE are not clear or seemingly ambitious. But unlike ROHS, a high goal alone might not be enough here, because a relatively low recycled content percentage may not appear to be commensurate with the ambitious environmental or health protection aims allowed under the TBT. The 5% target is also low enough that a ban on EEE without 5% recycled content would not be necessary and other, less trade-disrupting policies could probably be employed that would achieve the same outcome. Under the TBT, the environmental and health risks of non-fulfillment of the policy would be considered, as would the scientific information on those topics.[292] Processing technology, probably in the form of recycling capability, would also be considered. Plastics recycling would probably be portrayed as very difficult or environmentally unfriendly, which would damage the case for an exception. However, as recycling technologies improve, the case under the TBT would also improve.

In many of the WTO cases reviewed here, statements have been made that the interpretation of GATT Article XX and TBT Article 2.2 have been very specific to the facts involved and would not necessarily apply more broadly. Nevertheless, this analysis shows that it will be difficult to be granted an exception from WTO rules for restrictions on the use of hazardous substances. Multilateral negotiations on this topic would be, perhaps, even more difficult, because the severity of the problem would not be agreed, and the EU would have to convince the other parties that its policy goals were legitimate before a real discussion could commence. At least under the WTO the EU is free to set the level of protection it sees fit. But what use is that if all imported EEE is going to contain the very substances the EU is attempting to limit?

Similarly, a provision regarding recycled content is also incredibly difficult to get passed through the WTO. Requiring such a nominal amount of recycled plastics content hardly seems trade distorting, and yet the case for such a provision under WTO rules is quite weak. Multilateral negotiation on this topic would also be very difficult. The ironic thing is that a recycled content provision would be the perfect complement to WEEE, and would actually start creating a new worldwide market, i.e., a recycled plastics market, where one did not exist before. Such a

[290] The arguments that have been made, i.e., about other nations having to adopt comprehensive regulatory policies to cope with a recycled content provision, are easily overcome; but the uncertainty of the jurisprudence around the issue of extraterritorial effects remains.

[291] The link between a recycled content provision and the overall health or conservation aims of WEEE would also have to be articulated, and under XX(b) the necessity of the provision in reaching those goals demonstrated.

[292] A comparative risk assessment might again be useful here, in order to show the differences between treatment of virgin vs. recycled plastic.

provision could be seen as market expanding rather than trade limiting. If an unsuccessful attempt was made to include a recycled content provision into WEEE, the EU could still address this issue by requiring EU producers to include recycled content or by revising WEEE to include a provision for 5% of the plastics in EEE to by recyclable. Both would achieve similar aims, and latter would have an easier time meeting the burden of proof under the WTO.

4.8.1 The WTO and the precautionary principle

Analysis of these two cases highlights a larger issue with the WTO, and that is that WTO thinking on environmental cases runs the risk of becoming increasingly out of step with how environmental policy is currently being made. The WTO approach relies, sometimes explicitly, on very traditional statistics based and quantitative approaches to regulation such as assessments of risk and cost. Keeping in mind that WTO members are free to choose the level of health and environmental protection they desire, it is not clear how measures to achieve those levels of protection will be found compatible with WTO rules if they are based, for example, in an application of the precautionary principle.

Let us examine this in a little more detail. Applications for exceptions under GATT XX(b) appear to require a determination as to whether there is a risk to health (*Asbestos*, at 8.170) though the risks may be evaluated in qualitative or quantitative terms (*Asbestos II*, at 167).[293] Thus, the starting position in applying for an exception under XX(b) has essentially left out the possibility of covering the area where the precautionary principle is most valuable—when the existence of the risks themselves is unknowable, unquantifiable, highly uncertain, or inconclusive.[294]

Asbestos II does appear to concede that governments are not "obliged, in setting health policy, automatically to follow what, at a given time, may constitute a majority scientific opinion" (at 178), but the reasoning is actually based in *Hormones II*, which originally referred to diverging scientific opinions within a risk assessment (at 194). In other words, a health policy could be based on a minority viewpoint within the scientific community regarding a risk assessment, but that still assumes that the risks are assessable.

Similarly, *Asbestos* also found that if there is agreement that there is a definite health risk, it is not necessary to wait until it is certain that the risks of a substitute are lower before making policies (at 8.221). Again, this first requires agreement on a definite health risk before action can be taken.

Some commentators have argued that the precautionary principle is already covered in WTO rules because (pre)caution can be exercised during the risk assessments themselves or through the caveat the policies need not be made based on the view of the scientific majority at the time. This interpretation overlooks exactly the issue highlighted above, that policies to protect health or the environment may be required before risks can even be fully assessed.

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[293] Throughout the two asbestos cases, and in other cases and commentary, there seems to be confusion about the precise definitions and requirements of "risk assessment" and "assessment of risk".

[294] The fact that existence of the risks themselves is uncertain may even be due to an absence of available evidence, which is not to be confused with evidence of absence or disputed evidence.

Though not an environmental case per se, the WTO cases involving hormones (WTO, 1997, hereinafter *Hormones*; WTO, 1998a, hereinafter *Hormones II*) offer corroborating indications on the direction of WTO jurisprudence. The hormones cases are particularly relevant because they examined the application of the Sanitary and Phytosanitary Agreement (SPS), which is a side agreement to the GATT analogous to the TBT, to the precautionary principle and the use of risk assessment.[295]

In *Hormones II*, the Appellate Body found that the precautionary principle did not override the provisions in the agreement, noting that the agreement itself did not make exceptions available directly under the precautionary principle and that the status of the precautionary principle in international law was not clear.[296] In fact, the precautionary principle is not referenced in the GATT, the TBT, or the SPS. In other words, while a government may be able to legislate national policies based on the precautionary principle, that would not have any bearing in a dispute regarding the GATT and its associated side agreements.

Furthermore, *Hormones* and *Hormones II* found that the precautionary principle had already been incorporated into Article 5.7 of the SPS.[297] Thus, not only is the precautionary principle not directly referenced in the SPS, but there would be no need to include it because it has already been incorporated. Note, however, that the precautionary principle may only be applied provisionally or temporarily. Of course, the language of Article 5.7 is a far cry from what the precautionary principle would allow if fully implemented in practice—to make final or permanent policies when there is insufficient, inconclusive, or uncertain scientific information. Article 5.7 only allows a policy to be adopted provisionally until a more objective assessment of risk can be undertaken.[298] And at that time, all the other requirements of the SPS would still apply.[299] *Hormones II* found that the risk assessment must sufficiently warrant the measures at stake (at 253), hence removing the option of a precautionary policy.

The choice of which agreement is referenced in a dispute is not insignificant. The word "risk" does not appear once in the GATT, including under the Article XX exceptions. Under the TBT,

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[295] The SPS imposes obligations to WTO members that are different, and in addition to, the obligations under the GATT (see *Hormones*, at 8.38-8.40), much like the TBT.

[296] The status of the precautionary principle in relation to environmental matters was more certain, but still not solidified (see *Hormones II* at 123).

[297] Article 5.7 of the SPS states "In cases where relevant scientific evidence is insufficient, a Member may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from the relevant international organizations as well as from sanitary or phytosanitary measures applied by other Members. In such circumstances, Members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measure accordingly within a reasonable period of time."

[298] The EC did not attempt to justify its measures under *Hormones* by making use of Article 5.7 of the SPS.

[299] The language of the SPS makes risk assessment a much more fundamental part of the process (see Article 5 of SPS), but exactly what that process entails is not very clear. While it is not necessary to establish a minimum quantifiable magnitude of risk (*Hormones II*, at 253) and while factors that cannot be quantified are not excluded *a priori* from the risk assessment (*Hormones II*, at 253), it is still necessary to base any measures on a risk assessment (*Hormones*, at 9.1; *Hormones II* at 186) that can reasonably support the measures in question (*Hormones II*, at 193), and is able to identify specific risks (*Hormones*, at 8.134) and evaluate the probability of any adverse effects (*Hormones*, at 8.98).

the risks of non-fulfillment must be taken into account, but there is no mention of risk assessment. Under the SPS, the very language of the agreement talks about "assessment of risks". Theoretically, this would imply different burdens of proof under the different agreements.[300] Yet in practice, arguments are made about the need for a risk assessment to justify a measure aimed at the protection of health or the environment under GATT, the TBT, and the SPS.[301] In some cases, those arguments, or portions of them, have been accepted. The implication of this is that an implicit requirement of a full risk assessment under all three agreements means the scope of application for the precautionary principle is shrinking.

If a policy is being made regarding health or environmental protection, and any level of protection can be legitimately chosen, then it follows that policy measures could be put in place that do not rely on calculations of cost or risk. Yet it appears that in order to justify the measures at the WTO, such calculations would practically be required. Should information that was not initially required to formulate legitimate health or environmental measures later be needed to justify those measures in a trade dispute? And what if information about costs and risks is not available because it is not reliably quantifiable, or, indeed, not knowable in advance? Unfortunately, the trend in WTO jurisprudence appears to be diverging from the trend in the formulation of environmental policy, which makes ostensibly beneficial ideas, such as ROHS or a recycled content provision, very difficult to implement.

ROHS and a recycled content provision are not, in themselves, very comprehensive legislative initiatives. However, the latest legislative initiative in the EU, the proposed directive on the impact on the environment of electrical and electronic equipment, is such a proposal. This proposed directive is in the very early drafting stages and is designed to complement WEEE and ROHS. We now turn to examine the main provisions of this latest proposal, their likely effects on innovation, and their WTO compatibility.

[300] It has even been noted that the principles of the SPS do not extend to XX(b) (see *Asbestos*, at 8.180).
[301] In addition, the additional and different obligations of the SPS were found to be in effect even if the measure in question was not in violation of the GATT. The same line of reasoning could apply to the TBT, in which case not only is the *de facto* requirement for risk assessment becoming more stringent, but the number of cases where it would be applied is increasing.

5 DEEE--The Latest EC Proposed Directive

The EC has proposed an additional directive to manage the environmental impacts of EEE. The starting point for the proposed Directive on the Environmental Impact of Electrical and Electronic Equipment (DEEE) is quite different from that of WEEE and ROHS.[302] The latter two directives are more traditional command and control regulatory initiatives, while DEEE is explicitly based in the so-called New Approach.[303]

5.1 New approach

The New Approach has existed in the EU since 1985, and is designed to set common technical requirements for a product category, along with procedures for assessing conformity (EC, undated). Policy makers define the essential requirements, and it is left to the private sector to determine how best to meet those requirements.

The New Approach is intended to be flexible, cost-effective, and technology neutral. The guiding standards are developed through consensus in an open, transparent, and voluntary process organized by recognized standardization bodies (EC, undated). New Approach standards must be based on sound scientific knowledge, consistent, and easily modified.

The New Approach is intended to harmonize requirements regarding the design of EEE within the EU and to ensure free movement of goods in the internal market--it is not intended to address specific environmental concerns like WEEE and ROHS. DEEE is intended, however, to decrease the overall impact of EEE on the environment, efficiently use resources, and provide a high level of environmental protection. (EC, undated)

The New Approach encourages producers to consider the environmental impacts of EEE at the design stage, where the most improvement can be made. Coupled with design improvements, information will be provided to consumers to allow them to make better informed decisions about the EEE they purchase. Taken together, these two aspects of DEEE are intended to encourage innovation in sustainable products and result in continuous improvements in the environmental performance of EEE (EC, undated).

5.2 Overview of DEEE

DEEE is in the very early drafting stages. There is not yet an explanatory memorandum or an evaluation of the proposed directive's impact on business, and the specific requirements could undergo significant changes as the development of the directive progresses. The discussion of DEEE can only reflect the current text of the draft directive, though work is ongoing.[304] DEEE is intended to be a complement to WEEE and ROHS.

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[302] Though officially the directive is abbreviated EEE, DEEE will be used here to distinguish the directive from items of Electrical and Electronic Equipment.

[303] WEEE and ROHS also originated in the Environment Directorate of the EC, while DEEE originates in the Enterprise Directorate.

[304] The information presented here is taken from the most recent (February 2001) version of DEEE (EC, 2001b), which is not the final text of the directive. Citations to Recitals and Articles refer to the text of EC (2001b).

The recitals of DEEE cite two primary motivating factors behind the directive: the need for harmonization of national laws to remove barriers to trade and unfair competition and to encourage continuous improvement in overall environmental impact and resource consumption of EEE.

Some key definitions are the same across WEEE, ROHS, and DEEE, such as the meanings of reuse, recycle, and recover. DEEE also applies to the same equipment as WEEE, but includes EEE used commercially.[305] However, some terms are unique to DEEE, and these are set out below (Article 2).

> Manufacturer: the natural or legal person with responsibility for the design and manufacture of a product in view of its being placed on the market under their own name, regardless of whether these operations are carried out by that person themselves or on their behalf.
>
> Environmental aspect: an element or function of a product that can interact with the environment.
>
> Environmental impact or impact on the environment: any change to the environment, whether adverse or beneficial, wholly or partially resulting from products.
>
> Life cycle: the consecutive and interlinked stages, and all directly associated significant inputs and outputs, of a product from the design of the product to the final disposal.
>
> Life cycle assessment: a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and associated environmental impacts directly attributable to the use of a product throughout its life cycle.
>
> Ecological profile: a description of the magnitude and significance of the environmental inputs and outputs associated with a product throughout its lifecycle.

Within 24 months of entry into force of the directive, EU member states must have all the necessary laws and regulations in place necessary to comply with the directive. Within 60 months after entry into force, EEE that does not conform to the directive will not be allowed on the EU market. (Article 17)

The main requirement of DEEE is that all manufacturers must assess the environmental impacts of a product throughout its life cycle, make use of the assessment to choose the optimal balance between environmental factors and other appropriate considerations, such as technical or

[305] The definition in the text of DEEE (Article 2) is the same as in WEEE (Article 3, see section 3.2), but the equipment list in the Annex in DEEE is based on PRODCOM designations (an EU product classification code), rather than on a list of specific pieces of equipment. It is not clear why the definitions of EEE do not match precisely in the two directives. The EEE that is included under the directive can be updated in light of scientific and technical progress.

economic aspects, and document the specific design choices and the reasons behind them.[306] (Annex II)

The following environmental inputs and outputs must be identified and estimated:

- consumption of materials, energy, and other resources
- emissions to air, water, and soil
- pollution through physical effects such as noise, vibration, radiation, electromagnetic fields, etc.
- generation of waste material
- possibilities for reuse, recycling, and recovery of materials.

The estimates of the environmental inputs and outputs must be done through all the phases of the life cycle of the product, starting with raw materials acquisition, and going through manufacturing, packaging, transport, distribution, installation, use, and end-of-life.[307] The depth of the analysis will depend on the environmental impact of the product and the number of products that will be placed on the market. The final result should be an ecological profile, describing the significant environmental impacts and prioritizing those factors that may be influenced in the design stage. (Annex II)

Manufacturers must take the ecological profile into account to evaluate the opportunities for improvement in the environmental performance of the product, balancing, among other things, environmental considerations, safety and health, functionality, quality, performance, and economic factors. When doing so, manufacturers are obligated to apply the following principles (Annex II):

- strive to prevent pollution and conserve resources
- efficiently use energy and materials
- encourage use of recycled material and reuse of components and subsystems
- minimize release of hazardous substances to the environment
- optimize useful lifetime of the product by designing for durability, reliability, modularity, upgradability, repairability, and reusability
- facilitate recycling, recovery, and disassembly, in particular by using common component and material coding standards
- avoid transferring environmental problems between life cycle stages or products
- aim to achieve progress in improving overall environmental impact of each generation of the product.

Relevant information and/or labeling regarding the environmental design aspects of the product must be provided to those responsible for the manufacturing of the product, to customers, and to treatment facilities. (Annex II)

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[306] The requirements in Annex II apply to all EEE on the EU market, regardless of country of origin, and the requirements can be updated in light of technical knowledge and scientific evidence.

[307] Information on the directive's website specifically states that Life Cycle Analysis following International Standards Organization (ISO) guidelines is not required (see EC, undated).

Manufacturers of components or subassemblies must provide enough information to the EEE manufacturer so that they can identify and estimate the environmental inputs and outputs of the products containing the components or subassemblies. (Article 3)

EU member states must ensure that only EEE that complies with the above conditions is placed on the market or put into service. If EEE is found not to comply, the manufacturer is obliged to make it comply. If non-compliance continues, the EEE will be restricted, prohibited, or withdrawn from the market, with the exact grounds for doing so stated. Disputes about conformance with DEEE are referred to a standing committee. There is a provision for effective, proportionate, and dissuasive penalties. (Articles 4, 12, 14, and 18)

EEE meeting all the requirements of the directive will have a label attached. The label will indicate conformity with the directive, which may be achieved in two ways (Annexes III and IV).[308] The first is through internal design control, which essentially means that records demonstrating all the requirements of the directive are kept and measures are taken to ensure that the EEE is actually manufactured in accordance with the design specifications. The second way of demonstrating conformity is through an environment assurance system, which is a more general system that is not specifically tailored to the requirements of the directive but is nonetheless capable of demonstrating that the major provisions of the directive have been followed.[309] Participation in certain eco-labeling schemes, such as the eco-management and audit scheme (EMAS), will be assumed to indicate conformity with the provisions of the directive, at least to the extent that the eco-labeling scheme covers the requirements in DEEE.[310] The declaration of conformity may cover more than one product,[311] and the records indicating conformity must be kept for 10 years.

The operation of DEEE will be assessed within 5 years of its entry into force.

The DEEE directive is in its very early stages, on consultations are still ongoing. Given the directive's current stage of development, it is therefore not possible to do an analysis similar to the ones presented in prior chapters. Nevertheless, the broad direction and intent of the directive are clear from the draft, and some comments can be made on how to make the directive more innovation-oriented, and how to make it more robust to possible WTO challenge.

5.3 DEEE and innovation

Of WEEE, ROHS, and DEEE, the latter is the only one where innovation is explicitly assumed to be an outcome of the proposed directive, as stated in the explanatory material accompanying

[308] Specifications on the information the label must contain are in Annex V.
[309] This appears to refer to an environmental management system.
[310] Note that most eco-labeling schemes are not product specific, and instead refer to companies or production sites.
[311] The assessments may apply to categories or families of products.

DEEE (EC, undated).[312] Different stakeholders have also lodged opinions with the Commission on the impact of DEEE on innovation.[313]

It is interesting to note the dramatically different opinions on the directive's likely impact on innovation. Industry tends to claim that DEEE, as currently structured, will encourage innovation because it leaves discretion to manufacturers and therefore builds in maximum flexibility (ORGALIME, 2001a). At the same time, some industry stakeholders warn that the directive should balance environmental aims against other public interests, such as consumer safety concerns, increases in prices of EEE, and hindered innovation regarding the performance and functionality of EEE (EICTA and EACEM, 2001; AEA et al, 2001b).[314] NGOs have tended to claim that the directive could stimulate innovation if specific targets were put in place (EEB, 2000a) while industry claims the opposite (AEA et al, 2001b).

Is very difficult, in general, and particularly when the exact requirements of the directive have not yet been developed, to predict exactly what the innovative response to the directive would be. At least one industry association recognizes that that environmental improvements in EEE have been the result of innovation in the past (EICTA, 2001), and there seems to be little doubt that the sector is generally innovative (CGCAP, 2002; Knoth et al, 2001; WRI, 1998; Christensen, 2000).

However, innovation to address environmental concerns in isolation runs the risk of simply shifting the problem to another area such as worker or consumer health impacts (Ashford, 1997). The definition used in DEEE for life cycle and life cycle assessment do not make clear that the effects on consumer and worker health and safety should also be considered during the development of the ecological profile, and the requirements in Annex II are strictly focused on the environmental impacts of industrial activities. DEEE should not be counted a success if environmental hazards are addressed by simply transferring them to problems with worker health or other areas.

According to the theoretical framework outlined in Chapter One, innovation is an unlikely response to the current draft of DEEE. DEEE only stipulates that manufacturers follow very broad guidelines in considering the environmental impacts of EEE throughout its life. There are no specific requirements or targets in the directive, let alone stringent targets.[315] Indeed, given some of the language in the current draft, such as "strive to", "encourage", "facilitate" and "aim to" (see Annex II), it is not even clear how conformance to the main criteria of the directive would be determined in the first place. It would be very difficult to prove that a manufacturer did not strive to do something, or that he did not appropriately balance environmental

[312] Gains in the competitive advantage of EU firms is also one of the claimed benefits that will result from DEEE, but it is not clear how such an advantage would be obtained since all manufacturers regardless of location would have to meet the same requirements of DEEE.

[313] In contrast to WEEE and ROHS, the stakeholder comments regarding DEEE have been centrally collected and are available through EC (undated), or directly at http://europa.eu.int/comm/enterprise/electr_equipment/eee/comments.htm. This discussion incorporates the comments that were available on August 1, 2002, and that were written in English.

[314] Note that an innovative response to the directive could avoid these tradeoffs altogether.

[315] EICTA (2001) and the AEA et al (2001) believe the requirements in the current draft of DEEE are too prescriptive.

considerations with other factors.[316] Indeed, it is not even requirement that some positive environmental change be demonstrated as a result of taking life cycle thinking into account.[317]

However, the broad aim of the directive is sound. If substantial progress is going to be made in reducing the environmental impact of EEE, those impacts should be considered throughout the product's development, and particularly in the design phase.[318] In fact, 80% of a product's cost and materials choices are made in the design phase (WRI, 1998). The directive fails to fill out a legitimate broad framework with some specific, ambitious, and quantified targets that would encourage innovation and decrease particular environmental impacts.[319] Including particular targets would also make it easier to articulate the benefits of the directive, in addition to leading to more substantial improvements through innovation.

5.4 Costs of DEEE

Judging from the information available from the EC, recent activity regarding DEEE appears to be focused on developing the business impact assessment study (EC, undated). One stakeholder, the European Domestic Appliance Industry, was particularly interested in seeing a cost benefit analysis (CBA) of the proposed directive, and has since gone on to critique the proposed methodology (CECED, 2001c; CECED, 2002).

Given the nature of DEEE, it is hard to see how a CBA could be useful or even appropriate. The requirements of the directive are so general that it is a stretch to think how costs or benefits could be approximated for so many companies and products. Yet the specifications for the impact assessment ask for measurable and verifiable indicators to underpin the analysis (EU, undated). Costs for complying with DEEE are to be provided by those affected, i.e., primarily manufacturers, and the environmental (and other) benefits are to be calculated by the contractor who conducts the impact assessment. Calculation of the benefits is particularly difficult since each manufacturer, and even each product family, could deliver different benefits after a redesign informed by life cycle thinking.

With the built-in incentives for manufacturers to give a thorough accounting of all the possible costs of complying with DEEE and the difficulty of assessing the benefits, any CBA of DEEE is certain to encounter many of the problems outlined in Chapter 1. Any new approaches or technologies that are developed in response to DEEE will certainly not be included in the CBA. If more specific requirements were included in DEEE, this would not make the CBA much more accurate, and, in addition, the tendency to innovate in response to those requirements increases, which further reduced the efficacy of a CBA. Having already analyzed the cost and benefit calculations for WEEE and ROHS, it is hard to imagine the CBA for DEEE will be more robust or more meaningful. It is likely the CBA for DEEE will show considerable costs for compliance. But that assumes the methodology is appropriate. In circumstances like this, where costs and

[316] The very concept of "balancing" various factors will probably lead to the use of cost benefit analysis, thus further removing the chances of innovation in response to the directive.
[317] ANEC et al (2001) state that prior drafts of DEEE had more specific requirements.
[318] For additional support on this point, see McDonough and Braungart (1998) and Boks and Stevels (2001).
[319] For example, specific environmental impacts could include CO_2 emissions, toxic emissions, use of hazardous substances, energy efficiency, etc. The targets could also be based on relative improvement, rather than on absolute goals.

benefits are difficult to quantify, and the directive and the responses to it so uncertain, it would be much more helpful to utilize a different analytical technique, such as Technology Options Assessment, or to base a policy primarily on the precautionary principle.

5.5 Other considerations

The failings of the directive are even more acute in that it does not specify any environmental concerns that are of special significance. The responsibility to do so is clearly in the domain of those with the duty of guarding the public trust, i.e., policy makers, yet it is unclear from the directive if this task would be ceded to the standard making body. This would be inappropriate. Policy makers have decided that the environmental impacts of EEE pose some problems, and they should follow through in deciding which impacts are most significant and how much of a reduction in those impacts is warranted.[320] They should so specify within the text of the directive.

In addition, the proposed standard making body, the European Committee for Electrotechnical Standardization (CENELEC), has been accused of being more influenced by industry than by other stakeholders, in which case any environmental concerns or targets could unnecessarily reflect the views of industry (ANEC et al, 2001). The standard body should be sure to include government, NGOs, and workers/unions in the standard making process, as well as industry. Non-European organizations should also be included in the discussions, because all manufacturers importing to the EU will have to comply with the directive.[321] The scope of work of the standard setting body should be on the technical details only, not on the priority areas for action or required targets.[322] The work could include determining how quantified information should be presented, which units should be used, standard assumptions to be used (or ranges of assumptions), conversion factors (for example, how many pounds of CO2 are generated per kWh by an electricity plant burning natural gas), the boundaries of the analysis, how such information should be presented, suggestions on methods to be used for the quantification, etc. Where possible, international standards should be referenced, and indeed, though CENELEC appears to have already been chosen to perform this task, an international standard setting agency would be preferable to avoid any European bias in the outcome.

Industry stakeholders are right that they should be able to use their choice of analytical tools in order to demonstrate that they have met the requirements of the directive (EICTA, 2001; AEA et al, 2001b; ORGALIME, 2001a).[323] In being granted such flexibility, however, industry should be obligated to choose tools that with generate quantifiable indicators of environmental impact that are comparable across products. This is in keeping with the proven technique of having firm, ambitious targets set by policy makers and leaving the means to reach those targets flexible.

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[320] Of course policy makers could rely on specialized expertise in making their determinations of which environmental aspects were most important and the associated appropriate targets.
[321] Inclusion along these lines would also help with a WTO challenge.
[322] This view was supported by ANEC et al (2001), ORGALIME (2001a), and the Danish EPA (2001).
[323] An LCA along the lines of the ISO 14040 should be acceptable, but other techniques such as design for environment assessments, design checklists, design standards, etc., could also be used, provided they achieve the same end result.

There was some discussion about whether the data generated by the requirements of DEEE should be comparable across similar products or even if the information about the environmental impacts of EEE should be made available to consumers (EICTA, 2001; ORGALIME, 2001a). Obviously, it seems clear that information must be provided to consumers; otherwise the additional incentive to make improvements will come only from regulations. Those manufacturers who make dramatic improvements should be rewarded for doing so in the market.[324] Consumers will only be able to make informed decisions about the EEE they are purchasing if the information is available and comparable.[325]

The issues of conformance and enforcement will need more attention as DEEE develops. Conformance should hinge on meeting the specified targets and having the calculations and methods used in reaching those targets verified by a third party. Presumptions of conformity could be grated on the calculations and methods if they were done in conformance with a recognized standard, but merely adhering to an environmental management system or an eco-labeling scheme would not necessarily indicate that a particular target had been achieved.

Enforcement will remain difficult. Though third party verification will help, most of the requirements of the directive are based on calculations, as opposed to real operating experience of EEE manufacturing or use. The calculations themselves can be verified, but it is not clear how to ensure the EEE was actually manufactured, transported, distributed, used, and disposed in the manner the calculations assume. Assessing conformance with these aspects of the directive may require on-site inspections at production and disposal facilities.

The current draft of the directive claims that EEE not in compliance with DEEE would be forced to comply, or, if that was not done, it would be restricted, prohibited, or withdrawn from the market. This too seems like it would be very difficult. How could EEE that was already manufactured and on the market be forced to comply with design standards? It is also hard to imagine that EEE on the market would be withdrawn for not complying, particularly if the equipment were already in use. Any punishments for non-compliance should rely on being able to ascertain definitively if the requirements of the directive have been met, and, if not, the consequences should simple, effective, and proportional to the degree of noncompliance.[326]

Several stakeholders espoused using voluntary approaches to address substantive environmental concerns of EEE (EICTA, 2001; AEA et al, 2001b). Any suggestions on workable voluntary agreements to do so should be heard.[327] In the mean time, however, DEEE should be

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[324] Government purchasing could also target those manufacturers with demonstrated lower EEE environmental impacts.

[325] This raises the question of whether the label itself should have some indication of the relative rankings of particular pieces of EEE, which could be a topic for the standard making body to consider.

[326] For example, consequences could include fines based the discrepancy between claimed and actual environmental performance, additional contributions to the treatment costs of WEEE, a probationary period involving more thorough checks of calculations or production, or higher targets that must be met in the next generation of the product.

[327] Recall, however, the limitations of voluntary agreements, and particularly their impacts on innovation, from Chapter 1. An EIA press release regarding the proposed US CRT and MCE rule states that "one of the main goals of the electronics industry is to lessen the environmental impact of its products over their entire life cycle – from design, to use, to end of life" (EIA, 2002), yet the EIA is one of the authors of AEA et al (2001b) which is very

strengthened. This should not merely be a negotiating tactic, but actually an attempt to fulfill the aims of the directive itself.

The aims of the directive are sound, but the provisions must be improved if those laudable aims are to be realized. DEEE should keep the key requirements in Annex II while adding in some specific, ambitious, quantifiable, and verifiable targets for particular environmental areas of concern. The targets and the areas of concern should be determined by government, in consultation as necessary with experts, and the details should be worked out by a standard making body (preferably an international one). The means to reach the targets should be flexible, but the methodologies and calculations used to justify the chosen means should be verified by third parties. The data on the environmental impacts of different EEE should be comparable across similar products and should be made available to consumers so they can make informed purchasing decisions.

5.6 DEEE and the WTO

DEEE, being farther reaching than either WEEE or ROHS, would almost certainly come up against a WTO challenge. Indeed, some of the early stakeholder comments already appear to be laying the groundwork for just such a challenge (AEA et al, 2001; AEA et al, 2001b). Again, it is primarily stakeholders based in the US that raise the trade issue in reference to DEEE.[328]

Only a few preliminary comments can be offered on the potential WTO compatibility of DEEE at this time. It is possible DEEE could contravene Article III(4) of the GATT. The information available from the EC (undated) indicates that EEE from all manufacturers is subject to the requirements of DEEE, and that EEE being imported will be checked at the border. Following the logic of *Asbestos*, this could be seen as a violation of Article III(4). In addition, DEEE might be viewed as a technical regulation under the TBT, since the TBT and the definition of a technical regulation both make specific mention of labeling requirements.[329]

An exception under Article XX(b) of the GATT would be difficult for several reasons. DEEE does not make any claims for protection of human, animal, or plant life or health, and hence would probably not be deemed to be within the range of policies to do so. In addition, any claim in that regard would require some showing of the existing risks to health that DEEE is designed to curb. The necessity of the measures in DEEE would be difficult to substantiate in the absence of a clear health related policy objective and in light of their trade restrictiveness. Use of European standardization bodies or environmental assessment procedures such as EMAS may go against the discrimination requirement in the chapeau, as would the apparent lack of multilateral negotiations.

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critical of DEEE. A recent news article hinted at a move within the EC to use more voluntary agreements to achieve environmental goals (ENS, 2002b).

[328] ENS (2002a) states that an American industry association, the AEA, spearheaded the efforts against DEEE.

[329] However, the definition of a technical regulation also requires that a document lay "down [specific] product characteristics or their related processes and production methods" which DEEE, in its current form, does not do. The current product labeling provision in DEEE is the only part of the directive that is clearly within the terms of the definition of a technical regulation under the TBT. Exceptions to the TBT are still discussed in light of the recommendations that more specific requirements be included in DEEE.

A claim under Article XX(g) might fare a bit better. Recital 5 of DEEE does mention improving the resource consumption of EEE products, and Article 1 refers to "efficient use of resources". Clearly, the language in both of these cases could be made stronger, but it is a better showing than under XX(b). A claim under XX(g) is also bolstered by the fact that the key requirements of DEEE in Annex II refer to the consumption of materials and resource conservation, which could support an argument that the measures in the directive are "related to" conservation of natural resources. In some cases, where the improvements due to DEEE result in decreased emissions, the natural resources in question could be clean air, water, and land. The universally applicable requirements of the directive could be taken to show that the measures are made effective in conjunction with domestic restrictions. Finally, there are the requirements of the chapeau, which bring the same difficulties as those mentioned above. Though still challenging, a claim under XX(g) looks more promising than a claim under XX(b).

If DEEE were found to be in violation of the TBT, an exemption under Article 2.2 could be applied for. Recall that the TBT allows for policies designed to protect the environment, and the text of DEEE offers the most support for an exception based on this rationale. Recital 5 refers to "continuous improvement in the overall impact on the environment", Recital 6 states that the directive has "significant potential to improve the overall environmental impact of a product", and Article 1 of DEEE adds that the directive should provide "a high level of environmental protection". In addition, there are several requirements in Annex II that would result in increased environmental protection.

However, DEEE would also have to explain the risks that non-fulfillment would create. It is not possible to specify those risks at present, give the general nature of the proposed directive. For the same reason, it would also be difficult to say much about the "related processing technology" affected by the directive, which is one of the items that must be considered under Article 2.2 of the TBT. An inability to be more specific on these points would be a serious weakness in any application for an exception to the TBT. Troubles justifying the necessity and trade impacts of the measure and would probably be similar to those encountered under XX(b) and the chapeau of Article XX.

It looks as though the current version of DEEE would have some difficulty surviving a challenge under the GATT. The vagueness of the policy goals and requirements of DEEE makes it a challenge to satisfy the requirements for the exceptions under Article XX. Regarding the TBT, however, DEEE in its current form may not even be a technical regulation as defined in that agreement.

If DEEE were made stronger by included specific requirements, parties opposed to the directive would probably argue more forcefully about its WTO incompatibility, but the specificity of the requirements and aims may actually help claims for exceptions under Article XX. Specifically, an exception would be helped by setting clearer and higher goals and being able to state which environmental concerns are being addressed and the difference DEEE will make in reaching policy objectives.

On the other hand, more specific requirements could bring DEEE under the definition of a technical regulation within the TBT, thus opening another avenue of attack and requiring

additional effort to be granted an exception under Article 2.2. Note, however, that it is not clear whether specific performance goals, as opposed to technical specifications, would increase the likelihood of DEEE being viewed as a TBT, since TBTs are usually viewed as specification requirements.[330]

DEEE is sound in theory but in practice, as embodied in the current draft of the directive, it will not be able to fulfill its aims or its potential. As it is now, sweeping trade restrictions imposed for vague environmental benefits are likely only to upset both industry and NGO stakeholders with an interest in DEEE. The framework set forth in DEEE is precisely the type of guidance that will encourage continuous improvement and maximize the effect of changes that are made because they will be integrated into the earliest stages of product development. In order to accomplish such significant change, however, manufacturers and designers must be forced to think outside the box.

[330] In other words, clear environmental performance goals may still not be considered "product characteristics or their related processes and production methods" within the meaning of a technical regulation under the TBT, in which case even an improved version of DEEE would only have to rebut a challenge under the GATT.

6 Conclusion

The examination of policies to manage electronics waste began with a recognition that traditional, quantitative approaches to environmental policy making are not well suited to situations characterized by uncertainty or involving new risks. Traditional approaches tend to focus on managing tradeoffs, but that misses the opportunity to develop new innovative responses to environmental concerns that co-optimize economic and environmental concerns. However, simply adopting an amalgamation of newer approaches may lead to conflicting ends. This could be the case, for example, if the precautionary principle suggested a significant response to a problem but industry stakeholders were included in the early stages of policy design and exerted a heavy influence. Industry would be inclined to wait until the nature of the problem was fully known before acting, thus diluting the use of the precautionary principle in the first place.

One way out of this dilemma is for policy makers to deliberately and thoughtfully design innovation-oriented environmental policy interventions. Carefully designed policies can encourage affected actors to innovate in response and deliver increased environmental and health protection at equal or lower cost. For policy makers to make the most of this approach, however, they must understand that today's incumbent technologies and actors may not be willing or able to provide innovative solutions. Further, based on the strength of signal the policy maker sends, i.e., the stringency of the policy intervention, it is possible to encourage varying levels of innovative response relative to the policy goals. Recognition that innovation may displace leading actors and/or technologies also implies that costs calculated using current technologies will not reflect the actual costs of delivering improved environmental or health protection.

The environmental and health concerns associated with managing electronics waste are characterized by uncertainty and new risks, and are strong candidates for innovation-oriented policies. The US and the EU have both recently begun new initiatives to handle electronics waste, and the rationales for doing so are quite similar. These two cases are well suited for a comparison to each other and an analysis of whether the proposed policies will induce innovation.

The proposed rule in the US on managing cathode ray tubes and mercury containing equipment is not likely to induce any innovation or diffusion. The proposed rule is largely a relaxing of previous applied waste regulations and it is assumed that more CRTs and MCE will be recycled as result of decreased waste handling requirements. However, the financial incentives for industrial actors to alter their current waste handling practices are quite limited, and in the absence of any other requirements, it is not certain that the claimed environmental benefits of the rule will be realized. There is a particular disconnect between the stated aim of developing a CRT recycling industry, for example, and the lack of policy support in the rule to encourage that nascent industry. In short, there are not any requirements, and only minimal incentives, for industrial actors to change their waste handling practices in response to the proposed rule.

In addition, there are larger issues that the rule overlooks entirely. The rule does not apply to households, for example, who are still free to dispose of TVs and computer monitors (and all other electronics waste) in any manner deemed convenient. The rule only applies to EEE

containing CRTs and mercury, which leaves out the majority of electronics waste, and, further, the rule does not include any requirements for managing the other materials contained in that waste. Considerable information is available from pilot programs on the costs incurred and the materials collected from household electronics waste recycling efforts. The EPA should make use of the experience and learning that has accumulated from these programs in designing future policies.

Such policies should include household waste within their scope, cover more types of electronics waste and more materials within that waste, and contain definitive requirements for reuse, recycling, recovery, and/or recycled and recyclable content. The requirements should be stringent enough to encourage innovation in the handling of WEEE. Funding for research, the development of niche markets, or dissemination of best practice could also accompany any new regulatory initiatives. Policy makers must be careful not to let the dialog taking place under the auspices of the National Electronics Product Stewardship Initiative set the overall agenda or requirements for electronics waste handling requirements. These discussions could be fruitful in determining how requirements may be met, but the policy aims and requirements themselves should be set without undue influence from those most likely to be regulated.

Some of these ideas are incorporated into the two proposed directives for handling electronics waste in the EU. The EU directives are much broader in scope, covering WEEE from households and commercial sources, and covering many more types of electronics equipment. The EU directives also have definite targets for collection, reuse/recycling, and recovery. The EU directives are clearly much farther reaching than the proposed rule in the US.

The EU directives are also more likely to encourage innovation. Though the reuse/recycling and recovery targets can probably be met using current technology, the targets are scheduled for review in a few years time and are likely to increase. The directives are therefore encouraging diffusion and perhaps incremental innovation in the short run, and incremental and perhaps radical innovation in the medium term. The degree of innovative response hinges in part on how much of the plastics fraction of WEEE must be treated in order to meet the required targets. In fact, innovation in reuse and recycling might be better encouraged if different materials fractions of WEEE had unique targets. Such targets could be structured so as to reach the same reuse/recycling and recovery rates as in the current directive, while allowing for more tailored technological responses.

Though it does not at present, reuse of whole pieces of equipment should also count toward reaching the targets in the directives in order to emphasize the importance of this aspect of waste management and to extend the useful life of EEE before it is recycled. In addition, markets for recycled materials should be supported, as existing markets may not be able to absorb the increase in supply that will be generated by the directives. A requirement to include recyclable material in new EEE, as well as recycled material, would help to close the loop on recycling and stabilize recycling markets.

Generally speaking, the EU directives have taken a reasonable approach on the issues of financing the treatments costs of current and historic WEEE and WEEE from free riders. However, the details of the guarantees provided by current producers and other financing

mechanisms are very important, particularly in the determination of how treatment costs will be apportioned. A balance must be struck between the ability of a producer to pay, recouping treatment costs, and the convenience of the financial arrangement. Contrary to the arguments of industry, there does not appear to be any additional incentive to free ride if current producers finance the treatment of WEEE from free riders. Contrary to the arguments of NGOs, there is not any reason why the costs of treating historic WEEE should not be shown in a visible fee on new EEE.

At present, producers are not at all responsible for financing the collection of household electronics waste. This seems contrary to extended producer responsibility and to the overall aims of the directive. In theory, producer responsibility should cover the entire range of handling and treatment activities. However, the practical arrangements for doing so could become quite burdensome. Nevertheless, it seems reasonable for producers to partially defray the costs of collection either through fees internalized into the price of new EEE and hypothecated to local authorities who collect WEEE, or through any necessary investments to create or expand WEEE collection systems.

The proposed EU directive may suffer from an overly broad definition of WEEE. Large household appliances, IT equipment, and consumer equipment account for 90% of WEEE by weight and for approximately the same fraction of plastics used in EEE. Including other categories of EEE in the scope of the directives adds considerably to regulatory, bureaucratic, and financial burdens while seemingly providing little additional benefit. If categories of WEEE were included based on an environmental rationale, such as use of hazardous materials or high environmental impacts upon disposal, perhaps fewer categories of WEEE could be included while still realizing most of the key environmental benefits.

The environmental benefits of the ROHS directive may also be limited by the type and number of exemptions that have already been granted. It is not clear what the basis was for granting exemptions, nor is it clear that the environmental impact of those exemptions has been taken into account. Given the hazards associated with the materials falling under the ambit of ROHS, a full exemption may be overly generous. If substitute materials are not available in certain applications in the foreseeable future, then the ROHS deadline could be extended, or a decreasing allowable limit of the substance could be put in place, or research could be conducted to find substitutes. The procedures to add new exemptions or contest current exemptions that are based on scientific or technical impossibility or environmental, health, and/or safety impacts should be clarified to avoid lengthy disputes. Claims made in these circumstances should also be examined by third parties.

The EU directives are considerably more comprehensive, ambitious, and innovation-oriented than their American counterpart. This level of activity has attracted scrutiny from a number of organizations that may consider making claims at the World Trade Organization that the EU directives contravene the GATT. The bans on materials in ROHS and a requirement to include recycled content have received particular attention.

It is certainly possible that ROHS would be viewed as being counter to the GATT, particularly Article III(4). Of the available exceptions allowable under the GATT, ROHS has a stronger

argument under Article XX(b) covering policies to protect human health. Arguments under XX(b) would be helped considerably if the language tying ROHS to improvements in human health were made stronger, and if the health impacts resulting from use of the substances covered by ROHS were highlighted in the explanatory memorandum that accompanies the directive. A higher stated health related goal would also bolster a claim for an exception. These three improvements to the directive would prevent conclusions that the risk from the substances may not be great enough to justify a ban, a ban may not be necessary to achieve the stated goal, or that a less trade restrictive measure could reasonably be employed to achieve the policy goal. A claim for an exemption under Article XX(g) is severely hindered by the lack of a reference in ROHS to the preservation of natural resources as one of the drivers behind the directive. Under both XX(b) and XX(g), the requirements of the chapeau would also have to be met, but a definitive assessment of those requirements cannot be made until the directive is transposed into law and applied in practice.

ROHS could also be found to be a technical regulation under the TBT, where it is also possible to have an exception granted. The TBT allows exceptions for the protection of the environment, which would help a claim to an exception for ROHS. Issues regarding the necessity of ROHS, the risks of non-fulfillment, and requirements of the preamble are difficult to assess because this area of WTO law is much less well defined than the exceptions under Article XX of the GATT. Claims for an exception under the TBT would be strengthened by a clearer articulation of environmental and health risks from the use of ROHS substances, in addition to being conscious of how ROHS is implemented in individual countries and the trade affects accompanying implementation.

The WTO compatibility of a recycled plastic content provision in WEEE faces some similar problems. However, the initial hurdle to demonstrate that WEEE is a policy designed to protect health, the environment, or natural resources is more difficult to overcome because there is not much language in the text of the directive that would support claims in those areas. This is an obvious area for improvement. A clearer stated goal for WEEE would also help any claims for exceptions. At present, the goals are very clear in terms of recycling targets, but the larger question of how that bears on health or the environment is more vague. Ironically, a 5% recycled content provision may not be seen as commensurate with an ambitious goal regarding environmental or health protection because 5% may be too low. It would also be important to be able to show why measures that do not involve trade bans would not be able to achieve 5% recycled content in new EEE.

A recycled content provision has the challenge of showing that the difference in treating recycled plastic as compared to virgin plastic results in some health or environmental protection benefits. More data on these points could be provided and would be important in an argument for an exception under Article XX(b) or XX(g) of the GATT. Benefits regarding savings in raw material use could also be claimed, but only if the raw materials in question were from within the EU. The requirements of the chapeau would obviously have to be considered as well.

A requirement to include recycled content in new EEE could also be interpreted as a technical regulation under the TBT. Many of the same challenges and suggestions facing a recycled content provision under the GATT would apply here. As a policy, WEEE has an easier time proving its

legitimate goal of protecting the environment under the TBT than under the GATT, because environmental protection is an allowable aim under the TBT. A recycled content provision, however, would still face some difficulty in that regard.

In several instances, extraterritoriality arguments were raised against a claim for an exception under the GATT and TBT. However, the case law regarding extraterritoriality is not decided, and, in some circumstances, extraterritorial effects may even be allowed. In addition, the major finding regarding extraterritoriality thus far is that a measure which required the adoption of a similar regulatory program in another country would not be allowed under the GATT. However, neither ROHS nor a recycled content provision would require the adoption of a particular regulatory program. The fact that some benefits derived from ROHS or a recycled content provision might be experienced outside the EU should not be enough, on its own, to support an extraterritoriality argument.

Analysis of a recycled content provision in terms of its WTO compatibility indicates that it may be advisable for the EU to pursue plastics recycling via another avenue. This could be done by requiring their own producers of EEE to incorporate recycled content, or by requiring recycled content in all EEE on the market but pairing that with consequences less severe than a ban on EEE products that do not comply. The EU could also require that 5% of all the plastic in EEE by recyclable, which would make a showing under the GATT and TBT exceptions easier because the environmental and health benefits of treating recyclable plastic would all accrue in the EU and might be easier to demonstrate.

The examination of claims under the WTO has highlighted some larger issues of interest. The WTO approach to trade and environment disputes runs the risk of becoming increasingly out of step with how environmental policy is currently being made. The WTO approach relies, sometimes explicitly, on very traditional statistics based and quantitative approaches to regulation such as assessments of risk and cost. The WTO claims that members are free to choose the level of health and environmental protection they desire. But if the level of protection is based in an application of the precautionary principle, i.e., not based solely on what might be included in a quantitative risk assessment, it is hard to see how the chosen policy would survive a WTO challenge.

The choice of which agreement is referenced in a dispute is not insignificant. For example, there is no mention of risk under Article XX, but under the TBT the risks of non-fulfillment must be considered. This would imply different burdens of proof under the different agreements. However, even under Article XX(b) there is now a *de facto* requirement that the risk to health be assessed as part of the petition for an exception. A creeping requirement to base assessments of risk more or less exclusively on risks that can be quantified implies that the scope to apply the precautionary principle under WTO law is shrinking.

It has been suggested that the precautionary principle is already included under WTO law, but this is in fact not the case. In the first place, there is no reference to the precautionary principle in the GATT or the TBT. But more importantly, any application of caution, such as that allowed in Article 5.7 of the SPS, can only be applied provisionally or temporarily, and does not relieve WTO members from their other obligations under the agreement. The precautionary principle

should allow final or permanent policies to be made even in the face of insufficient, inconclusive, or uncertain scientific information. Any requirement that risks or scientific information be quantitatively assessed strips the precautionary principle of its true purpose in environmental policy – i.e., to facilitate decisions in the face of considerable uncertainty, indeterminacy, or even ignorance.

A third directive has been proposed in the EU that would require EEE manufacturers to assess and consider the environmental impacts of EEE throughout its life cycle. DEEE requires the identification and estimation of a number of environmental inputs and outputs for each product family, as well as asking manufacturers to follow certain design principles when balancing environmental considerations with other factors.

Though the aims of DEEE are laudable, the draft of the directive does not require that any targets be met, or even that any improvement in environmental performance be shown from one time period to the next. It is assumed, by the EC and by some industry and NGO stakeholders, that the directive will result in innovation, but without the presence of stringent guidelines it is not clear why this would be so. There is also the risk that a strict focus on the environmental impacts of EEE production and use could mean that any improvement in environmental performance would come at the expense of worker or consumer health or safety.

The holistic approach of the DEEE directive is welcomed, but it needs to be filled out with specific requirements. Priority areas of particular environmental concern should be identified by policy makers and targets appropriate for those areas specified in the directive. Once the targets are set, the means to achieve them should remain flexible, and some of the technical details about methods and calculations can be left to a standardization body. That organization would preferably be internationally oriented, as opposed to regionally based, and would involve government, NGOs, workers, and industry in the discussions. Information about the environmental impacts of EEE should be available to consumers and comparable across similar products.

Conformance and enforcement will also require additional fleshing out. Presumptions of conformance should only be granted if the referenced standards have similar required targets. Following broad guidelines such as those contained in many environmental management systems does not necessarily mean that any particular target has been reached. Conformance, methods to achieve targets, and calculations done to show targets have been reached, should all be subject to third party verification. Enforcement is, if anything, even more complicated. Since many of the requirements of the directive are implemented at the design stage, it will be difficult to ascertain if the EEE has been manufactured, distributed, used, and disposed of according to the design. Inspections at production and disposal facilities may be necessary in addition to verification of paperwork. Penalties for non-conformance should be simple, effective, and proportional to the severity of the violation. This may not require restricting or recalling EEE from the market, as is currently in the directive.

Given its early stage of development, it is hard to conduct an analysis of the WTO compatibility of DEEE. The import ban provision within DEEE would probably put it in contradiction to Article III(4) of the GATT. In its current form, the aims and requirements of the directive are

vague enough that it is difficult to meet the burden of proof for an exception under Article XX(b) and XX(g). It is also not clear what health or natural resource concerns DEEE is trying to address, or whether a ban on non-conforming imports is necessary to meet the aims of the directive. Note that some other enforcement mechanism might increase WTO compatibility because it would not be as trade restrictive. Revised language in the directive stating that its aim is to protect health and/or natural resources would also be beneficial. Any use of European based standardization bodies or conformance assessment procedures may be seen as a form of discrimination in violation of the chapeau of Article XX.

DEEE, in its current form, may not be considered a technical regulation under the TBT because the directive does not lay down any specific product characteristics or production methods. Even if more specific requirements were added to the directive, it might still not be a technical regulation because the targets would be performance goals as opposed to technical specifications. If DEEE did have to apply for an exception to the TBT, it would face many of the same challenges as under Article XX of the GATT. However, DEEE's case for environmental protection, an allowable exception under the TBT, is stronger than for the health and natural resource protection under the GATT. Under TBT Article 2.2, DEEE would have to address the risks of non-fulfillment of the policy, which could still be challenging even if more specific targets had been included in the directive. DEEE would also have to address trade related concerns similar to those under the chapeau to Article XX.

The US and the EU have taken quite different approaches to their policy initiatives regarding electronics waste. Neither initiative is as innovation-oriented as it could be, though the EU does a better job in that regard. Both sets of policies could be improved in terms of their basic mechanics and likely effects on innovation. It is hoped that the analysis presented here may help policy makers on both sides of the Atlantic to improve their current proposals and to achieve environmental policy goals in ways which harness innovation to deliver both environmental and financial benefits.

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