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E-Waste

Policy Paper

Mariëtte van Huijstee & Esther de Haan

December 2009

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(SOMO)

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Colophon

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Contents

1. Introduction

In the past two years the often illegal export of waste from electric and electronic equipment ('e-waste') to developing countries has received considerable attention. Partly thanks to agenda-setting efforts of NGOs like Greenpeace and the Basel Action Network, concern has arisen regarding the hazardous environmental and health effects of irresponsible disposal and recycling of these wastes at Asian and African destinations (e.g. China, Nigeria, Ghana). The issue has been placed on the agenda of e-waste sending and receiving countries alike, and several initiatives are being developed to combat these (illegal) e-waste transports. For instance, after conducting research on electronic waste exports in 2004, the inspection of the Dutch Ministry of the Environment performed several rule enforcement activities which had demonstrably diminished the unregistered trade in e-waste, reducing the risk of illegal export of e-waste from the Netherlands by 2006.[1] Furthermore, the WEEE directive – the European directive aimed at responsible recycling of electronic waste – is currently being reviewed in order to tackle the continued 'leakage' of e-waste to developing countries. On the receiving side, Uganda has decided to ban the import of old computers entirely, even though some critics find this decision is hampering efforts for e-commerce, e-learning, e-health and e-agriculture, especially in rural areas with limited income sources.[2] And in India - where e-waste reportedly increases with 10% a year - [3] e-waste regulations have been prepared by NGOs and electronics manufacturers and are currently being considered by regulators.[4]

Notwithstanding these efforts, reports about the piling up of e-waste in Asia and Africa, but also in North America, appear in online media virtually every week. This e-waste is not only causing environmental and health problems in the communities at the end of the electronics production chain[5]; it is also perpetuating serious problems at the beginning of the electronics chain, during the mining stage. When metals are mined irresponsibly for use in electronics, the earth's resources are squandered and mine workers and communities surrounding the mines may be damaged.[6]

Shifts in demands for metals can have an impact on the life time of a product, on recycling efforts and, directly or indirectly, on the mining of metals. These shifts in demands, in turn, can be caused by changes in electronic product sales, and by technological changes in electronic devices, which may either stem from the market or from regulators. As for the former, the trend towards lighter devices and the increasing amount of appliances in mobile phones have an enormous impact on the mining of metals. For instance, the growing demand of platinum as a result of the growing market of modern consumer electronics has been shown to have a negative impact on the labour conditions of mineworkers in South Africa. The effects of the ROHS directive on metal demands give an example of

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[1] VROM-Inspectie, "Buiten Beeld," (2005), VROM-Inspectie, "Het beeld verhelderd," (2007).
[2] Ultimate Media, "Uganda Business News: E-waste problem needs to be urgently tackled," 2009), <http://www.ugpulse.com/articles/daily/news.asp?about=E-waste+problem+needs+to+be+urgently+tackled&ID=12906> (26 October 2009), R. Wanjiku, "Kenya, Uganda at crossroads on electronic waste," 2009), <http://news.idg.no/cw/art.cfm?id=D25CB55B-1A64-6A71-CE1CCC405B541402> (26 October 2009).
[3] E. Ritch, "E-waste growing 10% a year in India," 2009), <http://cleantech.com/news/4220/e-waste-growing-10-year-india> (26 October 2009).
[4] The Economic Times, "India prepares strictest rules on disposing of e-waste," 2009), <http://economictimes.indiatimes.com/Infotech/India-prepares-strictest-rules-on-disposing-of-e-waste/articleshow/4906529.cms> (26 October 2009).
[5] A. Sepúlveda, M. Schluep, F. G. Renaud, M. Streicher, R. Kuehr, C. Hagelüken and A.C. Gerecke, "A review of the environmental fate and effects of hazardous substances released from electrical and electronic equipments during recycling: Examples from China and India," Environmental Impact Assessment Review, 30(2010) (2009), p. 28-40.
[6] MakeITfair website, "Broken computers, wasted lives," (March 2009), <http://makeitfair.org/the-facts/leaflets> (14 July 2009). MVO Platform and GoodElectronics, "Reset. Corporate social responsibility in the global electronics supply chain," (2009).

the effects of regulations. When the ROHS directive came into force, lead in soldering was largely replaced by tin, leading to a surge in the demand for tin.

The purpose of this policy note is to provide European governments, the electronics sector and NGOs with an overview of the current state of affairs on e-waste and to point out avenues to better address the e-waste problem. The current revision of the WEEE directive provides for an important opportunity in this regard. The policy note focuses on waste stemming from IT, Telecom and Consumer electronics (WEEE groups 3 and 4). The policy goal it envisions is the promotion of environmentally and socially conscious design of consumer electronics and an increase in recycling rates, since recycling of electronics limits the need for new mining activities with large environmental and social footprints, as well as the irresponsible disposal of e-waste.[7]

A draft version of this paper was sent out for review to representatives of recyclers, producers and environmental groups. Their comments were extensively discussed and incorporated. This review process led to multiple changes, further specification and elaboration, strengthening the basis of the analysis and policy recommendations in the paper.

[7] S. Nordbrand, "Out of Control: E-waste trade flows from the EU to developing countries," (Swedwatch, 2009).

2. The e-waste pipeline

2.1 Metals: from mining to recycling

The proliferation of information and communication technology causes the continued increase in the generation of electronic waste. In the Netherlands, the weight of IT equipment placed on the market equalled nearly 50 kilo tonnes in 2007, with a steady increase every year.[8] Sooner or later –and, thanks to the marketing strategies of electronics companies, often sooner than later- this equipment will be replaced and become waste. The ongoing evolution of new technologies further encourages the continued growth of electronics sales – and e-waste.

For the manufacturing of electronics various metals are used. One can distinguish between precious metals (gold, silver, platinum, palladium, rhodium, ruthenium, iridium), special metals (indium, selenium, tellurium, antimony, tin etc.), as well as base metals (lead, copper, nickel), each of which is used in varying ways in electronics.[9] A basic component in all electronics is copper, as it is commonly used in wiring because of its high electrical conductivity. Based on figures from the USA, it is estimated that 19% of global demand for copper is for electronics.[10] Other examples of metal use in electronics are the use of cobalt in batteries, indium in LCDs, gold in component interconnections, platinum in hard drives, and tin in circuit boards.[11] However, because of the high replacement rates of certain electronics, these valuable materials often become waste after a short product service life, and may even end up as waste at their region of origin within three years after their extraction.

Reserves of many of these metals are exhausted at a high rate.[12] The relative scarcity of these metals could result in supply problems in the future. How to continue to power our mobiles and build our laptops without these valuable metals? This is a question designers, manufacturers and producers of electronics will have to tackle when wanting to stay in business. But although this is a serious problem of the near future, there is a more acute problem associated with metal mining today: the unhealthy and unsafe labour conditions of miners, and the disruptive effects of mining on the surrounding communities.

The adverse effects of metal mining were demonstrated through empirical research conducted within the context of the makeITfair project.[13] Research on platinum mines in South Africa, cobalt mines in the DR Congo and Zambia and tin mines in DR Congo and Indonesia revealed dangerous working conditions, violation of labour rights, dislocation of communities, child labour, conflict financing, low wages, environmental destruction and pollution. When metals are not retrieved and recycled from old

[8] J. Huisman, et al, "2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE), Final Report," (United Nations University, AEA Technology, Gaiker, Regional Environmental Centre for Central and Eastern Europe, Delft University of Technology, for the European Commission, Study No. 07010401/2006/442493/ETU/G4, 2007).
[9] Umicore Precious Metal Refining website, "Amazing what we can recover from your electronic scrap," <http://www.preciousmetals.umicore.com/publications/brochures/show_ElectronicScrap1.pdf> (22 October 2009).
[10] MakeITfair website, "Background document on metals," <http://makeitfair.org/the-facts/makeitfair-publishes-information-on-the-use-of-metals-in-computers-mobile-phones-and-cars> (16 July 2009).
[11] D. Cohen website, "Earth's natural wealth: an audit," (NewScientist, 23 May 2007), <http://www.newscientist.com/data/images/archive/2605/26051202.jpg> (14 July 2009), makeITfair website, "Background document on metals," <http://makeitfair.org/the-facts/makeitfair-publishes-information-on-the-use-of-metals-in-computers-mobile-phones-and-cars> (16 July 2009).
[12] D. Cohen website, "Earth's natural wealth: an audit," (NewScientist, 23 May 2007), <http://www.newscientist.com/data/images/archive/2605/26051202.jpg> (14 July 2009).
[13] A joint NGO campaign for making IT fair, in which several European NGOs collaborate. See for more information: http://makeitfair.org/

electronics, the production of electronics feeds the continued demand for mining of these metals, and as such, the continuation of these problems.

Fortunately, most non-ferrous metals are well recyclable[14]; some are even recyclable for 95% or more (e.g. aluminium[15], copper, gold, platinum group metals[16]). Furthermore, metals are well recyclable, meaning they may retain their 'virgin' quality after proper recycling. The content of valuable metal compounds gives e-waste a positive monetary value, which increases the incentive for their recycling and recovery. For developing countries, high metal prices provide an incentive to import e-waste and try to recover these valuable metals.[17] However, the manner of recycling in these countries is often harmful to the environment and is very dangerous for the people that are involved in the informal recycling business.[18] Furthermore, the manner of recycling is significantly less efficient than in Europe (25% gold retrieved in China/ India compared to > 95% in Europe[19]), which implies that retrievable metals are still being lost.

In contrast to the situation in developing countries, industrialised countries have access to well developed recycling facilities which minimise environmental and health risks, but the corresponding highly complex recycling processes are costly. One of the drivers for the illegal export of e-waste from the developed to the developing world is the difference in recycling costs and thus profit margins on recovered materials between the regions, another reason is the higher market value of component part in developing countries.[20] But even when illegal waste exports would be brought to a halt and we would manage to collect and recycle all our discarded electronics in Europe – which is not the case as the following section will demonstrate – according to some experts, 100% recycling of electronics without environmental harm is a fairy tale.[21] First, collection will presumably never reach 100%. Second, not all materials can be 100% recovered. Third, because electronic products usually contain a mix of valuable and hazardous materials there is a risk of cross-contamination between materials, meaning that hazardous substances can contaminate the recycled materials and cause harm to users. Moreover, recycling of blended material often results in loss of one or the other. Fourth, recycling processes demand considerable amounts of energy. Fifth, even if 100% recycling would be possible, this could never cover increases in demand, which implies the continued need of extraction of virgin materials.

2.2 Collection and recycling rates in the Netherlands and Europe

Electronics recycling rates in the Netherlands are fairly high in comparison to other European countries, but there is still room for improvement. According to calculations by CREM, in the Netherlands on average 4.1 kg of WEEE groups 3 and 4 are discarded per inhabitant per year. Of that volume, 44% is discarded with the general trash, while 56% (2.3 kg /i/y) is returned by consumers to electr(on)ics collection points (e.g. municipal waste collection points, retailers). [22] However, there is no

[14] Umicore Precious Metal Refining website, "Exploring Umicore Precious Metal Recycling," <http://www.preciousmetals.umicore.com/publications/brochures/show_ExploringUPMR.pdf> (22 October 2009).
[15] Wikipedia website, "Aluminium," <http://en.wikipedia.org/wiki/Aluminium> (22 October 2009).
[16] Telephone conversation with Dr. Christian Hagelüken, Umicore Precious Metals Refining, 26 October 2009
[17] S. Nordbrand, "Out of Control: E-waste trade flows from the EU to developing countries," (Swedwatch, 2009).
[18] J. Puckett, S. Westervelt, R. Gutierrez and Y. Takamyia, "The digital dump, exporting re-use and abuse to Africa," (Seattle, WA., USA: The Basel Action Network (BAN), 2005).
[19] Telephone conversation with Dr. Christian Hagelüken, Umicore Precious Metals Refining, 30 November 2009
[20] Greenpeace, "Gif voor Ghana. De dump van Nederlands elektronica afval in Ghana.," (2008). Basel Action Network, "Turn Back the Toxic Tide. Briefing paper 7.," (June 2008).
[21] Telephone conversation with Dr. Christian Hagelüken, Umicore Precious Metals Refining, 26 October 2009; interview with Professor J. Brezet and A. Köhler, Delft University of Technology, Group Design for Sustainabiity, 27 October 2009. Basel Action Network, "Turn Back the Toxic Tide. Briefing paper 7.," (June 2008).
[22] Crem, "Een analyse van de stromen elektronica-afval in Nederland," (Crem, 2008).

guarantee that these returned products are properly processed, dismantled and/or recycled. [23] A considerable amount of these returned products is not delivered to the electr(on)ics producers' official take back systems NVMP and ICT-Milieu, but sold on to unregistered traders, who may export these to developing countries in turn. According to the same CREM report, 25% (0,6 kg /i/y) of the e-waste collected from consumers is eventually exported to Africa or China, whether legally as second hand goods, or illegally as e-waste.[24] These numbers do not include e-waste from the professional world (i.e. companies, organisations and institutions).

When turning these figures around, the amount of e-waste of groups 3 and 4 that is not recycled properly can be calculated; 1.8 kg/i/y (44% of the WEEE groups 3 and 4 thrown out by consumers) is incinerated, plus another + 0.6 kg/i/y is exported to developing countries. This means that 2.4 kg/i/y, or more than 50% of the group 3 and 4 e-waste that is discarded per Dutch inhabitant each year, is irresponsibly disposed of annually. The precious metals in this waste are either squandered and lost for reuse, or retrieved with serious environmental and health effects in developing countries. And again, e-waste figures stemming from the professional world still have to be added.

In a different study by Witteveen and Bos, the waste streams of all WEEE groups (including typically heavy equipment like washing machines) are investigated. This study yields much higher collection and recycling figures: of the average 18.5 kg e-waste per inhabitant arising each year, 11.8 kg (64%) is separately collected and recycled. [25] A further 2 kg is discarded with the general trash and thus incinerated, while the destination of the remaining 4.7 kg is uncertain, and thus may be exported.

European figures for WEEE collection (all e-waste groups) are more alarming than the Dutch figures. According to a recent memo by the European Commission (EC) "only a fraction of WEEE is currently collected and reported and treated in an appropriate manner ... A large portion of waste equipment is collected and leaked to substandard treatment plants or illegally exported. In weight terms, each year the equivalent of 80% of the electrical and electronic equipment put on the market the previous year becomes WEEE. The 80% are broken down as follows: 26% are reported as properly collected and treated, 2% are re-used, 10% landfilled and 42% separately collected but not accounted for." [26] In other words, 52% of the weight of equipment placed on the European market the previous year is either landfilled or unaccounted for, and the metals in this waste are at least partly lost for re-use. In the following section, the EC's proposals to improve the situation are reviewed.

[23] M. Cobbing, "Toxic Tech: Not in our Backyards," (Greenpeace International, 2008).
[24] Crem, "Een analyse van de stromen elektronica-afval in Nederland," (Crem, 2008).
[25] W. Bos, "Research into complementary waste streams for e-waste in the Netherlands," (2008).
[26] European Commission website, "Questions and answers on the revised directive on waste electrical and electronic equipment (WEEE)," (3 December 2008), <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/764&format=HTML&aged=0&language=EN&guiLanguage=en> (16 July 2009).

3. E-waste related regulation in the Netherlands and Europe

3.1 European policy framework

3.1.1 WEEE

Current WEEE Directive

In 2003, the EU directive on waste electrical and electronic equipment (directive 2002/96/EC, referred to as the WEEE directive) was adopted to stimulate re-use and recycling of electronic equipment and to provide electronics producers with incentives for ecodesign. The WEEE makes producers of electronics responsible for the collection and treatment of the waste resulting from the disposal of their own products. The WEEE directive also sets targets for collection and recycling. The current WEEE directive sets a collection target of 4 kg per person per year. Of the e-waste collected separately, treatment targets are the following: "for WEEE falling under categories 3 and 4 of Annex IA, a) the rate of recovery shall be increased to a minimum of 75 % by an average weight per appliance, and b) component, material and substance reuse and recycling shall be increased to a minimum of 65 % by an average weight per appliance".[27] Note that the recovery, re-use and recycling targets are somewhat misleading, as they refer to 75% and 65% of the appliances that are collected (i.e. 4 kg/i/y), instead of to 75% of the recycling potential. The Netherlands is among the European Member States that have already reached the targets in the current WEEE directive.[28]

Although the WEEE directive explicitly sought to provide electronics producers with an incentive for ecodesign, this ambition has not been realised with the implementation of the current WEEE. The only incentive for producers provided by the current WEEE is to make lighter equipment, but 'light' does not equal 'environmentally friendly'. This shortcoming is quite widely acknowledged among governmental, corporate and civil society actors.[29] In the Netherlands, the main reason for this failure lies in the collective nature of the Dutch e-waste collection schemes ICT-Milieu and NVMP. Because the contribution costs for producers are calculated on the basis of their market share, regardless the actual costs for recycling of their respective products, the producers do not experience a financial incentive for ecodesign through these systems.

Revision of the WEEE directive

Currently, an EC proposal for amendment of the WEEE directive is under consideration. The most important revision in the proposed directive is a new binding target for the collection of electrical and electronic equipment by electronics producers. The current collection target of 4 kg/inh/y does not properly reflect the situation in individual Member States. Under the commission proposal for a revised directive, Member States with higher consumption rates of electrical and electronic equipment are

[27] European Union, "DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on waste electrical and electronic equipment (WEEE). ," Official Journal of the European Union, 13.2.2003((2003).

[28] M. Cobbing, "Toxic Tech: Not in our Backyards," (Greenpeace International, 2008), M. Savage, "Implementation of Waste Electric and Electronic Equipment Directive in EU 25," (Institute for Prospective Technological Studies, 2006), ICT Milieu, "ICT Milieumonitor 2009," (2009).

[29] See Crem, "Een analyse van de stromen elektronica-afval in Nederland," (Crem, 2008), VROM, "Neveneffecten van producentenverantwoordelijkheid in het afvalstoffenbeleid," (2007), IPRWorks website, "Joint statement by a group of industry and NGOs on producer responsibility for waste electrical and electronic equipment," (2 November 2009).

required to collect more e-waste than others with smaller markets. In the proposal, the new collection target is set at 65% of the average weight of products placed on the market in the two preceding years. Furthermore, it is proposed to increase recycling targets by 5%, and to include re-using whole appliances into the recycling and re-use target. [30] It is proposed that these targets become binding in 2016, thus giving Member States time to adjust.

Policy discussion

When taking all collection channels together, in some Member States, collection targets of 65% of total WEEE arising have been reached. [31] However, the proposed collection target of 65% is a 'put on the market' instead of a 'waste arising' based target. Furthermore, the 65% collection target proposal is meant as a producer-only target, while collection takes place through many different channels: municipal waste collection point, retailers, re-use stores, commercial e-waste collectors and traders. These parties are not obliged to pass the collected waste on to producers. Producers fear that if the EC's proposal remains unchanged, they would have to buy back WEEE from commercial collectors. As Mark Dempsey from HP argues: "this [the 65% producer-only target, Eds] would lead to profiteering as commercial collectors would seek to trade WEEE to producers at a higher price. Forecasts suggest this could increase the cost of the WEEE Directive by £4 billion, potentially reducing the money producers can invest in Design for Environment".[32] Such a dynamic could be avoided by setting the collection target at Member State level, referring to the collection of all WEEE in that Member State, regardless of whether it was collected by producers or commercial collectors.

In the Netherlands, a considerable proportion of the e-waste that is collected by municipalities, retailers and electrical and mechanical contractors, is sold to (scrap metal) traders. Of the 18.5 kilograms waste arising per inhabitant annually, in total 11.8 is collected, but only 5.7 is collected by producers (i.e. 31% of total waste arising). This percentage would be even lower when collection is calculated as a percentage of EEE (electric and electronic equipment) put on the market in the previous year (which is how the current WEEE collection target is calculated).[33] These figures suggest that while for the Netherlands an overall collection target of 65% of EEE put on the market during the two preceding years is feasible and might not even be considered ambitious, [34] as a producer-only target, it implies a significantly higher target for producers, which might become impossible or very expensive to reach when alternative collectors are not obliged to hand the e-waste over to producers.

A recently opened discussion concerns the basis for the collection target; whether to base the collection target percentage on products put on the market the previous two years, or on actual waste arising. The main argument for a waste arising based collection target, is that a 'put on the market' collection target suggests a strong correlation between the products recently put on the market and the e-waste stream. It is argued that the two year time reference could appear counter-productive in

[30] European Commission website, "Questions and answers on the revised directive on waste electrical and electronic equipment (WEEE)," (3 December 2008), <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/764&format=HTML&aged=0&language=EN&guiLanguage=en> (16 July 2009).

[31] J. Huisman, et al, "2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE), Final Report," (United Nations University, AEA Technology, Gaiker, Regional Environmental Centre for Central and Eastern Europe, Delft University of Technology, for the European Commission, Study No. 07010401/2006/442493/ETU/G4, 2007). European Commission website, "Questions and answers on the revised directive on waste electrical and electronic equipment (WEEE)," (3 December 2008), <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/764&format=HTML&aged=0&language=EN&guiLanguage=en> (16 July 2009).

[32] Phone call with Mark Dempsey, Environmental Policy Advisor at HP, 3 December 2009

[33] ICT Milieu, "ICT Milieumonitor 2009," (2009).

[34] European Environmental Bureau, "EEB position paper on the proposal for the revision of the directive on waste electrical and electronic equipment (WEEE)," (15 June 2009).

terms of prevention and design for longevity, as it might give incentives to design products for quick turnover, in order to achieve the collection targets. The alternative, the waste arising based target, excludes such 'perverse' incentives, but has the downside of difficult assessment. Both collection target baselines have their up and downsides and their proponents.

Another frequently heard critique to the EC's revision proposal of the WEEE is that it does not differentiate collection targets per product category. Amongst other things, the Dutch Minister of the Environment herself has pleaded for such differentiation as a way to increase the environmental benefits of the revised directive.[35] From a purely weight based perspective, collection of small electric and electronic equipment like lighting equipment or mobile phones will not be prioritised, while from an environmental footprint perspective, collection of these product categories is worthwhile.[36]

Possibly the most important downside of the WEEE revision proposal is that it does not provide any more incentive for ecodesign than the current version. As in the current version, no guidance is given in the proposal regarding the implementation of individual producer responsibility (IPR, which makes producers responsible for the end of life costs of their *own* products). This would allow for a continuation of the Dutch collective e-waste collection systems in which costs for producers are shared when the products are returned at their 'end-of-life' (EOL), instead of paid for on the basis of the real future recycling costs of the products (which IPR would require for products they have been putting on the market since August 2005 - so called `new WEEE´).

The majority of the EU systems are based on the `pay as you get the old WEEE back´ system, suitable for historical WEEE financing. This has two important drawbacks for IPR:

1. It continues sharing of the cost of all WEEE among producers, including new WEEE. Thereby, the real costs of recycling of the new WEEE are diluted and no producer is paying for the actual recycling of its own new WEEE,
2. The payment of the recycling cost of new products is made X years later when it comes back – not when it is put on the market. This means that the `EOL cost´ comes too late often to seriously affect the design investment cycle and decisions being taken.

The incentive towards ecodesign of the proposal is further externalised by allowing for the continuation of charging 'visible fees'. In the current WEEE, producers are given the opportunity to charge visible fees to buyers of electronics, which show the end-of-life costs of a product separately from the price of the appliance at the time of purchase. This provision was originally meant as a temporary provision to cover the treatment costs of 'historic e-waste' (which includes waste from electronics producers that have stopped operating in the market before the directive was put in place). The new proposal would allow the use of visible fees for an indefinite period instead of until 2013/2015. This would contradict the principle of internalisation of end-of-life costs in the price of appliances. Furthermore, such a provision tends towards imposing an undifferentiated fee per product category towards consumers, covering the costs of collection and recycling. This again ´dilutes´ the cost signal and therefore reduces or distorts the economic feedback to the design phase. Under such circumstances, there is no economic incentive for producers to compete for improving the recyclability and durability of their products by reducing their real end-of-life costs through design.[37]

[35] J.M. Cramer, "Nr. 316 Brief van de minister van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer," (2 October 2009).
[36] European Environmental Bureau, "EEB position paper on the proposal for the revision of the directive on waste electrical and electronic equipment (WEEE)," (15 June 2009).
[37] Ibid.

3.1.2 RoHS

E-waste contains a variety of toxic metals and organic compounds. To address this toxicity, the Restriction of Hazardous Substances Directive (RoHS, directive 2002/95/EC) was introduced in the European Union alongside the WEEE directive. This directive requires the phase out of six toxic substances: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

As the RoHS directive is directly linked to the WEEE directive, the RoHS is currently also under review. The EC's revision proposal is directed at expanding the scope of the directive, and clarifying its provisions. No new substances are proposed to be banned. [38] However, NGOs call for adding substances to be banned. In a joint paper, Clean Production Action, the European Environmental Bureau (EEB) and Chemsec call for a phase out of all brominated and chlorinated organic substances in electric and electronic products, as these substances have the potential to form dioxins and furans when incinerated. The initiative of some proactive electronics producers to phase these substances out demonstrates that this is technically possible.[39] Greenpeace calls for banning more substances, among which antimony, phthalates and beryllium.[40]

3.1.3 Waste shipment regulation

The EU waste shipment regulation (regulation No 1013/2006) sets up regimes for the export of substances, differentiated by the environmental risks, associated with their disposal. The regulation prohibits the export of hazardous waste for recovery from the EU to non-OECD countries.[41] This is the European implementation of the United Nations Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. As some e-waste is considered hazardous, the transportation of this e-waste to developing countries is illegal. Other, non-hazardous e-waste may be exported for recovery, but not for disposal.

Transportation of old electronic equipment is allowed when it concerns secondhand goods that are still functioning, and as such, are no waste (yet). However, it is often difficult to discern when used electrical or electronic equipment is second-hand or waste. As the Dutch Ministry of the Environment noted in response to questions of the Swedish NGO Swedwatch: "used electronic equipment and/or e-waste is often seen as a by-load in second hand cars and trucks. Or it will be encountered in containers with 'second hand domestic materials' (furniture, pots and pans, mattresses, refrigerators, TVs , stereo sets, and an occasional computer) which may –or may not -present problems".[42]

Because of omissions in European waste shipment data, it is difficult to assess the exact amount of illegal shipments within and from the EU. Nevertheless, examples of illegal shipments have been well documented in the media.[43] Furthermore, a study by IMPEL (the European Union Network for the Implementation and Enforcement of Environmental Law), in which 13 European countries participated,

[38] Commission of the European Communities, "Directive of the European Parliament and the council on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)," (3 December 2008).
[39] Clean Production Action, EEB and Chemsec, "Draft position paper on RoHS revision," (July 2009), <<http://www.chemsec.org/images/stories/publications/ChemSec_publications/NGO_RoHS_Position_paper_July_2009-4.pdf>> (13 November 2009).
[40] Greenpeace website, "Gif in Elektronica," (2008), <http://www.greenpeace.nl/campaigns/giftige-stoffen-2/vervuiling-door-elektronica/gif-in-elektronica> (13 November 2009).
[41] European Environmental Agency, "Waste without borders in the EU?," (Luxembourg: Office for official Publications of the European Communities, 2009).
[42] Source: Questions to the Dutch Ministry VROM, Swedwatch
[43] European Environmental Agency, "Waste without borders in the EU?," (Luxembourg: Office for official Publications of the European Communities, 2009), M. Beck, "Mission Impossible?," Recycling International, (March 2007).

focused on the enforcement of waste shipment regulations. Of the 374 inspections of shipments leaving the Netherlands, 78 shipments (21%) were earmarked as illegal. [44]

Unfortunately the study does not indicate the number of cases in which the waste stemmed from electric and electronic equipment. A more specific indication of illegal e-waste shipments was provided during enforcement actions of waste shipment regulations by the inspection of the Dutch Ministry of the Environment in 2006; fifty-seven contraventions of the regulations were uncovered by Police and Customs. [45] It should be noted that the majority of the waste shipments that leave Europe from the Rotterdam port do not originate from the Netherlands but from other countries, since Rotterdam is one of the EU's main exit ports to the rest of the world.[46] Two thirds of the contraventions encountered during the Dutch inspections had originated in other countries than the Netherlands and were being exported from the EU via the Netherlands; Germany was the largest source of these illegal shipments, followed by the Netherlands, the UK and then France.

Combined, the studies on illegal waste shipments indicate that better reporting, monitoring, control, and international cooperation provide promising measures for combating illegal e-waste exports.[47]

3.1.4 Ecodesign

The European ecodesign guideline (directive 2005/32/EC) established a framework for the setting of ecodesign requirements for energy-using products. The initial guideline was recently replaced by Directive 2009/125/EC, which enlarged the scope of the directive from energy-using to energy related products (e.g. windows and shower heads). It defines the principles, conditions and criteria for setting environmental requirements for energy-related appliances, but does not include mandatory requirements for specific products. Such mandatory design requirements may be specified via implementation measures.[48] At this point, such requirements have been specified for instance for the standby mode of electric and electronic equipment for use in homes and offices as well as for certain kind of lamps. [49]

Until now, the implementation of the framework directive has been very much focused on increasing the energy-efficiency of the products it encompasses, largely ignoring other environmental aspects in the design of energy-using appliances. However, the framework directive does seem to provide for the opportunity to mandate other product requirements than energy requirements. As such, it might be considered to include design requirements with regard to recyclability of energy-using products in the directive, i.e. 'design for disassembly' requirements. If the revised WEEE will fail to include incentives for ecodesign towards consumers, the ecodesign guideline provides an alternative to mandate increased recyclability of electronics.

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[44] European Union network for the implementation and enforcement of environmental law (IMPEL), "IMPEL-TFS Seaport project 2: international cooperation in enforcement hitting illegal waste shipments," (June 2006).
[45] VROM-Inspectie, "Het beeld verhelderd," (2007).
[46] S. Nordbrand, "Out of Control: E-waste trade flows from the EU to developing countries," (Swedwatch, 2009).
[47] VROM-Inspectie, "Het beeld verhelderd," (2007), European Union network for the implementation and enforcement of environmental law (IMPEL), "IMPEL-TFS Seaport project 2: international cooperation in enforcement hitting illegal waste shipments," (June 2006), European Environmental Agency, "Waste without borders in the EU?," (Luxembourg: Office for official Publications of the European Communities, 2009).
[48] EUROPA website, "Ecodesign for energy-using appliances," (2008), <http://europa.eu/legislation_summaries/consumers/product_labelling_and_packaging/l32037_en.htm> (23 July 2009).
[49] Senternovem website, "Wetgeving Ecodesign," (2009), <http://www.senternovem.nl/ecodesign/wetgeving/index.asp> (23 July 2009).

3.2 Dutch policy framework

The Dutch policy framework is mainly an implementation of the above European regulation, and as such does not need much further clarification. One thing that needs to be stressed in the context of this policy note is that with regard to the WEEE directive, EU member states were free to organise the waste collection system as they saw fit. As mentioned previously, the Netherlands has developed a collective system of e-waste collection and treatment. In this system, two organisations, NVMP and ICT milieu, represent the producers, who organise the collection and treatment of their waste collectively. An important difference between the systems is that the costs for the NVMP are covered by the visible fee that is charged to consumers of electr(on)ic products, while ICT Milieu passes on the costs for collecting and recycling to ICT producers on the basis of their market share, who in turn calculate these costs into the cost price of their products. Collective systems like the Dutch systems have been criticised for not providing enough incentive to producers of electronic equipment to increase the degree of recyclability of their products in the design phase.[50] The reason is that in this system, producers and consumers do not pay more or less for the treatment of their waste in cases of better or worse ecodesign of the products; the treatment fee that consumers pay when buying new electr(on)ic equipment is the same within product categories, and the fee for producers for participation in the waste collection schemes is calculated on the basis of their market share, instead of on the recycling costs of their products. In the final chapter of this paper, recommendations will be made to increase the incentive towards ecodesign.

[50] Crem, "Een analyse van de stromen elektronica-afval in Nederland," (Crem, 2008), Greenpeace website, "Producenten moeten betalen voor inzameling en recycling," (2008), <http://www.greenpeace.nl/campaigns/giftige-stoffen-2/vervuiling-door-elektronica/producenten-verantwoordelijkhe> (23 July 2009).

4. Corporate initiatives

A good overview of corporate efforts to tackle the e-waste problem is provided by the Greenpeace quarterly 'Guide to Greener Electronics', of which the 13th edition was published last September.[51] This guide assesses the major consumer electronics producers' efforts with regard to chemicals, e-waste and energy. The guide demonstrates that the electronics sector knows frontrunners and laggards, while companies might not score equally well in each category. Although most global electronics producers are RoHS compliant, some companies (e.g. Nokia, Sony Ericsson), have committed to the phasing out of additional substances like phthalates, beryllium, and antimony. With regard to e-waste recycling, companies vary in their efforts to voluntarily provide take-back schemes in countries where such take-back is not mandatory. Furthermore, companies differ in terms of their reporting on collection and on the use of recycled plastic in their products. We refer to the Greenpeace guide for the scores of the companies on each of these indicators.

In light of the revision of the WEEE directive, it is important to note here that 11 out of the 18 companies in the Greenpeace guide have signed a joint statement promoting IPR in September 2009. The statement recognises that IPR is not well implemented throughout Europe, hampering the incentive towards more ecodesign. The statement calls for better transposition and implementation of the WEEE directive in national legislation.[52]

It is argued here that ecological design of electronics should not merely be understood as 'design for recycling': designing products in such a way that they can be dismantled easily and recycled efficiently, which decreases recycling costs and increases recycling yields. This is because under the current conditions, the demand for electronics will continue to grow. Research and Development (R&D) and marketing strategies of electronics producers contribute greatly to this development. These are naturally directed towards developing ever faster and smarter equipment – which often stimulates disposal of older appliances – and at enlarging their markets and increasing sales. Even when 100% recycling of old electronics could be realised, this could never cover increased demand.

Easy dismantling and recycling of electronics is therefore only one aspect of 'ecological' electronics. Truly ecological electronics are free from materials that pose direct or potential environmental and health risks, and contain a minimum of scarce and non-renewable materials (e.g. metals). Furthermore, ecological electronics allow for a long service life (repair, upgrade etc.), and enable their users for more sustainable lifestyles, e.g. reducing energy consumption of activities (such as travelling).[53] In addition, ecological electronics are designed to include recycled materials; currently, electronics recyclers have trouble returning some of their recycled materials to market (e.g. plastics).[54] Ecodesign should ideally be targeted at realising, or at least approaching these goals.[55]

[51] Greenpeace website, "Guide to Greener Electronics, version 13," <http://www.greenpeace.org/international/press/reports/HP-guide-to-greener-electronics-13> (2 November 2009).
[52] IPRWorks website, "Joint statement by a group of industry and NGOs on producer responsibility for waste electrical and electronic equipment," (2 November 2009).
[53] WWF and HP website, "Becoming a winner. IT solutions that help business and the planet.," (2008), <http://h41111.www4.hp.com/globalcitizenship/uk/en/pdf/IT-userguide.pdf> (7 December 2009).
[54] Telephone conversation with Norbert Zonnevel, European Electronics recycling Association, 2 December 2009.
[55] Interview with Professor J. Brezet and A. Köhler, Delft University of Technology, Group Design for Sustainabiity, 27 October 2009.

4.2 Future electronics

Sustainability considerations are not sufficiently integrated in the R&D process of current innovations of electronics.[56] For instance, recyclers indicate that the current trend of replacing metals for plastics with nanoparticles in electronics, presents them with challenges in the near future. As the exact traits of nanoparticles are still surrounded with uncertainty and associated with potential health concerns, recyclers are not sure yet how these electronics are best recycled.[57]

Another example of challenges for recycling associated with innovations, is provided by so called 'pervasive computing', which refers to highly miniaturised ICT appliances which are embedded in our daily environment without even noticing it. Although most of us may not be aware of this (yet), there are considerable R&D efforts going into the development of 'e-textiles', which refers to wearable electronics. According to research conducted at the TU Delft "there is a broad spectrum of future applications in the development pipeline entailing a fusion of functions or materials from electronics and textiles. Examples of alien materials, which are to be embedded seamlessly into textiles include sensors, actuators, lightening elements, electronic processing units and elements for power generation and storage".[58] Expectations are that such e-textiles will become mass applications within one decade.

Pervasive computing will change electronic waste streams in their amount and quality.[59] As one might imagine, separate collection of such microscopic, integrated electronics is a major challenge when the users are in fact unaware of (the location of) the electronics. This innovation trend poses questions about the feasibility of recycling in the future, and stresses the need for preventative measures. IPR in the WEEE directive may be insufficient by itself in guiding emerging technologies into an ecologically sustainable direction, since IPR, when properly implemented, primarily stimulates ecodesign at the product design stage. However, the technologies behind those products are already developed in that stage, and investments already made, which induces what is often referred to as 'path dependency': the process through which choices in the present are constrained by choices that have been made in the past (e.g. now that the technology is there, we can hardly stop its distribution). To avoid this dynamic for non-ecological technologies, incentives for sustainable innovation should already be experienced at the early stage of technology development. The concept of ecodesign should therefore be re-directed to cover environmental optimisation of emerging technologies right during the R&D stage, at universities and corporate R&D labs alike. It seems that for this to happen, sustainability considerations need to be integrated in innovation policies and budgets of both governments and electronics companies.

[56] C. Som, A. R. Köhler and M. Halbeisen, "Strategies for sustainable innovation in emerging technologies: the cases of nano textiles and smart textiles," Second International Conference on Multinational Enterprises and Sustainable Development, Nancy-Metz, France, (2009).
[57] Telephone conversation with Norbert Zonneveld, European Electronics Recycling Association, 2 December 2009.
[58] A. Köhler, "Considering recycling and disposal of future high-tech products during the innovation process. The case of electronic textiles.," (2008).
[59] L.M. Hilty, et al., "The Precautionary Principle in the Information Society - Effects of Pervasive Computing on Health and Environment," (Bern: TA-Swiss, 2005).

5. Conclusions and policy recommendations

The analysis of the e-waste problem has indicated that the irresponsible disposal of e-waste creates and sustains environmental and social concerns at the beginning and at the end of the electronics life cycle. When metals are not retrieved and recycled from e-waste, the production of new electronics increases the demand for mining of these metals. Metal mining often has destructive environmental effects, and under some circumstances, may impose serious health effects on the mine workers as well as have negative impacts on surrounding communities. At the end of the electronics life cycle, if e-waste is dumped, landfilled or improperly recycled, environmental pollution and health impacts threaten local communities and informal recycling workers in developing countries.

The complexity of the e-waste problem requires a diversified approach in its solution. First, increased collection, re-use and recycling of discarded electronics in Europe is an important element of solving the e-waste problem. If old consumer electronics like mobile phones and laptops are collected separately, the majority of the containing metals can be recycled and reused. Higher recycling rates would mean that fewer new resources would be extracted from the earth, and that the environmental and health costs of our toxic e-waste are no longer paid by developing countries. [60] However, recycling can hardly satisfy the increasing demand for materials for the rising production of electronics. Furthermore, innovation trends of electronics seem to complicate easy dismantling and recycling in the future. To address this, a shift towards more ecodesign is needed; designers of future electronics should put an effort into designing out toxics, designing out non-renewables, and design their products in such a way they can be easily dismantled and materials retrieved. To achieve the combined effect, multiple policy tools will probably be needed. The paper has provided insight into several of such tools to increase collection, reuse and recycling, and to stimulate ecodesign.[61]

5.1 Proposals for WEEE Revision

The current revision of the WEEE directive provides an opportunity to improve its effectiveness in reaching the above mentioned policy goals. Several amendments to the directive can be envisioned in this regard. In the revised WEEE, the EC could:

1. Set collection targets on Member State level that encompass all e-waste collection streams, instead of collection by producers only. The revised WEEE directive could mandate the registration of and reporting by all e-waste collectors and handlers in a Member State, and mandate Member States to monitor all waste streams (in fact, such monitoring of all waste streams by Member States is already mandated in article 12.1 of the current WEEE directive).

   With regard to the basis for the collection target, a ‘waste arising’ based target might be preferable, because of the possible perverse incentives of a high ‘put on the market’ based target. However, for such a collection target to be ambitious, a waste arising based collection target would need to be set significantly higher than 65%; at 80% at least.

2. Mandate Member States to specify collection and recycling targets per product category, to avoid that collection efforts of producers concentrate on weight attributes of e-waste instead of

[60] MakeITFair. “Broken computers, wasted lives”. March 2009. < http://makeitfair.org/the-facts/leaflets> (14 July 2009)
[61] See for comparable policy proposals: Crem, "Een analyse van de stromen elektronica-afval in Nederland," (Crem, 2008).

on its substances (valuable and hazardous). Within the fixed, overall WEEE collection target (i.e. 65% of EEE put on the market/ 80% of WEEE arising), target setting per product category should be flexible, allowing them to respond to the actual market situation in each Member State (e.g. lower collection targets for new products and product categories than for products with a stable market).

3. Provide Member States with guidance on how to implement a form of IPR (individual producer responsibility) that stimulates ecodesign. The challenge is to design an IPR system that is ambitious, feasible, and fair at the same time. This might be achieved by allowing the continuation of collective organisation (i.e. physical management) of WEEE collection, while expressing IPR in the financing of the collection and recycling system; by developing a financing methodology that creates real cost concern for EEE producers and thus makes a strong business case for designing a product that would be an `End Of Life Profit´ due to high recyclability, instead of an EOL cost. An important issue to solve in every financing system is how to finance `new´ waste while continuing to finance historic waste.

   A promising direction for facing these challenges would be to develop a model in which the financing is split for historic and future WEEE. For the financing of recycling of historic WEEE, the current market-share based financing models could be continued, while the financing for recycling of future WEEE could be calculated based on an estimation of the actual future costs of recycling of the products that producers put on the market.

   Whatever the exact form of the model, important characteristics would be that:
   a) there would be a difference in financing of historic and future waste;
   b) for future waste, financing is not based on market share of the costs of waste you are getting back today, but on the future EOL treatment costs of the products currently put on the market by each producer;
   c) for future waste, financing is based on an estimation of real costs of recycling;
   d) for future waste, no cross-brand financing is possible or is minimised so as to avoid diluting the real costs;
   e) for future waste, the time lag between product design and payment of its EOL costs is minimised in order to affect the design investment cycle.

4. Set minimum requirements for facilities that do preparation for recycling, requiring maximum separation of all recyclable materials, and providing health and safety standards to protect waste handlers.

5. Stimulate the setting up of an electr(on)ics refund system for consumers, contributing to increased e-waste collection volumes within these product categories.

6. Mandate the establishment of an e-waste authority in each Member State that is responsible for a) monitoring of registration and reporting by all e-waste collectors, handlers and treatment facilities, b) monitoring of and reporting on all e-waste streams in the Member State, c) within the fixed overall collection target, set flexible collection targets per product category in dialogue with producers and other stakeholders, d) oversee the financing of producer collection systems, making sure that these are financed on the basis of IPR, stimulating ecodesign, e) stimulate the setting up of consumer incentives for sustainable electronics consumption (e.g. introducing electronics refund systems, providing product information with regard to recyclability).

5.2 Proposals for additional governmental policy and action

Apart from the revision of the WEEE directive, the Dutch government and the European Union have other opportunities to contribute to solving the e-waste problem. European governments and/or the European Union could:

1. Provide producers with a financial incentive towards ecodesign. Instead of, or additional to, regulating this via the WEEE (as proposed under point 3 of the previous section), one could also provide tax breaks for producers with superior product portfolios in terms of ecodesign.

2. Integrate ecodesign requirements in innovation policies, and make sure that public money only stimulates innovations with ecological benefits compared to the status quo.

3. Closely monitor new evidence on the potential hazards associated with substances, and when information on potential hazards arises, add substances to the RoHS list.

4. Mandate recyclability requirements in the ecodesign directive according to best practice. This is not the preferable policy option though, since it does not allow for much flexibility in design for recycling.

5. Increase efforts to address illegal e-waste export and the related environmental and health concerns. At the least, it seems that cooperation between e-waste sending and receiving countries is necessary to address illegal e-waste exports.

6. Invest in/stimulate investment in adequate recycling facilities in developing countries.

5.3 Proposals for corporate policy and action

Next to governments, electronics producers have a responsibility and the opportunity to contribute to solving the e-waste problem. Electronics producers have several options in this regard. Electronics companies could:

1. Proactively phase out hazardous substances in their products. Efforts by companies such as Nokia and Sony Ericsson have shown that phasing out of other hazardous substances than the substances on the RoHS list is feasible. Companies that conduct such initiatives remain ahead of governmental legislation, and might even show governments the way, which provides for a competitive advantage.

2. Expand the meaning of ecodesign. Truly ecological electronics are free from materials that pose direct or potential environmental and health risks, and contain a minimum of scarce and non-renewable materials (e.g. metals). Furthermore, ecological electronics allow for a long service life (repair, upgrade etc.), and enable their more sustainable lifestyles for their users, e.g. reducing energy consumption of activities (such as travelling).

3. Collaborate with actors along the electronics supply chain, from mining companies to recyclers, to develop ecologically and socially sustainable electronics.

4. Producers should make sure that information relevant for repair, reuse and environmentally benign recycling is passed on to actors downstream the product life cycle. Such information is essential for restoring product functions, thus extending service live. Moreover, data concerning recyclability and safe disposal should be provided to recyclers.

5.4 Proposals for civil action

Civil society groups have an important role to play in addressing the e-waste problem as well. Important functions already fulfilled by civil society groups are agenda-setting, data collection and education. An important additional role civil society groups could play is to start up a societal discussion on the needs and characteristics of future electronics. What visions exist in society with regard to our future electronics environment? What needs will future electronics satisfy? And in the face of resource scarcity: which product categories should be prioritised over others? Such a societal discussion may avoid the pitfalls of path dependency in innovation processes, and at the same time provide for innovative ideas and visions on the role of electronics in our societies of the future, benefiting business and societal interest simultaneously.