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Tenth meeting**

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Agenda item 3 (d)

**Matters related to the implementation of the Convention:
Basel Convention Partnership Programme**

**Guidance document on the environmentally sound management
of used and end-of-life mobile phones**

Note by the Secretariat

The annex to the present note contains the revised guidance document on the environmentally sound management of used and end-of-life mobile phones as adopted by the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal at its tenth meeting (see decision BC-10/21).

Annex



Basel Convention

Mobile Phone Partnership Initiative

Guidance document on the environmentally sound management of used and end-of-life mobile phones

Prepared by the

Mobile Phone Working Group

(Revised version as adopted on 21 October 2011)

Foreword

The Secretariat of the Basel Convention would like to express its appreciation for the efforts of the Mobile Phone Working Group (MPWG), its members, observers and other stakeholders in the preparation of this document and the Mobile Phone Partnership Initiative Guidelines. In addition, special thanks is extended to the chairs of each working group, Geoff Thompson, Australia; Greg Rippon, Australia; Joachim Wuttke, Germany; Françoise Salame, Switzerland; Julie Rosenbach, United States of America; Bob Tonetti, United States of America; and especially to Marco Buletti, Switzerland, who chaired the Mobile Phone Working Group.

This guidance document has been revised on the basis of changes made to individual guidelines approved by MPWG. The Secretariat of the Basel Convention would like to express its appreciation to all of the companies that were involved in evaluating technical guidelines: Fonebak, ReCellular, Umicore, HOBI International, France Telecom-Orange Group, Vodafone, Motorola, Nokia, Sharp and Sony Ericsson; and to all project group chairs, who ensured that changes were properly reflected in the respective guidelines. The final guidance document, as revised, was adopted in its entirety by the tenth Conference of the Parties to the Basel Convention, held in Cartagena, Colombia, from 17 to 21 October 2011.

Finally, the Secretariat is also thankful to the Governments of Australia and Switzerland and to Shields Environmental for supporting the Mobile Phone Partnership Initiative financially. The voluntary contributions were used to carry out the work needed to complete the guidance document and the individual project guidelines.

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Abbreviations

ABS-PC	Acrylonitrile butadiene styrene/polycarbonate
ADF	Advanced disposal fee
ARF	Advanced recycling fee
BAT	Best available technologies
BEP	Best environmental practices
DBBE	Decabrominated biphenyl ether
DfE	Design for the environment
EMAS	Eco-Management Audit Scheme (European Union)
EMC	Electromagnetic compatibility
EMF	Electromagnetic fields
EMS	Environmental Management System
EPA	Environmental Protection Agency (United States of America)
EPR	Extended producer responsibility
ESM	Environmentally sound management
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LCD	Liquid crystal display
LED	Light-emitting diode
MPPI	Mobile Phone Partnership Initiative
OECD	Organization for Economic Cooperation and Development
OEM	Original equipment manufacturer
PPE	Personal protective equipment
RF	Radio frequency
RoHS	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (European Union directive)
SAR	Specific absorption rate
TCLP	Toxicity Characteristic Leachate Procedure (EPA)
UNEP	United Nations Environment Programme
WAP	Wireless Application Protocol
WEEE	Waste Electrical and Electronic Equipment (European Union directive)

1 Introduction¹

1.1 Purpose of the guidance document

1. The purpose of this guidance document is to provide information on how to manage used and end-of-life mobile phones from the time they are collected up to and including their refurbishment, material recovery and recycling. It should be considered as a complement to guidelines that were prepared by various project groups, revised on the basis of facility-type evaluations and approved by the Mobile Phone Working Group. This guidance document summarizes the information contained in the guidelines prepared by project groups 1.1, 2.1, 3.1 and 4.1A. The revised version reflects the changes made as a result of the evaluation of technical guidelines in a facility-type environment. The document is not a legally binding document under the Basel Convention.
2. The objective of the document is to provide guidance for the environmentally sound management of used and end-of-life mobile phones with an emphasis on reuse and recycling, thereby diverting such end-of life products from final disposal operations such as landfills or incinerators. The document was developed in accordance with the decision developed by the Mobile Phone Working Group and adopted by the Conference of the Parties to the Basel Convention at its seventh meeting, decision VII/4.
3. To this end, this document provides general guidance pertaining to the environmentally sound management of used and end-of-life mobile phones that includes such considerations as awareness-raising on design considerations, collection, processing, refurbishment, material recovery and recycling. It also provides guidance on reducing or eliminating releases to the environment from waste disposal and treatment processes. It should be noted that each of these operations should employ best available techniques (BAT) and be in line with best environmental practices (BEP) so that releases of hazardous constituents are prevented or minimized.
4. The guidance document, together with individual project guidelines, is intended to be used to raise awareness and further the implementation of the best practice activities associated with the various stages of the environmentally sound management of used and end-of-life mobile phones. The information and guidance contained in this document can be used to transfer current know-how on the collection of used and end-of life mobile phones; the refurbishment of used mobile phones; and best practices for material recovery and recycling. As such, the guidance document provides a foundation for a training programme or workshop aimed at helping implement the recommendations and actions developed by the project groups established under the Mobile Phone Partnership Initiative. The material found in the guidance document can also be used by Basel Convention regional centres to assist them in developing training materials on the topics covered in it.

1.2 Contents

5. The document contains a modified introduction taken from the project group 4.1A guideline and the revised executive summaries and recommendations from each of the individual guidelines produced under the auspices of project groups 1.1, 2.1, 3.1 and 4.1A, which had been adapted to suit the objective of this overall guidance document.
6. Throughout the guidance document, references to Annex I, II, III, or IV refer specifically to the annexes to the Basel Convention.

1.3 General provisions of the Basel Convention

7. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 and entered into force on 5 May 1992. The Basel Convention emphasizes, amongst other principles, environmentally sound management of hazardous wastes, which is defined as taking all practicable steps to ensure that hazardous wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes. The Convention stipulates a number of specific objectives, including the following:
 - The reduction of transboundary movements of hazardous and other wastes subject to the Basel Convention
 - The prevention and minimization of the generation of hazardous wastes
 - The active promotion of the transfer and use of cleaner technologies
8. These objectives are supported by a regulatory system for the monitoring and control of hazardous wastes that has been set up and is set forth in the full text of the Convention. Some of the key elements of the regulatory system of the Basel Convention are prior notice and informed consent; prohibition of exports to countries which are not contracting Parties to the Convention; legal provisions for the duty to reimport; and the responsibilities of Parties involved in transboundary movements. One of the provisions under the Basel Convention which places an obligation on the state of export is to provide advance notice to and obtain approval from importing and transit

countries before any shipment of hazardous waste is initiated. It should be recognized that all countries have the sovereign right to ban the entry or disposal of foreign hazardous wastes and any other wastes in their territory.

9. Countries of export and import are required to assure themselves that wastes destined for final disposal or recycling will be managed in an environmentally sound manner. No transboundary movement should be allowed to proceed if the exporting and importing countries believe that the wastes in question will not be managed in an environmentally sound manner. Lastly, each shipment of hazardous waste or other waste must be accompanied by a movement document from the point at which a transboundary movement begins to the point of disposal. Once consents have been obtained, wastes must be transported with the appropriate packaging and labelling, as required by international transportation rules such as the United Nations Recommendations on the Transport of Dangerous Goods and Model Regulations.

10. Article 11 of the Convention concerns bilateral, multilateral and regional agreements or arrangements regarding the transboundary movement of wastes. It is prohibited for Parties to the Convention to trade in hazardous wastes and hazardous recyclables with non-Parties unless there is an Article 11 agreement or arrangement. This provision was introduced to prevent Parties from engaging in transboundary movements of hazardous wastes with countries which do not abide by the rules and principles established by the Convention. Under paragraph 2 of Article 11, Parties may enter into such agreements or arrangements with non-Parties so long as those agreements or arrangements do not derogate from the environmentally sound management of hazardous wastes, as required by the Convention, and those agreements or arrangements stipulate provisions which are not less environmentally sound than those provided for by the Convention, in particular taking into account the interests of developing countries.

11. Article 11 agreements or arrangements must include consistent scope of coverage; prior notification and consent; prohibition of shipments without consent; efforts to reduce transboundary movements; use of authorized facilities that operate in an environmentally sound manner; prohibition of exports if the country of import has prohibited such imports; shipments only by authorized persons; alternate measures for stranded shipments; and the use of tracking documents (in accordance with decision II/10, annex).

1.4 What is a mobile phone?

12. A mobile phone (sometimes called a cellular phone or a cellphone) is a small, sophisticated personal two-way radio. It sends and receives radio signals, carrying voice in personal communications with other mobile phones and landline telephones. Mobile phones serve not just as a personal luxury or an addition to traditional line telephones but also as a primary means of communication in areas of the world where no wired communication infrastructure is in place.

13. Attention to the design of a mobile phone for environmental considerations must begin with recognition of the dramatic evolution of the product over the last three decades. It can be said that historically mobile phone manufacturers have been driven by consumer demand, with initial changes occurring usually for non-environmental reasons, but many of the changes have also had beneficial environmental effects.

14. The first and strongest demand from consumers was for greater portability. The first mobile phones were so large and heavy that they were usually installed only in motor vehicles, wired into their electrical systems. The first generation of truly portable phones was still large and heavy; they contained lead-acid batteries, came with carrying bags with shoulder straps and weighed upwards of 4 kg. The mobile phone industry quickly phased out lead acid batteries, and then phased out their nickel cadmium (NiCd) substitutes. These devices, however, progressed steadily to smaller, lighter models in the 1980s, and today mobile phone handsets typically weigh less than 100 g and are powered by a small battery.

Figure 1. Weight and size reduction chart²

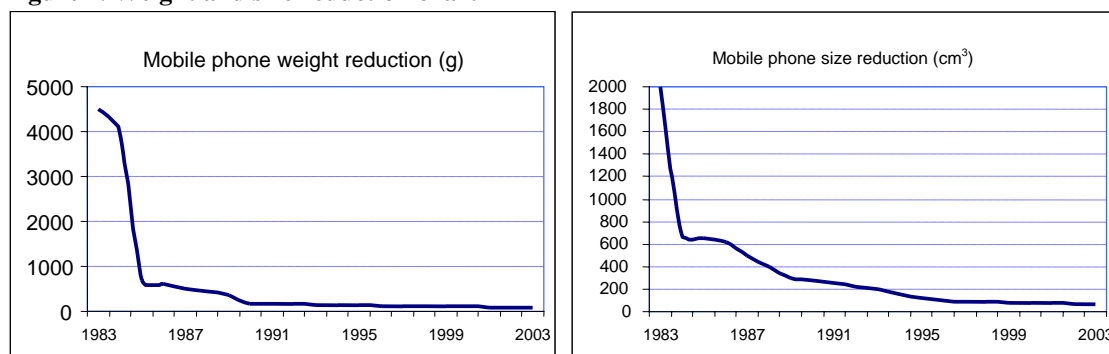
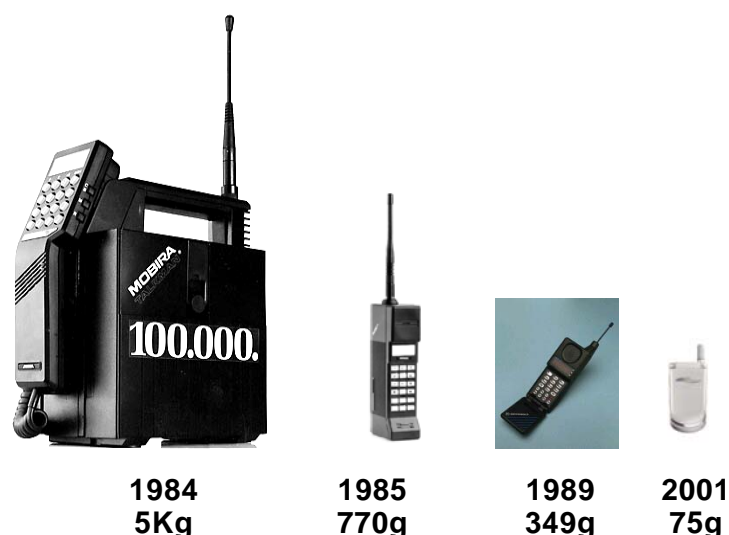


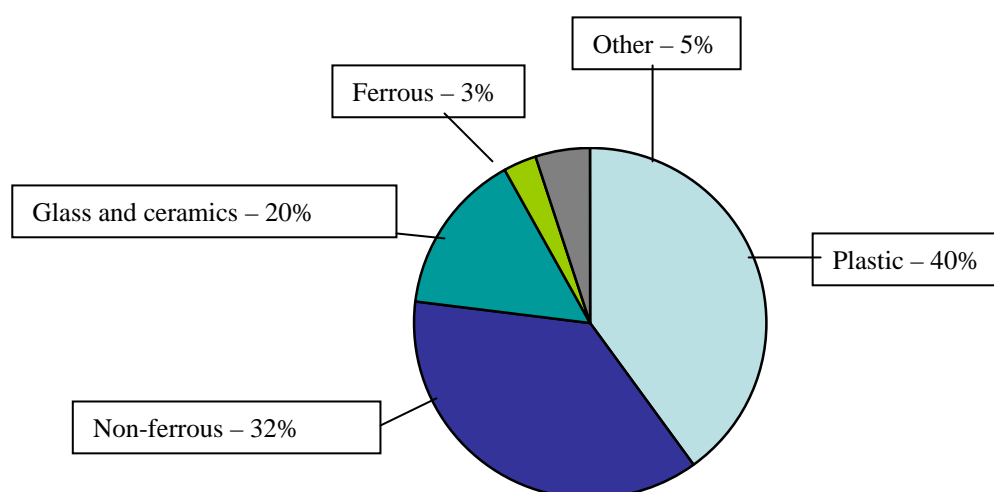
Figure 2. Mobile phone weight and size reductions

15. The environmental benefits of this reduction in size and weight, a development that has encompassed electronics, batteries and cases, include the fact that the entire process of manufacturing a modern phone consumes far fewer natural resources, in terms of both energy and materials, than in the past. Furthermore, it is clear that such design changes will continue towards additional environmental objectives and benefits, with consumers, Governments and environmentally conscious manufacturers alike driving the process.

16. It is useful to know, in a general sense, how a mobile phone is made and what it contains. Mobile phones are similar in composition to other electronic devices, being made up of plastics, metals, ceramics and glass, as shown below in figure 3 below. A more detailed list of substances used in mobile phones is given in appendix 2.

17. In more general terms, a mobile phone is made up of the following basic components:

- A handset, which includes a case (usually plastic); a display or screen, monochrome or colour, with a glass cover; a keypad; and an antenna
- A printed wiring board, inside the handset case, with integrated chips, resistors, capacitors and wires, making up the electronic brains of the phone
- A battery
- A microphone and a speaker

Figure 3. Mobile phone composition (weight and volume)

18. None of these parts is particularly different from the parts of other electronic devices such as personal computers or portable consumer electronic devices, either in terms of constituents or in the way that they are made, except, of course, that they are quite small.

19. Mobile phones differ from manufacturer to manufacturer and from model to model. Consequently, the substances used in any mobile phone will be somewhat different from the substances in another. The following table identifies primary constituents, minor constituents and micro constituents of mobile phones (not all substances are used in every mobile phone – for example, the battery may be nickel-metal hydride or lithium-ion – so the total does not add up to 100 per cent).

	<i>Percentage</i>
Plastics	40
Glass and ceramics	20
Copper and compounds	10
Nickel and compounds	10
Potassium hydroxide	5
Cobalt	5
Lithium	4
Carbon	4
Aluminium	3
Steel, ferrous metal	3
Tin	1
Minor constituents (Br, Cd, Cr, Pb, Mn, Ag, Ta, Ti, W, Zn)	<1
Microconstituents (Sb, As, Ba, Be, Bi, Ca, F, Ga, Au, Mg, Pd, Ru, Sr, S, Y, Zr)	<0.1

20. This guidance document also considers accessories for mobile phones which are no longer used, which includes the battery charger and may include a carrying case, a separate speaker set in an earplug, a separate microphone and other small devices that connect to the handset.

21. The battery of a mobile phone, contained in its own sealed plastic case, is removable from the mobile phone and is one of three types, each named for the chemistry of the battery's active substances: lithium-ion, using a lithium-cobalt compound, or lithium-polymer, a similar battery chemistry, with a different electrolyte; nickel-metal-hydride, using a nickel hydroxide compound; or nickel-cadmium, using nickel and cadmium. This is an older type of battery chemistry. There is a general movement away from the nickel-cadmium battery as some producers prefer the higher energy densities and less toxic constituents of the other two battery types, but it can still be found in older phones that are still in use.

22. Current battery technologies also improved charge-discharge cycle characteristics (for example, less memory effect) than NiCd batteries; however, they are still limited in the number of cycles before performance degrades.³ Future energy technologies, such as fuel cells, may provide greater lifespan, but there are regulatory issues that need to be resolved.⁴

23. Everything in a mobile phone is solid-state: there are no moving parts or liquids that might be released in normal use. Mobile phones do, however, contain small amounts of some substances that are potentially hazardous and which may be released into the environment if the phone is mismanaged at the end of its life. Exposure to substances of concern when managing end-of-life mobile phones is covered in appendix III.

1.5 Why mobile phones were selected for the first partnership under the Basel Convention

24. Mobile phones were selected for the first partnership under the Basel Convention for the following reasons:

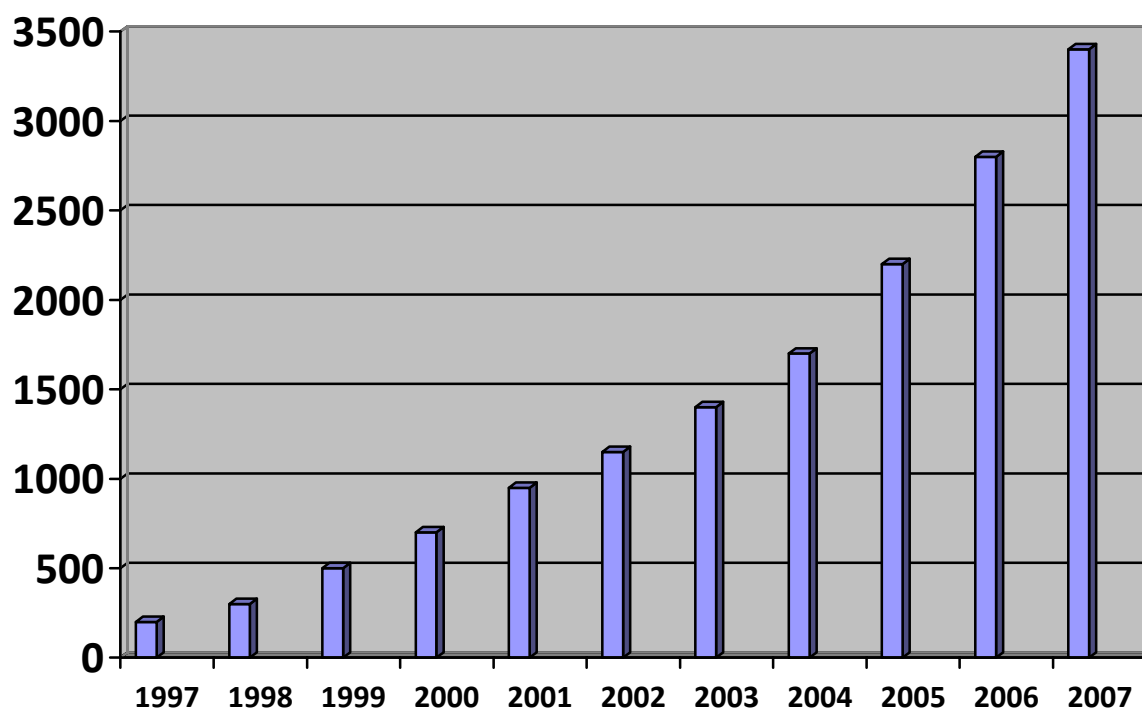
- People in all countries can relate to this high-visibility product
- The technology has global application
- Recovery of electronic and electrical equipment is highly topical issue
- There is a limited number of mobile phone manufacturers, facilitating consensus-based project management

25. In addition, all stakeholders have recognized the waste management challenges presented by large volumes of mobile phones, even though they are a very small part of the total waste burden. The average citizen of an

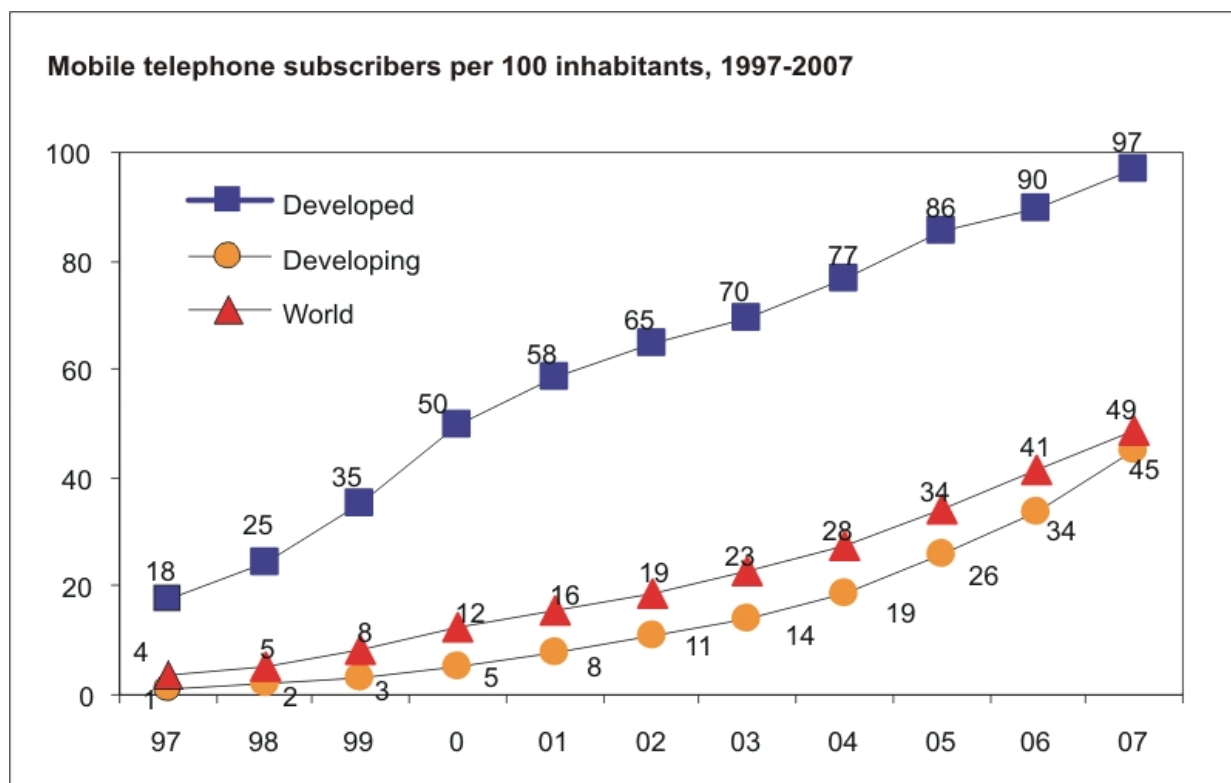
Organization for Economic Cooperation and Development (OECD) member country generates 500 kg of waste per year,⁵ the equivalent of 5,000 mobile phone handsets. The European Commission has estimated that all electrical and electronic waste forms about 17–20 kg per annum of electrical and electronic waste for the average citizen of the European Union.⁶ Analysis of electrical and electronic waste collected in Switzerland shows that mobile phones form only 0.12 per cent of collected waste electrical and electronic equipment (WEEE).⁷

26. However, the use of mobile phones has grown exponentially from less than 200 million users in the 1970s to 1.758 billion in 2004,⁸ as shown in figure 4 below. As of March 2009, there were more than 3.8 billion mobile phone connections.⁹ This exponential growth from 1994 to 2007 also holds true for developing countries. It should be noted that in 1997 the difference between developed and developing countries was 18:1, while by 2007 that difference had shrunk to almost 2:1. At the time of the revision of this guideline, there were more than 3.8 billion mobile phone connections.¹⁰ Sooner or later, they must all be discarded, and this quite often takes place sooner rather than later, as mobile phones are usually taken out of use well before they cease to operate.¹¹ in industrialized countries. UNEP found that mobile phones generally have a lifespan of less than two years before they are replaced by new phones because their owners want newer features or because the older phones are incompatible with new service carriers. In Japan alone it is estimated that by 2010, 610 million mobile phone units will be discarded.¹² This is not, of course, to say that mobile phones can be neglected at the end of their lives. Although the size of an individual mobile phone is small, the cumulative size of mobile phones is substantial. The total mass of all mobile phones produced worldwide is tens of thousands of tonnes per year, and accessories represent tens of thousands of tonnes more. Also, the fastest-growing markets for new and used mobile phones are in many developing countries. The result of that growth is waste when such phones reach the end of their lives.

Figure 4: Mobile phone subscribers (millions)



Source: International Telecommunication Union (www.itu.int).

Figure 5: Mobile phone subscribers per 100 inhabitants

27. It should also be remembered that although mobile phones present no environmental or human health hazard in ordinary use, hazardous substances may be released into the environment from certain landfills, incinerators and recovery and recycling facilities if the phones are not properly handled. Special attention must be paid by developing countries because those countries are not as likely to have adequate resources and waste management infrastructures to ensure that used mobile phones are being managed in an environmentally sound manner. Mobile phones must be managed in an environmentally sound way in order to minimize releases into the environment and threats to human health.

1.6 Mobile Phone Partnership Initiative

28. It should be borne in mind that the Basel Convention's goals include waste prevention and minimization; reduction in transboundary movement; and environmentally sound management of waste to protect human health and the environment. Environmentally sound management (ESM) is defined as "taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes".¹³ The Basel Declaration on Environmentally Sound Management,¹⁴ adopted in 1999, and the Strategic Plan of the Convention,¹⁵ adopted in 2002, calls for establishment of partnerships between governments, industries and other non-governmental organizations to ensure practical application of environmentally sound management. Sustainable partnership is an important complement to government actions, not a substitute for them.

29. Representatives of the world's foremost manufacturers of mobile phones – Alcatel, LG, Matsushita (Panasonic), Mitsubishi, Motorola, NEC, Nokia, Philips, Samsung, Sharp Telecommunications Europe, Siemens and Sony Ericsson – responded promptly to that call and in December 2002, at the sixth meeting of the Conference of the Parties to the Basel Convention, signed a declaration on sustainable partnership on the environmentally sound management of end-of-life mobile phones. Three telecom operators, Bell Canada, France Telecom-Orange and Vodafone, signed the declaration in December 2004. All agreed to work with the Secretariat of the Basel Convention and joined with Parties and Signatories to the Convention to develop and implement Mobile Phone Partnership Initiative (MPPI) activities.

30. The overall objective of MPPI is to promote the objectives of the Convention in the area of the environmentally sound management of end-of-life mobile phones. In particular, it should:

- Achieve better product stewardship
- Influence consumer behaviour towards more environmentally friendly actions

- Promote the best reuse, refurbishing, material recovery, recycling and disposal options
- Mobilize political and institutional support for environmentally sound management

31. Consequently, the Mobile Phone Working Group (MPWG) was established with a mandate to develop its terms of reference and propose a concrete work programme. In developing its work programme, the MPWG took into consideration a number of waste management principles including the following:

- Prevention and minimization of waste in production by implementing no-waste or low-waste technologies
- Reduction of hazardous substances in processes and products
- Reduction of waste requiring final disposal through environmentally sound reuse, recovery and recycling
- Environmentally sound final disposal of wastes which cannot be recovered or recycled

32. In April 2003, the MPWG discussed these issues¹⁶ and decided to set up four projects to carry out its work programme.

Project 1: reuse of used mobile phones

33. This project addressed the preferred option for used mobile phones, i.e., continue their useful lives through reuse. The group responsible for this project developed guidelines on refurbishment of used mobile phones that are intended to encourage companies which refurbish used mobile phones to implement environmentally sound practices which will protect human health and the environment. The guidelines should facilitate a process whereby products re-entering the market comply with applicable technical performance standards and applicable regulatory requirements. Those guidelines were developed, revised on the basis of the results of facility-type evaluation studies and approved by the MPWG.

Project 2: collection and transboundary movement of used mobile phones

34. This project reviewed successful collection schemes, including initial sorting of collected phones and separation of those which can be reused (with or without refurbishment) from those which are suitable only for material recovery and recycling. The group responsible for this project was to provide advice on programmes, legislation and regulations for effective collection of used and end-of-life mobile phones and develop guidelines for such collection.

35. The information provided should form a basis for setting up pilot projects for collection and treatment schemes in selected regions. The group also reviewed rules that may apply to transboundary movement of used and end-of-life mobile phones. The guidelines on collection were developed, revised on the basis of the results of facility-type evaluation studies and approved by the MPWG. In addition, the group recommended an approach for transboundary movements of used mobile phones which have been evaluated and assessed as likely to be suitable for reuse, possibly after repair, refurbishment or upgrading in the importing country.

Project 3: recovery and recycling of end-of-life mobile phones

36. This project was to address environmentally sound processing of mobile phones for material recovery and recycling, beginning with the separation of handsets, batteries and peripherals and directing those materials to proper specialized facilities for treatment and recovery of constituents such as plastics and metals. The group responsible for this project was to develop guidelines on environmentally sound recovery and recycling of end-of-life mobile phones. Those guidelines were developed, revised on the basis of the results of facility-type evaluation studies and approved by the MPWG.

Project 4: design considerations, awareness-raising and training

37. This project was to address outreach efforts by manufacturers to promote design improvements which would help ensure that end-of-life mobile phones are managed in an environmentally sound manner. It covered such issues as environmental improvements made in mobile phones since their invention; best practices currently employed by manufacturers; and recommendations for incorporating environmental considerations into design. The guidelines produced by this project group should raise awareness of existing best practices and should also offer environmental recommendations to be considered by mobile-phone designers. These guidelines were developed, revised on the basis of the results of facility type evaluation studies and approved by the MPWG.

2 Design considerations¹⁷

38. The primary purpose of this section is to raise awareness of environmental design issues concerning mobile phones. It recognizes the significant progress made by manufacturers in reducing the environmental impact of mobile phones over the 15 years to 2006 and those improvements which are currently being implemented. The future promises even greater and more widespread use, with multiple new hardware and software technologies, all of which require life-cycle thinking to prepare for their manufacture, lifetime use and end-of-life disposal.

39. The project was to identify barriers and opportunities and to challenge manufacturers to go beyond current thinking and continue to implement improvements in the environmental design of mobile phones. It looked at the evolution of design changes since the introduction of modern mobile phone in the 1980s, such as dramatic reductions in weight and changes in battery chemistry, and the end-of-life environmental impacts of those design changes.

40. As part of this project, the forces driving environmental design changes were considered – substance restrictions and bans such as the European Union Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and its Directive on waste from electrical and electronic equipment (WEEE),¹⁸ as well as continuing environmental demands from consumers – and the mobile phone manufacturers' ongoing responses.

2.1 Summary

41. It is recognized that a great deal of progress has been made in the design of mobile phones. Mobile phone design has changed dramatically over the three decades since it began (further details are given in section 1.4 above) and the overall environmental impact of newly designed mobile phones is much less than at the beginning of mobile phone development in respect of the use of material resources, the use of energy and end-of-life impacts. Nevertheless, design should now take into account ease of collection, reuse, refurbishment and recycling as there are hundreds of millions of mobile phones at the used and end-of-life stage each year.

42. Design improvements will include introducing reuse and recycling information into product marking; labelling of internal software; and further reducing the use of hazardous substances, making reuse, refurbishment, material recovery and recycling easier and extending the life of products.

43. The Basel Convention obliges Parties to ensure that the generation of hazardous wastes is reduced to a minimum (Article 4, paragraph 2), and product design can play a significant role in achieving that goal. The most direct government mandate that presently affects the design of mobile phones is the European Union RoHS Directive, which bans the use of six substances (lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers)¹⁹ in electrical and electronic devices, including mobile phones placed on the European Union market after 1 July 2006. Of the six substances banned by the RoHS Directive, four of them – cadmium, mercury, hexavalent chromium and polybrominated biphenyls – have no essential function in mobile phones and are either not normally used or can be easily replaced.

44. Lead has been used in mobile phones, although in very small quantities, in tin-lead solder, which very efficiently bonded components into integrated electronic devices. Although the amount of tin-lead solder in a mobile phone was typically less than one gram per phone, mobile phones no longer use tin-lead solder in their electronics.²⁰ Nevertheless, the major mobile phone manufacturers have long sponsored fundamental research and cooperative work with suppliers to identify alternatives that are free of lead, and of brominated fire retardants, that can maintain the quality and reliability needed in hand-held electronic devices.²¹ This early work has resulted in some manufacturers producing mobile phones which use neither lead nor brominated fire retardants, and there are already mobile phones on the European Union market and beyond which meet the substance requirements of the RoHS Directive. In addition, some of these substances are also of concern in material recovery and recycling operations because they may be released into the environment during some recycling processes and must therefore be managed in an environmentally sound manner.

45. Additional improvements in the design stages and in reducing the use of hazardous substances are required so that environmentally sound management of used and end-of life mobile phones can be facilitated and enhanced. This is considered to be part of life-cycle thinking (sometimes called the life-cycle approach), a concept to be applied by all manufacturers so that personal communications using mobile phones will be environmentally sustainable for the future. It is not just a design concept.

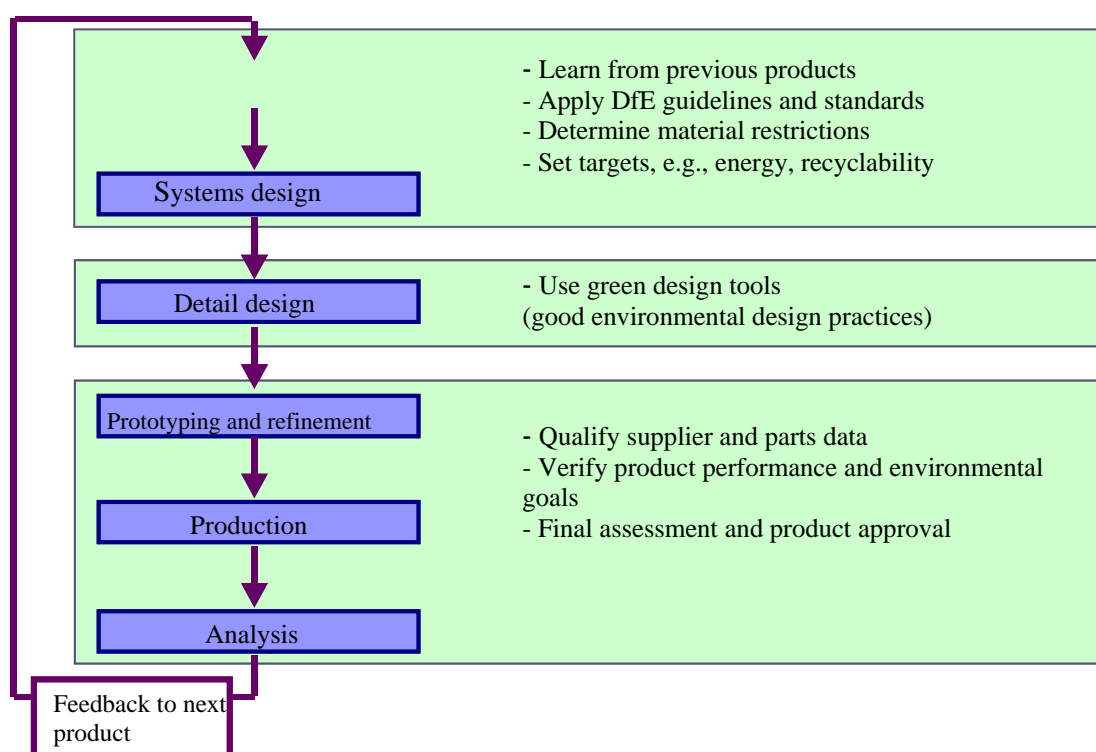
46. Figure 6 below shows the steps that are taken when life-cycle thinking (LCT) is applied to product design. Beginning with experience from previous products, knowledge of current material restrictions such as the RoHS Directive and general Design-for-Environment (DfE) guidelines, designers can set targets for improved environmental performance. Then, using software tools, the designer can quickly see how a product will affect energy consumption, resource depletion, greenhouse-gas production, air pollution, toxicity, carbon footprint and so

on. By trying different design solutions and inputting data to the software models, designers can visualize and assess how different materials choices and manufacturing techniques change the environmental profile of their products.

47. In addition, the extended producer responsibility (EPR) concept is gaining global popularity. Under EPR, producers take steps to manage their products properly at the post-consumer stage. It involves both sustainable product design (less use of toxic materials, use of recycled and recyclable materials, upgrade potential, and ease of disassembly for repair and recycling) and participation in take-back and recycling programmes. It recognizes that manufacturers are in the best position to control the longevity, content and recyclability of the products which they design and market, and that is why this concept should be promoted. Lastly, EPR can be seen as an extension of the life-cycle thinking concept, which is already applied by all mobile phone manufacturers (figure 6 below).

48. We all recognize the environmental achievements that mobile phone manufacturers have already made. It is clear that some manufacturers have been particularly proactive in their environmental thinking. We also recognize that some technical differences between mobile phones are legitimately based upon valuable proprietary innovations, the special expertise of individual manufacturers and differing consumer needs. Some technical incompatibilities, however, would seem to be unnecessary and give rise to the generation of waste. This unnecessary generation of waste can be reduced or eliminated through design changes in mobile phones, either by making them compatible, through hardware or software, with all technical transmission technologies or by incorporating a modular component that can be easily changed in order to make the mobile phone adapt to different transmission technologies.

Figure 6. Steps in life-cycle thinking: design



49. In addition, low-energy mobile phones are desirable. Very energy-efficient mobile phones will open up a wider choice of battery technologies and also of renewable-energy battery-charging sources such as solar cells and muscle power. Battery chargers are inefficient, and the energy used to charge mobile phone batteries, even when they are fully charged but are still connected to chargers (stand-by mode), greatly exceeds the energy delivered by those batteries in actual use.²² A very-low-energy mobile phone could also reduce or eliminate the need for flame retardants.

50. It should also be mentioned that current rates of reuse, material recovery and recycling of mobile phones are quite low. That being the case, any design improvements such as those mentioned above should enhance material recovery and recycling options. In addition, recycling of mobile phone plastics for the production of new plastics presently faces several barriers. An engineered plastic such as acrylonitrile butadiene styrene/polycarbonate (ABS-PC), which is used in mobile phone cases, should have positive economic value as a recyclable material. This is only true, however, if it is collected in reasonably large volumes and is free of other substances that would make it

unsuitable for recovery processes. In addition, the presence of a brominated flame retardant may reduce the resale market and price for recovered ABS-PC because many potential buyers do not want a flame retardant to be present.

51. Several major brand-owners of electronic products have made public that they are committed to developing, financing and administering programmes to divert e-waste from disposal by ensuring that it is properly recycled. Such programmes, known as extended producer responsibility (EPR) programmes, place the onus on producers to manage their products properly at the post-consumer stage. As an example, EPR has rapidly gained great popularity in Canada and in other parts of the world because it has the potential to stimulate producers to design longer-lasting, less hazardous and more recyclable products. In Canada, the EPR programme has already been applied to a broad range of post-consumer product streams such as used oils, scrap tyres, batteries, beverage containers and packaging.

52. EPR recognizes that brand-owners and manufacturers are in the best position to control the longevity, content and recyclability of the products which they design and make. The application of EPR gives an incentive to manufacturers to design their products in such a way as to minimize the costs involved in a wide range of end-of-life management activities, including collection and recycling.

2.2 Recommendations

53. Project group 4.1A put forward a number of recommendations dealing with design considerations, as follows.

2.2.1 Transmission technology and hardware incompatibility

1. The unnecessary generation of waste should be reduced or eliminated through design changes in mobile phones, either by making them compatible, through hardware or software, with all technical transmission technologies, or by incorporating a modular component that can be easily changed in order to make the mobile phone adapt to different transmission technologies.
2. Manufacturers of mobile phones should take steps to eliminate waste caused by unnecessary transmission technology incompatibility. Effort should be made to adopt a single transmission technology protocol throughout the world, and all new mobile phones should be designed in accordance with such a universal standard.
3. A battery charger may weigh more than the handset, so this incompatibility can result in more than double the amount of waste generated at a mobile phone's end of life.²³ Again we note that some manufacturers have addressed this area of incompatibility by making a small number of chargers applicable to a broader range of their mobile phones. It is recommended that these efforts should be continued by all mobile phone manufacturers, and that they should be expanded to a wider range of suitable devices within each manufacturer's product line, and also between the various manufacturers and where appropriate network operators. One example of a voluntary commitment by European manufacturers is the "Memorandum of understanding regarding harmonization of a charging capability for mobile phones" of 2009.²⁴
4. It is recognized that charging a battery, particularly a lithium-ion battery, requires care and special electronic circuitry to avoid damage, and that each manufacturer's concerns about brand quality and warranties are involved in possible cross-brand utilization of battery chargers and peripherals. It is nevertheless recommended that this area of potentially beneficial compatibility be investigated both within brands and between brands in order to utilize universal battery chargers, while careful consideration is given to prevent standardization from stifling innovation or compromising product safety.

2.2.2 Energy use

5. Further efforts should still be made to design more energy-efficient mobile phones, especially as phones continue to support more functions. The energy consumption of handsets in actual use should continue to be reduced through the use of increasingly efficient electronic components and software power management.
6. Although some manufacturers have reduced the energy consumption of battery chargers as part of the ongoing drive to achieve the most cost-effective and efficient technologies available, it should be further reduced across the mobile phone manufacturing industry through additional design improvements. European Commission Regulation No. 278/2009²⁵ also covers battery charges, among other things. Further energy reductions are under way due to the Energy Star programme and the European Commission Code of Conduct on Efficiency of External Power Supplies,²⁶ developed in conjunction with mobile phone manufacturers. Both of these voluntary programmes are currently undergoing revision to further reduce standby power and increase energy efficiency limits of external power supplies.
7. All mobile phone manufacturers should join the European Commission Code of Conduct on Efficiency of External Power Supplies and advocate that the energy limits and implementation dates set for mobile phone

chargers by the Code of Conduct and the Energy Star programme are fully aligned to ensure globally consistent requirements.

2.2.3 Design of mobile phones with reuse, material recovery and recycling in mind

8. Manufacturers should continue to consider reuse and, if necessary, repair and refurbishment in their design processes to facilitate repeated use by multiple consumers and much longer life before disposal.
9. Design changes should take into consideration material recovery and recycling as design can have a significant impact upon material recovery and recycling at the end of a mobile phone's useful life. During the design phase, manufacturers should take into account issues of increased recyclability and reduction in toxicity.
10. Mobile phone designers and manufacturers should work specifically towards the goal of recovery of plastic mobile phone cases in order to recycle them. Elimination of paints for colouring and substitution by pigments within the plastic will further improve the economics of material recovery and recycling for the separated plastic cases because cases with different pigments, but not paints, can be mixed and recovered as black plastic, which has a large market share. In addition, consideration should be given to greater consistency in material selection during the design stage for all mobile phones, which would allow plastics recyclers to eliminate sorting steps necessary to achieve compatibility of plastic types.
11. Beryllium and brominated flame retardants have been identified as substances of concern during the processing of end-of-life mobile phones. Manufacturers should consider substituting beryllium in copper alloys and brominated flame retardants in plastics used in mobile phones with available alternative alloys or other materials that perform the same function.
12. Reusable parts such as fuel-cell cartridges, soon to be used in mobile phones, can be designed and manufactured for very long, widespread use and systems should be put in place for their recovery and reuse.
13. Consideration should be given to applying existing voluntary consumer labels for environmentally sound mobile phones, such as the German label "Der Blaue Engel"²⁷

2.2.4 Hazardous substances

14. Manufacturers should always take into account the likelihood of some environmental and human risk in the management and mismanagement of their mobile phones at the end of their lives. In addition, it is recommended that manufacturers should investigate the feasibility of replacing all toxic substance with benign substitutes.
15. Manufacturers should communicate with users, recyclers and others to determine such circumstances and exposures and then set priorities between such hazardous substances, taking into consideration those six substances – lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers – which have been banned by European Union's RoHS Directive, for replacement, where possible, with alternatives that are more benign and fulfil the same functions.
16. It is recommended that all manufacturers should require, through explicit contract terms and conditions, all suppliers to disclose the substances used in component parts and subassemblies, and to comply with the specifications set by the manufacturers for substances banned or restricted from use.

2.2.5 Life-cycle thinking

17. Manufacturers should adopt life-cycle thinking and apply it at the design phase of mobile phones; this has arguably the greatest contribution to make to reducing environmental impacts during the lifetime of the phones.
18. Small and large manufacturers should continue to be involved in research activities to improve opportunities for material recovery and recycling of end-of-life mobile phones, and to improve environmental performance through longer lifetimes.
19. In applying life-cycle thinking in product design, manufacturers have identified a number of opportunities for improvements that should help refurbishment, material recovery and recycling of used and end-of-life mobile phones:
 - (a) To facilitate disassembly and separation of handsets:
 - Minimize the number of steps necessary for disassembly

- Minimize the use of welds and adhesives
 - Reduce the variety and number of connectors such as fasteners and screws
 - Minimize the number of tools required for disassembly
 - Use reopenable snap fits for joining plastic parts
 - Use designs that facilitate removal of modules for reuse
 - Use advanced materials for active disassembly
- (b) To facilitate production of new plastics through recycling:
- Limit the plastic types used throughout the mobile phone
 - When different plastics must be used, use combinations that are compatible with respect to material recovery and recycling
 - Mark plastics with plastic type labels
 - Avoid non-recyclable composites and coatings
 - Avoid incompatible coatings
 - Use moulded-in colours and finishes on plastics, rather than paints
 - Avoid adhesive-backed labels, stickers and foams
 - Use labels and marks made from the same or compatible material used elsewhere in the product
 - Avoid metal inserts in plastic parts
 - Eliminate the use of brominated flame retardants
- (c) To facilitate the recovery of metals:
- Eliminate or reduce the use of hazardous substances

3 Collection of used mobile phones²⁸

3.1 Summary

54. This section addresses collection systems for used mobile phones. The actual guidelines developed by project group 2.1 offer advice and guidance on collection systems, including an assessment of best practices in for the existing collection systems of used mobile phones. It reviews successful collection systems, which typically separate used mobile phones that can be reused (with or without repair or refurbishment) from those that are suitable only for material recovery and recycling. It identifies best practices, possible funding options and logistics for setting up national, regional and international collection systems for used mobile phones, especially in developing countries and countries with economies in transition.

55. This part of the guidance document is intended to encourage countries to set up collection systems that best suit their needs so that most if not all used mobile phones are collected and end-of-life mobile phones are diverted from final disposal operations such as municipal landfills. In many cases, landfills and incinerators are not equipped to deal with some of the potentially hazardous substances in mobile phones, and those substances could be released to the environment via leachate or atmospheric emissions.

56. Lastly, the guidelines on the collection of used mobile phones provide guidance on managing environmental and occupational health and safety issues during the collection and storage of used mobile phones before they are directed to repair, refurbishment or material recovery and recycling facilities. They are geared for use by environmental and other regulatory agencies and authorities, any organization that is interested in setting up a collection system for used mobile phones, manufacturers, telecom operators, mobile phone distributors and repair, refurbishment and recycling facilities. The information should be also of value to users of mobile phones who are encouraged to take their used phones to collection points.

3.2 Recommendations

57. Project group 2.1 put forward a number of recommendations dealing with collection systems, as follows:

1. Users of mobile phones should take efficiency into account in deciding whether to discard an old phone in favour of a new one.
2. Users should avoid depositing end-of-life mobile phones into the municipal waste collection system, which will result in the phone being disposed of in landfill or incinerated. Telecom operators and distributors can make a proportional contribution to raise users' awareness by informing and educating customers about potential environmental impacts of equipment and to ensure that new and used mobile phones and accessories are responsibly managed throughout their life cycle.
3. As reuse or recycling value may drop quickly, users should be encouraged to avoid storing or setting aside unneeded mobile phones and to deliver them promptly to a collection system. However, if a collection system is not available or the collection point is not convenient, a user should hold the mobile phone in storage until the next opportunity arises to deliver it to a collection point.
4. A used mobile phone collection system should have collection points conveniently located for users so that they can bring their mobile phones to such collection points. In addition, the collection system should be free of charge for users.
5. Collection of used mobile phones through telecom operators', retailers' or manufacturers' distribution channels should be a key element of in an efficient collection system. Other collection methods may also be considered. In the case of collection by mail, postage may also be paid by the collection system, especially where a large number of used mobile phones are being sent in a shipping package. Collection systems will operate most efficiently when integrated with existing product collection and distribution frameworks.
6. Collection points must be the initial part of the collection system, which should also include appropriate facilities where evaluation and/or testing and labelling can be carried out to decide whether used mobile phones destined for reuse are in working order and can be directly reused, or require repair, refurbishment or upgrading prior to reuse, or are to be sent for environmentally sound material recovery and recycling.
7. In general, the management responsibilities of the collection points should be simple and limited in scope, dealing only with collection, or may include some ability to perform preliminary evaluation to determine whether the mobile phone is potentially reusable. Collection facilities should usually not be involved in further testing or processing, leaving the more difficult responsibilities for the refurbishment or other facility, such as a central collection point.

8. In addition to collection points for consumers, it is important to consider collection from the repair sector, both formal and informal, to ensure that parts and mobile phone scrap do not end up in landfills. Such collection schemes could be undertaken by paying a price per kilo of scrap collected and is likely to be funded from recoverable commodities.
9. Depending on the capacity available in particular countries and the logistics involved in managing used phones and accessories, the separate collection of used mobile phones is recommended in order to preserve the working characteristics and resale value of those collected.
10. Depending on the capacity available in particular countries and the logistics involved in managing used phones and accessories, used mobile phones should be collected separately from other equipment if they are to be shipped for reuse, including reuse after refurbishment, repair or upgrading.
11. A collection point should ensure the security of the phones collected. Where the collection point conducts a preliminary evaluation of potential for reuse, appropriate packaging material should be used to separate used mobile phones from each another while in storage and during transportation to protect them from undue wear and to preserve their surface appearance, operational capability and market value for possible reuse. The type of material would depend on the availability of space at the point of sale.
12. Collection points should store used mobile phones in a way that is appropriate for their intended possible reuse and inside a building to avoid physical damage to the mobile phones as a result of exposure to rain or other adverse weather conditions.
13. Used mobile phones should be safely stored at each collection point until a sufficient quantity is accumulated for transport to another collection point or to an evaluation and/or refurbishment facility. There should then be a regular pick-up and transportation system which will take all the collected mobile phones from a collection point to another facility for evaluation and/or testing. The timing of pick-ups and transportation should be mindful of (a) the cost involved in logistics, both financially and environmentally, and (b) the potential rapid loss in value during delays. The collection of used mobile phones should, where possible, operate within existing new product delivery and collection schedules.
14. After preliminary evaluation, used mobile phones which are destined for reuse should be packaged in such a way as to protect their integrity.
15. Whenever possible, used mobile phones should be collected with their batteries, chargers and accessories.. However, it should be noted that in some markets, phones, batteries and other accessories may be returned separately. It should be assumed that every battery retains some degree of electrical charge. A loose battery is therefore a potential fire hazard. Consequently, at the first point of collection, any loose batteries should be identified and properly managed. If the batteries are removed, they should be packaged in such a way as to avoid contact with their terminals, to avoid short-circuits and fires. Batteries should be sent only to facilities that are specially qualified to recycle or process batteries for materials recovery, and should be protected against extremes of temperature. Care should be taken to ensure that the transportation of batteries complies with all applicable regulations or courier requirements, i.e., IATA regulations for the handling of lithium metal and lithium-ion batteries.
16. Whenever possible, used mobile phones should be collected with their battery chargers and accessories, even if the battery chargers and accessories are not to be reused. Battery chargers are more likely to be unique to specific phones, and should not be reused with other mobile phone types because of the risk of damage to batteries and phones.
17. Collection systems for used mobile phones should be accountable in a way that is practical and transparent to audit. This may require keeping a written record of the actual number of used mobile phones received, currently in storage, and shipped. Information about the reuse, recycling and final disposal of used mobile phones and accessories is usually obtained directly from recycling and refurbishment companies.
18. While every effort should be made to collect used mobile phones separately to be reused to the maximum extent practicable, if they are collected in bulk for material recovery and recycling they may be accounted for by the total mass of each shipment.
19. The collected used mobile phones should be sent only to environmentally sound facilities, whether for intermediate accumulation, refurbishment and repair or for materials recovery and recycling.
20. Governments and other stakeholders should consider actions that could be taken to promote successful collection schemes. It is important for all stakeholders to play their role in addressing used mobile phones and accessories.

21. Competent authorities should consider the need for operating conditions and requirements that are uniquely applicable to used mobile phone collection systems, balancing any risks to human health and the environment against any perceived need for oversight and accountability.
22. Consideration should be given to providing incentives to users to participate in a used mobile phone collection system.
23. Sellers of new mobile phones should consider offering appropriate incentives for the collection of used mobile phones when needed. Discounts on the purchase of new phones, free air time and free SMS are some of the possible incentives to be considered.
24. Manufacturers, telecom operators and mobile phone distributors should consider the possibility of sharing, as part of EPR systems, the physical and/or financial obligations entailed by the collection and management of used mobile phones. This is particularly necessary and should be implemented as soon as possible in countries where the legislation and infrastructure for the collection of used mobile phones is lacking.
25. Any financial mechanism established to hold and manage money collected either as a pre-paid fee, advanced recycling fee (ARF), advanced disposal fee (ADF) or as a refundable deposit should be transparent to all concerned persons, including governments and the public.
26. If a direct and transparent fee is charged to the original buyer of a mobile phone and the used mobile phone is exported for reuse, it may be necessary for some portion of that fee to follow the used mobile phone to an importing country to provide for its environmentally sound management there at the end of its life.

4 Transboundary movement of used and end-of-life mobile phones

4.1 Summary

58. This section addresses transboundary movement of collected used and end-of-life mobile phones. Once collected, the mobile phones should be evaluated and/or tested, and labelled, to determine whether they are suitable for reuse, possibly after repair, refurbishment, or upgrading, or if they are destined for material recovery and recycling or final disposal.

59. This part of the guidance document should be of assistance to regulatory agencies and authorities, manufacturers, network operators, repair, refurbishment and recycling facilities and any organization that is involved:

- In the export or import of used mobile phones for reuse.
- In the movement of used mobile phones suitable for reuse, possibly after repair, refurbishment, or upgrading in the importing country.
- In transboundary movements of end-of-life mobile phones destined for material recovery and recycling or final disposal.

60. The type of transboundary movement procedure to be applied depends on the condition of the collected mobile phones after evaluation and/or testing and labelling. It is recommended that Basel Convention transboundary movement controls should be implemented for end-of-life mobile phones destined for material recovery and recycling (Annex IV B operations) or final disposal (Annex IV A operations) where the end-of-life mobile phones contain Annex I constituents, unless it can be demonstrated that these end-of-life mobile phones are not hazardous using Annex III characteristics.

61. To determine what is and what is not covered under the Basel Convention, the Convention defines the “wastes” to be covered in Article 2.1 of the Convention, and stipulates that wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law. The Convention then defines disposal by reference to a set of technical annexes. In addition, every Party may determine, by its own national legislation, to define additional substances and objects as wastes and hazardous wastes.²⁹

62. If, following Article 2.1 of the Basel Convention or national legislation, at least one of the Parties involved in a transboundary movement has determined³⁰ that used mobile phones destined for repair or refurbishment in the importing country are classified as wastes, then the decision tree procedure (see appendix 4 (b)) should be used. The Basel Convention control procedure would then apply where such waste mobile phones are hazardous wastes in accordance:

- with Article 1.1(a) and contain Annex I constituents, unless it can be demonstrated that these used mobile phones are not hazardous using Annex III characteristics, or
- with Article 1.1(b) and are considered hazardous waste by the national legislation of one of the Parties involved

63. However, if, following Article 2.1 of the Basel Convention and national legislation, none of the Parties involved in a transboundary movement have determined that used mobile phones destined for repair or refurbishment in the importing country are classified as wastes,³¹ the Basel Convention control procedure will not apply. In such circumstances the voluntary notification procedure (appendix 4(a)) or the decision tree (appendix 4(b)) should be considered by the countries involved to ensure that such movements are being monitored, and the importing country is given an opportunity to react (consent, object, or identify conditions) to such movements.

64. Both procedures, the voluntary notification and the decision tree, as described in appendix 4 (a) and (b), respectively, would be subject to further review at specific time intervals in order to ensure that the objective of environmentally sound management is upheld and to reflect the knowledge and experience gained, including those from the proposed MPPI pilot projects.

65. The transboundary movement of collected mobile phones that have been tested and labelled as suitable for reuse without further repair, refurbishment or upgrading are outside the scope of the Basel Convention and these recommendations, and such phones can be shipped as commodity products, provided that a reuse destination in the receiving country is assured. If such used and functional mobile phones have been classified as hazardous waste by the States concerned, or are otherwise restricted under applicable national law such as by a prohibition on import of such used goods by States concerned, Parties and exporters shall respect those applicable restrictions.

4.2 Recommendations

66. Project group 2.1 put forward a number of recommendations dealing with transboundary movement of used and end-of-life mobile phones, as follows:

1. All used mobile phones that have been collected should be evaluated/tested, and labelled, prior to any transboundary movement.³²
2. When mobile phones are to be tested the test should utilize at minimum an “air” or “ping” test, loop-back test, a screen and keypad test, and a battery test to determine to what extent they are suitable for reuse with or without repair, refurbishment or upgrading.
3. Used mobile phones that have been collected but have not been evaluated and/or tested and labelled as suitable for reuse are subject to Basel Convention procedures, unless it can be demonstrated that these end-of-life mobile phones are not hazardous using Annex I and Annex III characteristics.
4. End-of-life mobile phones destined for material recovery and recycling (Annex IV B) or final disposal (Annex IV A) containing Annex I constituents are subject to Basel Convention transboundary movement controls, unless it can be demonstrated that those end-of-life mobile phones are not hazardous using Annex III characteristics.
5. Where used mobile phones that have been evaluated and assessed to be likely suitable for reuse,³³ possibly after repair, refurbishment or upgrading in the importing country, have been classified as waste by at least one Party involved in their transboundary movement, the decision tree (appendix 4 (b)) should be used.
6. Where used mobile phones destined for repair or refurbishment in the importing country are not classified as waste by any Party involved in their transboundary movement, a voluntary notification procedure (appendix 4(a)) or the decision tree procedure (appendix 4(b)) should be considered by the countries involved to ensure that such movements are being monitored, and the importing country is given an opportunity to react (consent, object or identify conditions) to such movements.
7. The following shipments are to be considered outside the scope of this procedure and of the Basel Convention, unless mobile phones being shipped are defined as or considered to be hazardous waste under paragraph 1 (b) of Article 1 of the Convention or are restricted under applicable national law such as by a prohibition on import of such used goods by the States concerned:
 - Collected mobile phones that have been tested and labelled as being suitable for reuse without further repair or refurbishment
 - Shipments by individual customers of their own mobile phones for repair or refurbishment (e.g., under warranty) and intended to be returned to them
 - Defective batches of mobile phones sent back to the producer (e.g., under warranty)
8. When hazardous wastes derived from imported used or end-of-life mobile phones are to be sent back to the original exporting country or to a third country, the Basel Convention notification procedures are to be followed. As appropriate, these documents should include references to original documents to ensure effective tracking.
9. In situations where hazardous wastes are to be sent back to the original exporting country or to a third country, it is recommended that the contract between the exporter and importer specify details of the return of the hazardous waste, return dates and financial responsibilities.
10. All transboundary movements of used and/or end-of-life mobile phones should follow applicable transport rules.
11. Consistent with MPPI guidelines, importing countries should take measures to establish an appropriate infrastructure to ensure that mobile phones which reach the final end of their lives are collected and recycled in environmentally sound facilities, be those located within or outside the country.

5 Refurbishment of used mobile phones³⁴

67. This section deals with the refurbishment of used mobile phones. It is intended to encourage companies which refurbish, repair and recondition used mobile phones to implement environmentally sound practices which will result in the protection of human health and the environment. It is also intended to facilitate a process whereby mobile phones re-entering the market to be reused comply with applicable technical performance standards and applicable regulatory requirements.

68. The guidelines prepared by project group 1.1 describe refurbishment of used mobile phones as follows: any refurbishment facility that disassembles and or changes any part of the mobile phone (component, software or accessory) shall be responsible for the quality of the introduced component and workmanship of the activities carried out. When making any changes to the mobile phone, the refurbisher shall make sure and take responsibility for ensuring that the product meets all relevant regulatory requirements relating to the market into which the product is to be resold. These shall include but not be limited to telecom standards, product safety, EMC (Electromagnetic Compatibility), EMF (Electromagnetic Field), exposure limits (i.e., Specific Absorption Rate (SAR)), and producer responsibility. The recommendations regarding refurbishment should support the global initiatives to “bridge the digital divide” and the attainment of target 18 of Millennium Development Goal 8: “In cooperation with the private sector, make available the benefits of new technologies, especially information and communication technologies”.

5.1 Summary

69. In this section, information is provided on how to achieve high refurbishment standards so that used mobile phones can be reused, thus extending their life. It is intended to encourage companies that refurbish or repair used mobile phones to implement practices in an environmentally sound manner which will protect human health and the environment, and at the same time it should facilitate a process whereby products re-entering the market comply with applicable technical performance standards and applicable regulatory requirements.

70. The guidelines on the refurbishment of used mobile phones and this section deal with issues such as product handling, evaluation and refurbishment (storage, cleaning of used mobile phones, disassembly, soldering, reassembly, use of authorized software, compliance with import requirements); handling and management of components and materials removed from used mobile phones; administrative measures and record keeping; plans to meet the objectives of environmentally sound management; relevant waste management permits, licences or other authorizations required by regulatory authorities; training of personnel; inspections and monitoring; and guidance for the remarketing of refurbished mobile phones (compliance with operational standards, labelling requirements and import requirements).

71. The information should also assist individuals, companies and agencies involved in collection schemes and transportation of used and refurbished mobile phones, and consumers who use the refurbished mobile phones. Lastly, any organization that is involved in buying or selling mobile phones for reuse should also find this information useful.

5.2 Recommendations

72. Project group 1.1 put forward a number of recommendations dealing with the refurbishment of used mobile phones, as follows:

5.2.1 Product handling and refurbishment

1. Facilities that refurbish used mobile phones should take steps to identify and sort used mobile phones which are to be refurbished from those that should be recycled for material recovery due to damage, wear, age or performance.
2. Refurbishment facilities should take care not to release data stored on the used mobile phones that they receive and should seek to remove and destroy such data.
3. Care should be taken to ensure that prolonging the life of a mobile phone does not result in the product exceeding the expected life of some of the components in the product. This problem is not unique to mobile phones
4. Used mobile phones should be evaluated and assessed to determine the extent to which they are suitable for re-use with or without repair or refurbishment. As a minimum, this assessment will include:
 - (a) **An “air” or “ping” test:** calling a test number (which will vary from country to country and from network to network), to generate a service response, and indication of whether or not the handset is functional.

- (b) **A “loop back” test:** blowing or speaking into the handset while on a call, to determine whether or not the microphone and speaker are functional.
 - (c) **A screen and keypad test:** switching the handset on and pressing each of the keys, to indicate whether or not the LCD and keys are functional.
 - (d) **A battery test:** testing the battery with a volt meter to indicate whether or not the battery is functional.
5. All refurbishers should adhere to the practice of selling or transporting only those mobile phones that have been tested for functionality, unless to a properly authorized recycling vendor or outsource repair centre.
 6. All refurbishing companies should utilize a reusable, recyclable or biodegradable material as a storage and packaging medium for used mobile phones, and encourage such further use.
 7. Refurbishment facilities should store and handle used mobile devices prior to their refurbishment in a manner that protects the mobile phones and reduces the potential for releases of toxic substances into the environment and for injuries to workers.
 8. In general, only benign cleaning solutions should be used to clean used mobile phones. If they are not, refurbishers should use cleaning solutions in an environmentally sound, efficient and safe manner. Where applicable, local laws and regulations should always be adhered to.
 9. When disassembling mobile phones or components of such phones, the refurbishment facility should ensure that where necessary the appropriate tools are used in order to prevent damage.
 10. Care should also be taken to preserve the value of the component or material to a practical extent practical and to protect workers and the environment.
 11. Refurbishment facilities should ensure that any solder used during the refurbishment process is compatible with the original solder used within the mobile phone and is compatible with any substance restrictions in the destination market. Soldering joints should be of the same condition and quality as contained in the original product. All soldering activities should be undertaken in conformity with occupational health and safety requirements to minimize worker exposure to fumes and dust.
 12. Only manufacturer-specified genuine or refurbished genuine parts should be used. In particular, non-genuine parts must not be used for safety or system critical functions. Parts should be sourced from suppliers with independent third party accredited quality management systems. Parts should be subject to receiving inspection suitable to function to assure the quality and performance level of the parts. Corrective action processes should be in place to ensure the effective management of quality issues.
 13. Refurbishment facilities should ensure that parts used in the refurbishment of mobile phones, including electrical devices, cases and covers, are of a type and design that will allow the mobile phones to comply with the rated operational characteristics specified by the original equipment manufacturer.
 14. Replacement antennas should have the same part number as the original equipment, and should not alter the mobile phone’s operational characteristics (including SAR) as specified by the original equipment manufacturer.
 15. Replacement batteries should include the same safety circuitry and insulation found with the original equipment. All replacement batteries must allow the mobile phone to conform to the rated operational characteristics (including SAR) specified by the original equipment manufacturer and be able to hold an appropriate charge.³⁵
 16. In accordance with appropriate waste shipping regulations, any battery that fails the inspection process and is rejected should be placed in a specifically designated container for proper transport to a recycling facility.
 17. End-of-life batteries and any associated circuit boards or electronic assemblies containing lead-based solders are to be managed in an environmentally sound manner and in accordance with the Basel Convention when destined for transboundary movement.
 18. Replacement battery chargers should include the same safety circuitry, insulation and filtering found with the original equipment.
 19. The maximum power level for a particular model must not be exceeded as a result of refurbishment. Technical standards for mobile phones usually specify a maximum power level and an allowable tolerance above and below this nominal value.

20. Facilities should not add or update software for refurbished mobile phones that would change the rated operational characteristics specified by the original equipment manufacturer as this may affect compliance of the mobile phone with standards for interference or for human exposure to radio frequency (RF) transmissions.
21. When refurbishers are exporting refurbished mobile phones to other countries, care should be taken to ensure compliance with the Basel Convention; with the decisions of its Conference of the Parties (for Parties to the Basel Convention); and with all applicable legislation governing product imports, technical standards, labelling, and health and safety requirements.
22. Used mobile phones resold into foreign markets should be packaged and handled in a manner that is consistent with their planned reuse.

5.2.2 Management of components and materials removed from used mobile phones

23. Refurbishment facilities should ensure that components and other materials removed from mobile phones, which are destined for reuse, are handled in a suitable manner that preserves their value.
24. Used mobile phone components and materials, not suitable for reuse, should be managed on site in a manner that preserves their value for materials and energy recovery.
25. In the case of materials that can be used only for purposes of materials recovery and recycling, the facilities should handle the materials on site so as to protect workers and the environment.
26. Refurbishment facilities should be encouraged to minimize the landfilling of used mobile phone components and materials and arrange for appropriate material recovery and recycling where practicable.
27. Items removed from used mobile phones, which may include batteries, electronic components, circuit boards and other items removed during reassembly, should be managed in an environmentally sound manner and in accordance with any applicable requirements of the Basel Convention when destined for transboundary movement.
28. Refurbishment facilities should be aware of the Basel Convention guidance documents on transboundary movements of hazardous wastes destined for recovery operations and on preparation of technical guidelines for the environmentally sound management of wastes subject to the Basel Convention.
29. Refurbishment facilities should handle residual materials on site in a manner that protects against releases into the environment and ensures that they are safely transported to an appropriate facility.
30. Facilities should first characterize their process residuals using testing or by having knowledge of the materials and processes used at the facility.
31. If residuals are to be disposed of, the refurbishment facilities should ensure that the residuals are delivered to a landfill or incineration facility that is suitable for the specific residual, is properly authorized by relevant regulators, is well maintained and is well operated.
32. Refurbishment facilities should also be aware of the Basel Convention technical guidelines for the identification and environmentally sound management of plastic wastes and for their disposal, technical guidelines on specially engineered landfill (D5), and the draft technical guidelines for the recycling/reclamation of metals and metal compounds (R4). These guidelines are available from the Secretariat of the Basel Convention.
33. In the case of domestic movements, refurbishment facilities should ensure that all mobile phones, components (e.g., batteries) and residuals destined for materials recovery and recycling are prepared for shipment and transported in a safe and secure manner that complies with applicable hazardous materials and/or dangerous goods transport regulations of the country and/or region.
34. In the case of transboundary movements, refurbishment facilities should ensure that all mobile phones, components (e.g., batteries) and residuals destined for materials recovery are prepared for shipment and transported in full compliance with the Basel Convention.

5.2.3 Administrative measures and personnel training

35. Refurbishment facilities should maintain records of all mobile phones received and their disposition.
36. Records should be kept for a period that is consistent with relevant national or local regulations and practice.

37. Refurbishment facilities should have systems in place for defining specific ESM objectives, develop plans to meet the objectives, implement such plans and monitor progress towards achievement of those objectives.
38. All certified refurbishers should be compliant with an ESM policy and have an ISO 14001, EMAS or similar certification, including those that are “tailor made” for individual circumstances, such as for specific industrial sectors or enterprises.
39. Refurbishment facilities should ensure that all their employees are thoroughly familiar with proper procedures for carrying out their responsibilities during normal facility operations and during emergencies.

5.2.4 Inspections and monitoring

40. Refurbishment facilities dealing with products that are potentially hazardous to the health and safety of their workers or the environment are required to have processes, documented or otherwise, in place to ensure that those products are regularly inspected and monitored as required by their country's regulatory authority.

5.2.5 Compliance with regulatory, operational and import/export requirements

41. Refurbishment facilities dealing with products and materials that are defined by their country as “waste” are required to hold all relevant waste management permits, licences or other authorizations required by their country's regulatory authority.
42. Refurbishment facilities should be in compliance with all applicable local regulations and permits or other authorizations that are related to the environment or human health and safety.
43. Refurbishment facilities should perform, at regular intervals, evaluations to identify applicable local authorizations and to determine how these requirements apply to the facility.
44. Where refurbishers or other parties are exporting refurbished mobile phones, care should be taken to ensure compliance with all applicable laws governing product trade.

5.2.6 Guidance for the remarketing of refurbished mobile phones/mobile phone products

45. Any organization that remarkets used mobile phones should ensure that those mobile phones continue to meet all applicable industry and government standards and requirements, including the original product's rated operational characteristics.
46. Refurbishers, and other parties which recondition and repair mobile phones, should ensure that their practices are consistent with applicable telecommunications and other legislation. Labelling may be a requirement and such labelling may be on the mobile phone itself or in the product packaging as determined by the aforementioned applicable regulations.
47. Any party refurbishing or remarketing a mobile device should inform the subsequent purchaser that the product is used and/or refurbished and provide contact information necessary in the case of faulty product. It should be noted that there may be specific labelling requirements under telecommunications or other regulations for such refurbished devices.
48. If any mobile phones that are not refurbished and require shipment across boundaries, such shipments should follow the Guideline for Transboundary Movement of Collected Mobile Phones.

6 Material recovery and recycling of the end-of-life mobile phones³⁶

73. This section provides guidance on best practices for the environmentally sound material recovery and recycling of end-of-life mobile phones. It is presumed that the segregation of those mobile phones destined for reuse and refurbishment has already taken place. This section does not cover the reuse, refurbishment (project 1.1), collection and transport of end-of-life mobile phones (project 2.1), as other project groups of the Mobile Phone Partnership Initiative are addressing these areas and they are covered in other sections of this guidance document. However, robust collection of used mobile phones is strongly endorsed as the necessary first step in material recovery. Mobile phones that are not collected - and the vast majority are not - cannot provide a source for material recovery. Thus, this section presumes that the separate collection of used mobile phones, and their segregation for reuse and refurbishment, has already taken place.

74. It addresses the recycling of all components of mobile phones, which include the handset, which is usually a case (mostly plastic), a display screen, a keypad, an antenna, a printed wiring board and a microphone and speaker; a battery; a battery charger; and other accessories such as carrying case, earphones and connecting cables.

75. It also discusses the adequacy of the present material recovery and recycling infrastructures and their capacity for handling the increasing number of mobile phones which will become obsolete and be directed to material recovery and recycling facilities rather than to landfills, incinerators or some other form of final disposal.

76. Lastly, it includes recommendations to national authorities regarding programmes and policies which may be implemented to ensure that material recovery and recycling of end-of-life mobile phones is conducted in an environmentally sound and also an economically efficient manner.

6.1 Summary

77. This section also describes exposure to substances of concern and risks to human health and the environment, and emphasizes that particular care is necessary to prevent exposure of workers and general public to substances of concern during material recovery and recycling processes which involve the generation of dust and fumes. Dusts may be generated during shredding of mobile phones, during the subsequent handling of shredder outputs and during handling and processing of smelter slags. Fumes may be generated during metal sampling and smelting processes and also during certain steps in plastic recovery and recycling such as granulation. Exposures to a number of substances are of particular concern: beryllium in dusts and fumes, and dioxins and furans generated by burning plastics. Potential exposures to substances of concern when managing end-of-life mobile phones are listed in appendix 3. This is of particular relevance since mobile phone material recovery and recycling processes such as smelting result in the generation of some residues which require disposal.

78. Processing and recycling of mobile phone handsets focus on the recovery of metals. In appendix 5, a flow chart shows a process from collection of mobile phones up to recovery of precious metals and other materials. The process always includes recovery of copper and precious metals such as gold, silver and palladium because they are so valuable. Some material recovery and recycling processes also result in the recovery of materials such as steel, aluminium and magnesium, tin, cobalt, lead and plastics. Batteries, which must always be removed from the handset during the early stages of any environmentally sound material recovery and recycling process, can be safely recycled to recover iron, aluminium, copper, nickel, cobalt and cadmium, depending upon the battery type and also on the particular recovery process. A necessary step in the material recovery and recycling of mobile phones is manual separation of batteries in order to minimize contamination of other materials during subsequent material recovery and recycling stages, and also to maximize recovery of the substances contained in the batteries. Manual separation may also be used to separate certain accessories from mobile phone handsets and, in some cases, plastic parts may be separated for recycling. Some components can be recovered for potential reuse; disassembly of small devices, however, is very labour-intensive. Mechanical separation, including shredding, crushing and size reduction followed by various separation techniques, can also be used. However, if mechanical means are used, only devices designed for processing electronic scrap should be used so that the loss of precious metals, and also the emission of dusts generally, will be minimized.

79. Recovery of plastics from mobile phones for material recovery and recycling (as opposed to energy recovery) is not widely practised at this time because of the lack of viable techniques for separating a plastic fraction of marketable quality. There is, however, ongoing research on the recycling of plastics from electronic waste which could make this option technically feasible and economically viable in the future. To recycle plastics, as opposed to using them to recover energy, either a labour-intensive process for dismantling and sorting must be employed to gain clean plastic fractions, or mechanical separation must be utilized, which may result in a plastic fraction that is contaminated with metals. Consequently, it is important to promote the development of pre-processing technologies to help achieve greater efficiency for this intermediate step.

80. Mobile phones, either in whole form (minus batteries) or after manual or mechanical separation of components or materials, can be processed in specialized smelters where copper and precious metals such as gold, silver and palladium, and other metals, are recovered. Direct smelting of end-of-life mobile phones permits recovery

of metals such as copper, precious metals and most other metals (except iron, magnesium and aluminium); plastics can be used as a source of heat and also as reducing agents.

81. Smelting of used mobile phones requires specialized equipment and most smelters do not have the necessary pollution control systems for the environmentally sound material recovery and recycling of electronic scrap. Electronic scrap, including mobile phones, contains plastics and halogens (chlorine and bromine) which, when burned, can lead to the formation of dioxins and furans, which are highly toxic and carcinogenic. Nevertheless, with proper smelting operation and pollution control equipment, controls can be put in place to assure the environmentally sound recovery of metals from mobile phones.

82. Although the environmentally sound management of end-of-life mobile phones includes the recovery of materials, particularly copper and precious metals, it does not require the recovery of every substance. Mobile phones are small, their disassembly is expensive, and even in large quantities they do not contain many substances that can be efficiently recovered in amounts which are economically significant. Eco-efficiency research which examines the environmental and economic dimensions of the recovery process is ongoing.

83. Also, pre-processing, material recovery and recycling facilities must operate within a regulatory framework that establishes a balance between the need for environmentally sound management and the need for economic efficiency. Thus, in developing the appropriate regulatory infrastructure for mobile phone material pre-processing, recovery and recycling facilities, Parties should take into account the size of the enterprise, the type and quantity of scrap materials and also the nature of the operation. It is recognized that developing countries, and also those with economies in transition, face the greatest challenges in building the governmental and industrial infrastructures needed to achieve the environmentally sound management of end-of-life mobile phones.

84. All mobile phone pre-processing, material recovery and recycling facilities should have an Environmental Management System (EMS) in place to ensure adequate control over the impact of the facility not only the environment but also on worker and public health. EMS could include ISO-14001 or equivalently certified management systems such as the European Eco-Management Audit Scheme (EMAS) or other similar programmes. The facility should operate in accordance with written procedures regarding operating methods for the plant and equipment, management system, control of site activities, measurement and record keeping, and implementation of site safety rules. The design of the facility should be subject to health and environmental impact assessments and must comply with all applicable health and environmental regulations and be properly licensed by all appropriate governmental authorities. The facility must comply with all applicable health and environmental regulations and be properly licensed by all appropriate governmental authorities. Written plans regarding emergency preparedness and financial guarantees for emergencies and facility closure should also be maintained.

85. The guidelines on material recovery and recycling of end-of-life mobile phones prepared by project group 3.1 also address the need for plant personnel to be properly trained and also to be provided with appropriate personal protective equipment.

86. The development of EMS systems such as ISO 14001 or equivalent for facilities in developing countries could be costly and infeasible. In this context, the Basel Convention regional centres could play an important role in encouraging certification of material recovery and recycling facilities using such management tools. Basel Convention regional centres, which provide training and technology transfer on environmentally sound management, should aim primarily at strengthening the capacity of governments in their regions to comply with the Basel Convention, with the decisions of its Conference of the Parties and with the technical requirements for the environmentally sound management of wastes.

6.2 Recommendations

87. Project group 3.1 put forward a number of recommendations dealing with material recovery and recycling of the end-of-life mobile phones, as follows:

6.2.1 Goals and objectives

1. Parties and Signatories to the Basel Convention are encouraged to implement policies and/or programmes which promote the environmentally and economically sound material recovery and recycling of end-of-life mobile phones.
2. Consistent with the Basel Ministerial Declaration on Environmentally Sound Management, used and end-of-life mobile phones should be diverted, by a robust collection programme, from final disposal practices such as landfilling and incineration to the more environmentally sound practices of reuse, refurbishment, material recovery and recycling.
3. It is very important that end-of-life mobile phones be collected effectively (which is usually not the case today, even in industrialized countries), taking into consideration the Guideline on Collection of Used and End-of-Life Mobile Phones, developed by MPPI project group 2.1. Environmentally sound material recovery and recycling of mobile phones requires the setting up of an effective recycling

chain, comprising the steps of robust collection of used phones, testing/refurbishment/reuse if appropriate, preparing/dismantling of non-reusable phones or parts, and recycling of handsets and batteries.

4. Environmentally sound material recovery and recycling of mobile phones and associated accessories such as chargers, plugs, cigarette lighter adapters, Bluetooth devices, headphones, hands-free car sets, protective cases and belt clip/holders, consistent with the practices contained in this guideline, should be utilized.. All possible steps should be taken to ensure that unsound mobile phone material recovery and recycling practices are avoided, such as those where proper worker and environmental protections are not implemented (e.g., “primitive” and “backyard” operations) and those where there is no attempt made to maximize material recovery.
5. Priority should be given to eco-efficient material recovery and recycling processes which achieve high recovery yields of the various materials contained in mobile phones and associated accessories such as chargers, plugs, cigarette lighter adapters, Bluetooth devices, headphones, hands-free car sets, protective cases and belt clip/holders, and to minimize losses of valuable materials, while reducing the environmental impact of mobile phone production.

6.2.2 Development of material recovery and recycling infrastructure

6. The Basel Principles of self-sufficiency and least transboundary movement, as well as the necessity of economic efficiency, should be taken into account when considering investments in mobile phone material recovery and recycling facilities or operations, as well as when developing domestic policies for environmentally sound material recovery and recycling. .
7. Because compliance with these guidelines may mean an increase in material recovery and recycling costs, Parties, industry and other interested parties should collaborate to ensure that there is adequate financing for mobile phone material recovery and recycling initiatives.

6.2.3 Environmentally sound management and facility-level guidelines

8. A regulatory infrastructure should be developed at an appropriate governmental level and should include legal requirements such as authorizations, licences, permits or standards. It should:
 - Cover facility operation, workers’ health and safety, control of emissions to air, land and water and waste management. The licence or permit should describe and authorize specific facility capacities, processes and potential exposures.
 - Require that facilities operate according to best available technologies while taking into consideration the technical, operational and economic feasibility of doing so.
 - Encourage the development and implementation of an environmental liability regime for material recovery and recycling facilities, to prevent environmental damage.
 - Encourage information exchange between facility managers and governmental authorities in order to optimize recovery operations.
 - Move toward internalization of the costs of the environmentally sound management of end-of-life mobile phones.
 - Encourage facilities to make use of environmental management systems such as: the ISO 14000 series, the European Eco-Management Audit Scheme (EMAS) or other similar programmes.
 - Recommend that recycling facilities develop adequate monitoring, recording and reporting programmes.
 - Encourage recycling facilities to set up adequate employee training programmes.
 - Require that recycling facilities have adequate emergency plans.
 - Require that recycling facilities establish an appropriate plan for closure and after-care which ensures that the financial means for such closures are available.
9. Mobile phone material recovery and recycling facilities should be certified by an independent environmentally sound management system, such as the ISO 14000 series and the European Eco-Management Audit Scheme (EMAS), or by an equivalent system. The procedures which must be followed for pre-processing facilities to achieve certification or registration for international environmental sound management systems should be simplified.

10. The general facility guidelines set forth in appendix 6 should be implemented by all pre-processing, smelting, refining and other processing facilities which are involved in any aspect of mobile phone material recovery and recycling.
11. If shredding is utilized, mobile phone batteries should be removed prior to shredding. Batteries should also be removed prior to any smelting or refining and should be sent to an authorized battery recycler.
12. Where mobile phones, or their components, are shredded or heated, measures should be implemented to protect workers, the general public and the environment from dusts and emissions. Such measures should include adaptations in equipment design or operational practices; air flow controls; personal protective equipment for workers; pollution-control equipment; or a combination of those measures.
13. Companies with the capacity to pre-process, smelt, refine or perform other steps in mobile phone material recovery and recycling should identify themselves to their competent authorities. The competent authorities should inspect and verify that those companies are practicing environmentally sound management consistent with these recommendations and this guideline .
14. Mobile phone collectors and pre-processors should observe due diligence in assuring themselves that subsequent handlers and processors operate consistent with this guideline.

6.2.4 Design for material recovery and recycling

- 15 The material recovery and recycling phase of end-of-life mobile phones should be taken into account by manufacturers during product design, by considering the issues of increased recyclability and reduction in toxicity (see the guideline of project group 4.1 for greater detail).
16. Beryllium and certain flame-retardants have been identified in this guideline as substances of particular concern during the processing of end-of-life mobile phones. Manufacturers should give consideration to the use of substitute materials which perform the same function.
17. Mobile phone manufacturers should collaborate to enhance the recyclability of plastics in mobile phones. Specifically, consideration should be given to greater consistency in material selection during the design stage for all mobile phones, which would allow plastics recyclers to eliminate sorting steps necessary to achieve compatibility of plastics types.
18. If shredding with subsequent material sorting is applied, special attention must be placed on preventing the potential loss of precious metals, which are very valuable both from an economic and an ecological point of view. It is recommended that circuit boards be removed before shredding and sorting processes and that the boards be sold for reuse or treated for recovery in appropriate metallurgical operations.³⁷

6.2.5 Future collaborative steps

19. Parties to the Basel Convention are encouraged to extend the role of Basel Convention regional centres in developing training and technology transfer on environmentally sound material recovery and recycling of end-of-life mobile phones so as to assist developing countries and countries with economies in transition in implementing regulatory frameworks for the environmentally sound management of end-of-life mobile phones.
20. Legal, technical, and financial assistance should be provided to developing countries and countries with economies in transition to help them establish the appropriate legal, technical and social infrastructures needed to achieve the environmentally sound management of end-of-life mobile phones.
21. An audit checklist or similar tools should be developed to assist Parties and others in performing inspections and due diligence audits based on this guideline.
22. Further eco-efficiency analyses should be performed to greater inform decision-making by Parties, as well as other interested persons, regarding optimal approaches for the material recovery and recycling of end-of-life mobile phones.

Appendix 1

Mobile Phone Partnership Initiative

Glossary of terms

Note: *These terms were developed for the purpose of the overall guidance document and individual project guidelines, and should not be considered as legally binding; nor should these definitions be considered as internationally agreed. Their purpose is to help readers to understand the guidance document better. The processes of dismantling, refurbishment or reconditioning and repair may entail the removal of batteries, electronic components, printed wiring boards and other items which should be managed in an environmentally sound manner, and in accordance with the Basel Convention when destined for transboundary movement.*

Basel Convention: UNEP Convention of 22 March 1989 on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which came into force in 1992.

Components: Parts or items removed from used mobile phones, which may include batteries, electronic components, circuit boards, keyboards, displays, housing or other parts or items.

DfE: Design for environment; meaning a product has been designed to reduce environmental impact throughout its whole life cycle.

Dismantling: (Manual) separation of components or constituents in such a way that recycling, refurbishment or reuse is possible.

Disposal: Any operation specified in Annex IV to the Basel Convention.

Direct reuse: Definition to be developed under project 2.1.

EMC: Electromagnetic Compatibility. The capacity of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to other equipment in that environment or being adversely affected by the electromagnetic emissions of other electrical equipment.

EMF: Electromagnetic Field. Electromagnetic fields are a combination of both electric and magnetic fields. EMFs occur naturally (light is a natural form of EMF) and also as the result of human invention. Nearly all electrical and electronic devices emit some type of EMF. Safety standards are applicable, but these may vary from country to country.

Eco-efficiency: Producing economically valuable goods and services with less energy and fewer resources while reducing the environmental impact (less waste and less pollution) of their production. In other words, eco-efficiency means producing more with less. It may include, for example, producing goods through recycling when that is more efficient, and more environmentally friendly, than producing the same goods with primary resources and methods.

End-of-life mobile phone: A mobile phone that is no longer suitable for use and is destined for disassembly and recovery of spare parts, for material recovery and recycling or for final disposal. Includes off-specification mobile phones which have been sent for material recovery and recycling or final disposal.

Environmentally sound management: Taking all practicable steps to ensure that used and end-of-life products, and wastes, are managed in a manner which protects human health and the environment.

Evaluation: The process whereby collected used mobile phones are assessed to determine whether they are likely to be suitable for reuse. This assessment may include:

- (a) A visual check;
- (b) A “power-on” check;
- (c) A check of whether the model is included in a list of handsets provided by the refurbishment company.

Hydrometallurgical processing: Processing of metals in cyanide, and/or strong acids such as aqua regia, nitric acid, sulphuric acid and hydrochloric acid. **Incineration:** A thermal treatment technology whereby municipal wastes, industrial wastes, sludges or residues are burned or destroyed at temperatures ranging from 1,000°C to over 1,200°C (high-temperature incineration, used mainly to incinerate hazardous wastes) in the presence of oxygen, resulting in rapid oxidation of the substances incinerated. Most incinerators have air pollution control equipment to ensure that emission levels meet the requirements prescribed by the regulatory authorities.

Integrated copper smelter: A facility, or related facilities in the same country under the same ownership and control, that melts down metal concentrates and complex secondary materials which contain copper, and also precious and

other metals, using controlled, multi-step processes to recycle and refine copper, precious metals and many other metals from managed product streams.

Labelling: The process whereby individual or batches of mobile phones are marked to designate their status according to the guidelines developed under project 2.1.

Landfilling: The placement of waste in or on top of ground containments, which are then generally covered with soil. Engineered landfills are disposal sites which are selected and designed to minimize the likelihood of releases of hazardous substances into the environment.

Leachate: Contaminated water or liquids resulting from the contact of rain, surface water and groundwater with wastes in a landfill.

Life-cycle management: Holistic way of considering the environmental issues associated with a substance, product or process from resource utilization through manufacture, transportation, distribution and use to waste management and disposal of residues from treatment or recycling operations.

Material recovery: Relevant operations specified in Annex IV B to the Basel Convention.

Mechanical separation: Mechanical means of separating mobile phones into various components or materials.

Mobile phone (sometimes called a cellular phone or cellphone): Portable terminal equipment used for communication and connecting to a fixed telecommunications network via a radio interface (from International Telecommunication Union K.49 (00), 3.1). Modern mobile phones can receive, transmit and store voice, data and video.

Printed wiring board: Also called a printed circuit board, consisting of integrated chips, resistors, capacitors and wires.

Pyrometallurgical processing: Thermal processing of metals and ores, including roasting and smelting, remelting and refining.

RoHS: Directive of the European Parliament and Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

RF: Electromagnetic energy transmitted through radio and microwaves.

Recycling: Relevant operations specified in Annex IV B to the Basel Convention.

Refurbishment or reconditioning: The process of creating a refurbished or reconditioned mobile phone.

Refurbished or reconditioned mobile phone: A mobile phone that has undergone refurbishment or reconditioning, returning it to a satisfactory working condition fully functional for its intended reuse and meeting applicable technical performance standards and regulatory requirements, including the original product's rated operational characteristics. The intended reuse must include full telephony capability. **Repairing or repair:** A process of fixing only a specified fault or series of faults in a mobile phone.

Reuse: A process of using a used mobile phone, or a functional component from a used mobile phone, again, possibly after repair, refurbishment or upgrading.

SAR: Specific Absorption Rate, which is the amount of radio frequency electromagnetic radiation absorbed by the body. The unit of measurement is Watts per Kilogram (W/Kg). SAR is determined, in laboratory conditions, at the highest certified power level of the mobile phone. When in use, the actual SAR may be well below this value because of automatic power control by the mobile phone. SARs of each model of mobile phone are measured as part of the safety standard compliance process.

Segregation: Sorting and removing mobile phones from other (electronic) wastes for possible reuse or treatment in specific recycling processes.

Separation: Removing certain components and constituents (e.g., batteries) or materials from a mobile phone by manual or mechanical means.

Testing: The process whereby used mobile phones, which may already have been evaluated, are assessed to determine the extent to which they are suitable for reuse with or without repair or refurbishment. As a minimum, this assessment will include:

(a) An "air" or "ping" test: Calling a test number (which will vary from country to country and from network to network) to generate a service response, and to show whether the handset is functional;

(b) A "loop-back" test: Blowing or speaking into the handset, while on a call, to determine whether the microphone and speaker are functional;

(c) *A screen and keypad test:* Switching the handset on and pressing each of the keys to show whether the Liquid-Crystal Display and keys are functional;

(d) *A battery test:* Testing the battery with a voltmeter to show whether the battery is functional.

Transport of Dangerous Goods: United Nations Recommendations on the Transport of Dangerous Goods, which deal with classification, placarding, labelling, record-keeping, and so on to protect public safety during transportation.

Treatment: Any activity after the end-of-life mobile phone has been handed over to a facility for disassembly, shredding, recovery, recycling or preparation for disposal.

Upgrading: The process whereby used mobile phones are modified by the addition of the latest software or hardware.

Used mobile phone: A mobile phone which its owner does not intend to use any longer.

WEEE directive: Directive of the European Parliament and Council on Waste Electrical and Electronic Equipment.

Wastes: substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national legislation.

Appendix 2

Substances contained in mobile phones³⁸

Mobile phones may differ from manufacturer to manufacturer and from model to model. Consequently, the substances in any mobile phone will be somewhat different from the substances in another model. The following table shows substances in three categories: primary constituents, minor constituents, and micro- or trace constituents. (As not all substances are used in every mobile phone, e.g., they may have a nickel-metal-hydride or lithium-ion batteries, the numbers do not add up to 100 per cent.)

Name of substance	Location in mobile phone	Typical percentage content of mobile phones (including battery and peripherals)
Primary constituents:		(1 per cent and over)
Plastics	Case, circuit board	~40%
Glass, ceramics	LCD screen, chips	~20%
Copper (Cu), compounds	Circuit board, wires, connectors, batteries	~10%
Nickel (Ni), compounds	NiCd or NMH batteries	~2-10% *
Potassium hydroxide (KOH)	battery, NiCd, NiMH	<5% *
Cobalt(Co)	Lithium-ion Battery	1-5% *
Carbon (C)	Batteries	<5%
Aluminium (Al)	Case, frame, batteries	~3% **
Steel, ferrous metal (Fe)	Case, frame, charger, batteries	~10%
Tin (Sn)	Circuit board	~1%
		* Only if these battery types are used, otherwise minor or microconstituent.
		** If aluminium is used in the case, the amount would be much larger, ~20%.
Minor constituents:		(Typically under 1% but over 0.1%)
Bromine (Br)	Circuit board	
Cadmium (Cd)	NiCd battery	
Chromium (Cr)	Case, frame	
Lead (Pb)	Circuit board	
Liquid crystal polymer	LCD screen	
Lithium(Li)	Lithium-ion battery	
Manganese(Mn)	Circuit board	
Silver (Ag)	Circuit board, keypad	
Tantalum (Ta)	Circuit board	
Titanium (Ti)	Case, frame	
Tungsten (W)	Circuit board	
Zinc (Zn)	Circuit board	

Name of substance	Location in mobile phone	Typical percentage content of mobile phones (including battery and peripherals)
Micro- or trace constituents:		(Typically under 0.1%)
Antimony (Sb)	Case; circuit board	
Arsenic (As)	Gallium arsenide LED	
Barium (Ba)	Circuit board	
Beryllium (Be)	Connectors	
Bismuth (Bi)	Circuit board	
Calcium (Ca)	Circuit board	
Fluorine (F)	Lithium-ion Battery	
Gallium (Ga)	Gallium arsenide LED	
Gold (Au)	Connectors, circuit board	
Magnesium (Mg)	Circuit board	If Mg is used in the phone case, the amount would be much larger, ~20%
Palladium (Pd)	Circuit board	
Ruthenium (Ru)	Circuit board	
Strontium (Sr)	Circuit board	
Sulphur (S)	Circuit board	
Yttrium (Y)	Circuit board	
Zirconium (Zr)	Circuit board	

Appendix 3

Exposure to substances of concern when managing end-of-life mobile phones³⁹

Land disposal

1. Land disposal of mobile phones may place them in contact with co-disposed acids, and, over an extended period of time, the substances which are soluble in those acids may leach out. There has apparently not been any research carried out to show which substances will leach from a mobile phone, except for lead. There have been several studies showing that electronic circuit boards leach lead under landfill conditions simulated by the United States Environmental Protection Agency Toxicity Characteristic Leaching Procedure (TCLP).⁴⁰
2. If a landfill is not bound by an impermeable barrier, substances may migrate into groundwater, and eventually into lakes, streams or wells, and give rise to potential exposure to humans and other species. However, lead does not tend to migrate in soil but instead remains fixed to soil particles.⁴¹ Consequently, lead exposure through drinking water as a result of leaching and migration into groundwater is a minimal risk.
3. The greater risk from land disposal is from migration of hazardous substances up the food chain and from direct ingestion of contaminants, contaminated soil and water from landfills that are not controlled. Some landfills, particularly in poor regions, are visited by people, including small children, looking for valuable materials. The route of exposure will be almost entirely by ingestion, either directly through drinking water or through food that has previously absorbed been contaminated with substances of concern.

Waste incineration

4. Incineration of mobile phones oxidizes the plastic in the case and in the circuit board. Depending on the conditions, the oxidation of plastics may be incomplete, and hydrocarbon particles and other soot may be produced. This is particularly so if the waste incineration is informal and completely uncontrolled, as in metal drums or by open burning, which may occur in poor regions. People may burn circuit boards, for example, to concentrate the metals in ash to sell for metal recovery and recycling.
5. Some metals, including cadmium and lead, have relatively low melting temperatures and may melt during incineration and form fumes or minute metal oxide particles which are carried into the incinerator exhaust together with the air emissions. If these metals, and any other metals that are contained in mobile phones, do not melt at the temperatures of incineration, they remain in bottom ash. That bottom ash, if disposed of on land, may give rise to concerns about exposure to hazardous substances as described above. In addition, leaching from ashes under land disposal conditions may be substantially faster than leaching from solid mobile phones.
6. Also, if incineration does not take place at a sufficiently high temperature sustained for a sufficient time, the plastics and other hydrocarbons contained in a mobile phone may not be completely oxidized to carbon dioxide and water and may combine with halogens to form new halogenated hydrocarbons, including dioxins and furans.
7. If waste incineration is informal and completely uncontrolled or is even somewhat better controlled, burning mobile phones releases substances of concern in air emissions and to other environmental media in subsequent management of fly ash and bottom ash.⁴²

Metal recovery and recycling

8. Mobile phones, especially when processed in large volumes where economies of scale can be applied, are a good source of metals. The principal interest of metal recovery from mobile phones is in the recovery of the metal of greatest amount – copper – and the metals of greatest value – gold, palladium and silver. In addition, recovery of cobalt from Li-Ion batteries is also of economic interest. If mobile phone cases are made of aluminium or magnesium, these metals too are of economic interest.
9. Processing for metal recovery may begin with shredding in dedicated e-waste shredders to reduce mobile phones to smaller pieces, approximately 2 cm in size, where this is more suitable for feeding into a smelter. The shredding process generates both high volumes of noise and some dust particles that may contain any of the substances in the mobile phone. Unless these particles are controlled, workers may be exposed to those substances by inhalation and ingestion. In normal shredding, however, the amounts of substances released in the shredding process are small. If batteries have not been removed before shredding, they will release caustic substances, and may cause electrical short circuits and fire, which may give rise to its own releases of toxic emissions.

10. The shredding process may be followed by material separation steps to separate metals from one another and non-metals from one another. A variety of technologies are employed for material separation, including magnets, eddy-current separators and flotation. The dust particles created in the shredding process continue to be present and require control to prevent worker exposure. Separated materials with no market value require disposal in authorized landfills, or incinerators as appropriate.

11. The smelting process, which separates copper, other metals and precious metals from other materials, is a high-volume, high-temperature operation. Metal fumes and metal oxide particulates may be released, exposing workers and downwind communities unless the emissions are controlled. The most problematic metal emission from smelting may be beryllium, but the concentration of beryllium in mobile phones is low enough for it to be controlled at very low concentrations, far below air-quality standards. If hydrocarbons are present in materials being smelted, the process may release particles of incomplete combustion and, if halogens are also present, may release dioxins and furans. These releases can be controlled through properly engineered processes and emission-control systems, but require attention to appropriate infrastructure and sound management.

12. Metal recovery from separated batteries, like smelting, involves high-volume, high-temperature processes and metal fumes and metal oxide particulates may be released, exposing workers and communities. Cadmium is a component of nickel-cadmium batteries, has a low melting temperature and is easily emitted in furnace exhausts, most commonly in the form of cadmium oxide particulates. As with smelting, these releases can be controlled through properly engineered processes and emission-control systems, but require attention to appropriate infrastructure and sound management.

13. Smelting is followed by a number of metal-specific electro-refining, dissolution and precipitation processes (hydrometallurgical processes) in which individual metals are upgraded and refined to market grade. These steps may generate wastewater that may contain high concentrations of toxic metals; such wastewater, if such wastewater is not completely reused within the refining facility, it will require special attention to appropriate infrastructure and sound management.

14. The slag that is produced in the smelting process also contains substances of concern. If it still contains relatively high concentrations of metals of economic interest, it should be reintroduced into the smelter or into other smelting processes to recover those metals. Such continued smelting entails potential releases of fumes and particulates but increases metal recovery and avoids landfill disposal. Slag may also be ground to powder as a preparation for further metal recovery by selective leaching and precipitation of desired metals. These further processing steps may give rise to potential exposures of workers to metal-containing dust, and to wastewater with high concentrations of toxic metals, and should be controlled by the use of properly engineered processes and sound management.

15. Slag is typically a silicate glass, and when it has been stabilized and made insoluble through high-temperature processing it does not leach substances of concern and may be safely used as a building or road construction aggregate. If slag has not been rendered stable and insoluble, its use on land or its ultimate disposal in landfill has the same potential for release of substances of concern as described above.

Plastic recovery and recycling

16. Plastics from mobile phones have not so far been widely recovered for use as plastics, because few facilities can sort plastics efficiently into clean streams of a single type. In smelters with appropriate flue gas treatment, plastics may be utilized in the metal recovery process, where they serve as a source of heat, a substitute for other hydrocarbon fuels and as a reducing agent. If mobile phone cases were designed to be easily removed and free of contaminating substances such as paints, labels and metals, and if they could be collected in a reasonably large volume, the engineered plastics of mobile phones, usually an acrylonitrile butadiene styrene/polycarbonate (ABS-PC), could be recycled with a positive economic value. The manual demanufacturing of mobile phones prior to precious metal recovery can produce reasonably clean streams of such plastic. Research on the identification and sorting of plastic is ongoing, and this option may be economically viable in the future. Indeed, the well-known German Fraunhofer Institute⁴³ demonstrated in its pilot project launched in 2001–2002, called “RegioPlast”, that recycling plastic from electrical and electronic waste is technically feasible and economically viable for larger and clean plastic parts.⁴⁴

17. The plastic recovery process would begin with sorting the plastic types, which would not involve any exposure to hazardous substances. Sorted plastics would then be granulated, a process that can generate heat and, if not properly managed, smoke and fire.

18. Plastic cases may contain a brominated fire retardant, most probably decabrominated biphenyl ether (DBBE). DBBE is an additive flame retardant, and some amount may be released from the plastic during the granulation process, but studies show that the amount involved would be small.

19. After granulation, the plastic would be moulded into a desired shape under high pressure and temperature, and exposure to substances contained in the plastic might occur, but this would be no different than for the same type of plastic derived from other sources.

Appendix 4 (a)

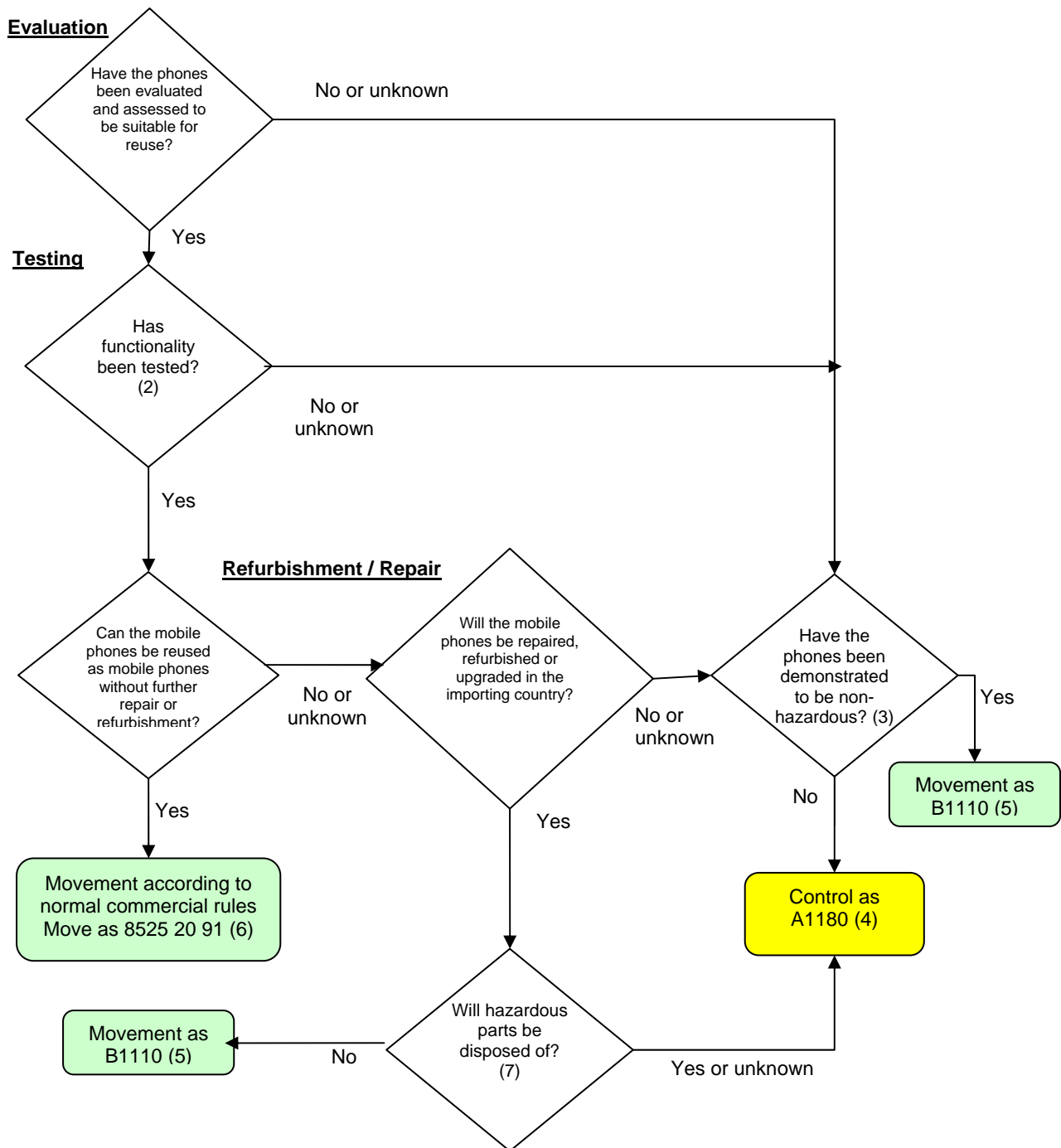
Voluntary notification procedure

1. In cases where used mobile phones are sent regularly to the same repair, refurbishment or upgrading facility by the same exporter, and if there is no existing agreement between the exporter and the government authorities (importing and exporting countries), the exporter will provide a Statement of Evaluation and Intent to Reuse ("the Statement") to the Governmental Authorities⁴⁵ of the countries of export and import, and transit (if any), by means of e-mail, fax or other agreed method, prior to the departure of the shipment from the country of export. One Statement is sufficient for shipments within a defined time period of up to one year, or other time period as agreed by the parties involved.
2. In the case of single shipments of greater than 200 units of used mobile phones, or other quantity as agreed to by the parties involved (especially of trial shipments to a new repair or refurbishment facility), that have been evaluated and assessed to be likely suitable for reuse, the exporter will provide a Statement to the Governmental Authorities of the countries of export and import, and transit (if any), by means of e-mail, fax, or other agreed method, prior to the departure of the shipment from the country of export. In this case, the Statement would substitute an actual count of the shipment for a maximum count.
3. Statements, as described in paragraphs 1 and 2 above, would include the following:
 - (a) A commitment by the exporter that MPPI guidelines will be followed and assurances that such shipments will be managed in an environmentally sound manner;
 - (b) A description of the shipment, in particular, content, maximum count and packaging;
 - (c) An indication of whether the information is for a single shipment or multiple shipments, and estimated frequency at which such shipments are to be exported;
 - (d) An indication of the proposed date of the first and the last shipment during the defined time period;
 - (e) Identification of the ports of export and import;
 - (f) Identification of and contact information (name, address and phone number) for the importer and exporter;
 - (g) A description of the evaluation used to determine that the used mobile phones in the shipment are suitable for reuse, possibly after repair, refurbishment or upgrading;
 - (h) Identification of and contact information (name, address, and phone number) of local persons associated with the importer and exporter who can provide any additional information about the shipment;
 - (i) Information on how residues and wastes arising from repair, refurbishment or upgrading operations will be managed.
4. All phones, individually or in partitioned batches, must be appropriately documented with reference to the aforementioned Statement, or by other suitable method, so that recipients in the importing country are properly informed.
5. The Governmental Authorities should acknowledge by e-mail, fax or other agreed method the receipt of the Statement within the three calendar days, or other agreed time period, and should send that acknowledgement to the States concerned and to the exporter and the importer. After this time period has elapsed, any evidence of effective delivery of the Statement to the Governmental Authorities will be deemed as the acknowledgement date.
6. If the Governmental Authorities have provided authorization or have not responded within 14 calendar days from the acknowledgement date, transboundary movement may commence for the single shipment or the shipments within the period of time defined in the Statement. An updated Statement may be submitted at any time. However:
 - (a) If further information⁴⁶ is requested by the Governmental Authority of the State of export, import or transit, the shipment must not commence until the requested information has been provided;
 - (b) If the response indicates that there is no objection but suggests conditions, then the shipment may commence only after the necessary conditions have been taken into account.
7. The Statement is provided solely for use by the Governmental Authority and is not for disclosure to third parties if the statement is marked as business confidential.
8. The content of this procedure should be reviewed at specific time intervals in order to ensure that the objective of environmentally sound management is upheld and to reflect the knowledge and experience gained, including those from the proposed MPPI pilot projects.

Appendix 4 (b)

Decision tree procedure (1)

Decision tree for transboundary movements of collected used and end-of-life mobile phones (1)

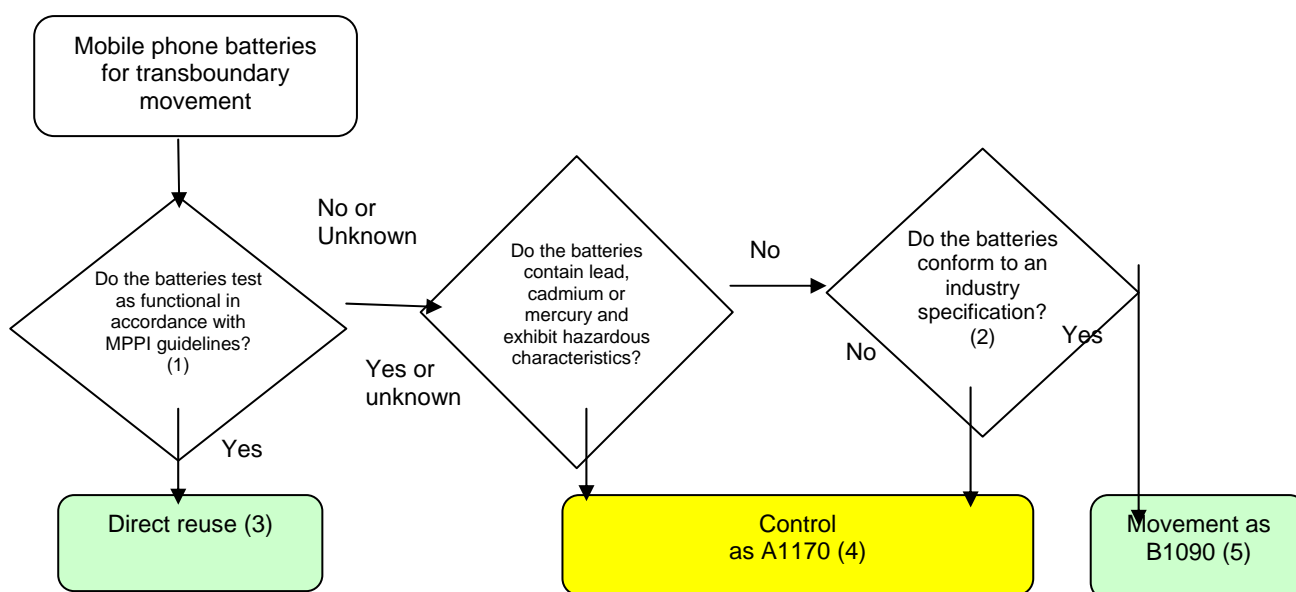


No. Further recommendations and explanations

- (1) Movement within OECD or European Union countries, subject to bilateral agreements, or those defined, as products under national legislation may not be subject to this procedure.
- (2) Results of evaluation and/or testing should be available through labelling, serial number referencing, or other suitable methods.
- (3) An end-of-life phone is hazardous if it contains Annex I constituents, unless it can be shown (through testing or other evidence) not to possess an Annex III characteristic. If batteries are present, they should be considered as part of the analysis (see the decision tree on transboundary movement of collected batteries).
- (4) The material should be controlled as hazardous waste under the Basel Convention. The code refers to the Annex VIII category. If one of the States concerned is not a Party, then a valid Article 11 agreement must be in place.
- (5) The material should not be controlled as hazardous waste under the Basel Convention. The code refers to the Annex IX of the Convention. Exporters should nevertheless ensure there are neither export restrictions in place from the country or region of export nor import restrictions from the country of import applicable to these used mobile phones.
- (6) The material should not be considered as a waste, but rather as a commodity. The number refers to the code number of the Harmonized Commodity Description and Coding System. For mobile phones with batteries, those batteries should have been tested as described in the MPPI guidelines to determine whether they can hold an appropriate charge.⁴⁷
- (7) If the repair, refurbishment or upgrading will not be conducted in compliance with the MPPI guidelines or if components or parts of used phones, involved in a transboundary movement, contain Annex I constituents and are expected to be replaced, or otherwise likely to be destined, as a consequence of repair or refurbishment, to go to an Annex IV destination in the importing country, then shipments should be considered as a controlled hazardous waste shipments, unless it can be shown that the components or parts do not exhibit Annex III characteristics. The Governmental Authorities will make a determination as to the appropriate de minimis waste quantities and values (level of contamination) above which Basel Convention controls will be exercised. In Annex IX of the Basel Convention, the waste entry B1110 ("Electrical and electronic assemblies") has two footnotes: 1. "In some countries, these materials (used mobile phones) destined for direct reuse are not considered wastes." 2. "Reuse can include repair, refurbishment or upgrading, but not major reassembly" in the importing country.

Shipments by individual customers of their own mobile phones destined for repair or refurbishment (e.g., under warranty) and intended to be returned to them; and defective batches of mobile phones sent back to the producer (e.g., under warranty) are to be considered as not falling within the scope of this procedure and of the Basel Convention.

Decision tree for transboundary movements of collected mobile phone batteries



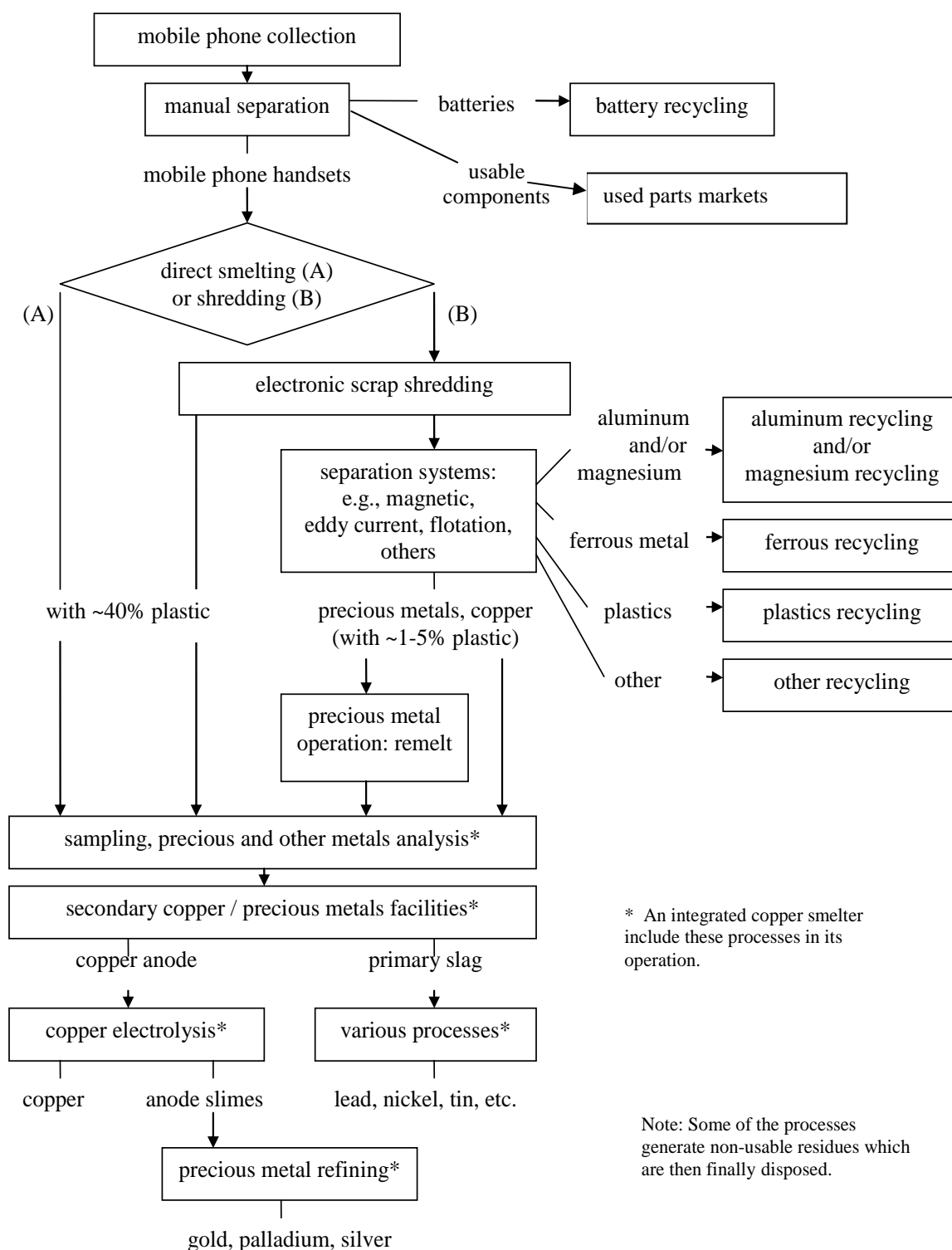
No.	Further recommendations and explanations
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- | | |
|-----|--|
| (1) | In order to determine whether a battery should be considered suitable for reuse and be considered non-waste it should be tested as described in the MPPI guidelines to determine whether it can hold an appropriate charge. ⁴⁸ |
| (2) | All mobile phone battery shipments should be sorted and/or pre-treated to meet appropriate national or internationally recognized specifications. |
| (3) | If the battery has been tested, as described in the MPPI guidelines, to determine whether it can hold an appropriate charge and has passed, ⁴⁹ then it is considered a commodity and not a waste. |
| (4) | If the battery shipment does not meet the conditions of not containing lead, cadmium or mercury and does not conform to appropriate national or internationally recognized specifications, it should be controlled under the Basel Convention. The number here refers to Basel Convention Annex VIII hazardous waste category. If one of the States concerned is not a Party then a valid Article 11 agreement must be in place. |
| (5) | The number here refers to the Basel Convention Annex IX hazardous waste category. Exporters must nevertheless ensure there are neither export restrictions in place from the country or region of export nor import restrictions from the country of import applicable to that Annex IX category. |

The content of this decision tree procedure should be reviewed at specific time intervals in order to ensure that the objective of environmentally sound management is upheld to reflect the knowledge and experience gained, including those from the proposed MPPI pilot projects.

Appendix 5

Recovery of precious metals and other materials from mobile phones



Appendix 6

General material recovery and recycling facility guidelines⁵⁰

1. Mobile phones and their accessories will generally be treated by facilities that engage in raw material recovery and will thus require a higher degree of governmental environmental oversight in accordance with the environmental risks associated with their processing systems. Environmental management systems become an important aspect of these operating facilities.

Environmental management system

2. The material recovery and recycling facility should possess and maintain a documented environmental management system to ensure adequate control over impact on the environment. The environmental management system may include, but is not limited to, ISO 14001 certified management systems.

3. The system should also incorporate record-keeping of shipping documents, bills of lading and chain-of-custody information in the form of audits on material destined for downstream markets.

4. The facility should operate pursuant to written standards or procedures regarding operating methods for the plant and equipment, systems for management, control of site activities, site safety rules and requirements and methods for ensuring observation and monitoring (i.e., an overall operating, systems and safety manual).

Licensing/permits

5. The facility must comply with all applicable environmental regulations (international, federal, provincial and municipal).

6. Material recovery and recycling facilities should be licensed by all appropriate governmental authorities. Specific permits required could include the following: storage permits, air emissions permits, water permits, hazardous waste permits and those required to meet landfill and other disposal regulations. Processes should be in place to ensure continued compliance with the requirements of the permits.

7. Licensing and permits should:

- Require that facilities operate according to best available technologies, while taking into consideration the technical, operational and economic feasibility of doing so.
- Be consistent with governmental, regional and local regulatory requirements.
- Address facility operation, workers' health and safety, control of emissions to air, land and water and waste management.
- Describe and authorize specific facility capacities, processes and potential exposures.

Monitoring and record-keeping

8. Material recovery and recycling facilities should develop adequate monitoring, recording and reporting programs. Such programs should be maintained to track:

- Key process parameters.
- Hygiene-risk elements such as beryllium.
- Compliance with applicable regulations.
- Generation of any emissions or effluents.
- Movement and storage of waste, especially hazardous waste.

9. The facility should have adequate record-keeping systems to ensure compliance: records of employee training, including health and safety, manifests, bills of lading and chain-of-custody of all materials, emergency response plans, closure plans in case a plant or operation closes, record-keeping policies, fire prevention and suppression procedures, equipment failure backup plan, and security plans.

Emergency planning

10. The facility should have a regularly updated emergency plan that provides guidelines on how to react to emergencies such as fires, explosions, accidents, unexpected emissions and weather-related emergencies (e.g., tornadoes and hurricanes). The emergency plan should also indicate what reporting and monitoring is required in specific instances.

11. The plan should be communicated to the local emergency response authorities.

Occupational health and safety (best practices to ensure workers' safety)

12. The facility must comply with all applicable health and safety regulations (federal, provincial/state and industry standards). The facility must ensure occupational health and safety of employees by:

- Providing continuous health and safety training of personnel.
- Providing ergonomic work areas with safe and effective tools.
- Avoiding heavy lifting where possible and training employees to lift in a safe manner. In some cases lifting tools may be required.
- Making available and enforcing the use of personal protection equipment.
- Labelling all hazardous materials.
- Safeguarding dangerous mechanical processes.
- Avoiding exposure to unacceptable occupational risks such as airborne dust and fumes through the use of process dust collection systems.
- Periodic air monitoring to monitor elements of risk including but not limited to lead, cadmium and beryllium.
- Providing process fire suppression equipment and systems where appropriate.
- Considering policies that prohibit eating food or smoking in process areas.
- Providing for worker health benefits or insurance and long-term disability and death benefits.
- Providing liability compensation for accidents.
- Encourage the development and implementation of an environmental liability regime for recycling facilities to prevent environmental damage.

Personal protective equipment

13. Plant personnel should be provided with appropriate Personal Protective Equipment (PPE) to ensure employee safety. The level of PPE required will depend on the level of potential risk to which the employee is exposed and the type of equipment with which the employee works:

- **Eye protection:** Safety glasses should be worn to prevent eye injuries. Eye washing stations should be available in areas easily accessible by employees and as regulated by local legislation.
- **Head protection:** Hard hats may be required in certain areas, such as in proximity to overhead racks and around automatic dismantling machines and smelting furnaces.
- **Hand protection:** When opening boxes, using safety knives, handling sharp objects or using pallet jacks, gloves may be required. When manually dismantling material or handling chemicals, gloves should be also be worn. Gloves help protect hands from cuts, scrapes, chemical burns and infection by blood-borne pathogens.
- **Skin protection:** In certain conditions, such as working in proximity to furnaces, chemical equipment and some types of automated equipment, a fire-resistant work smock may be necessary to protect exposed skin from burns or chemicals.
- **Foot protection:** Steel-toed shoes should be worn to prevent foot injuries from falling objects, pallet jacks, chemical spills, etc.
- **Hearing protection:** Earplugs should be worn in work areas where prolonged noise exposure would lead to hearing damage.
- **Respiratory protection:** Dust masks or face masks should be worn in areas where there is a risk of dust inhalation.

Employee training

14. The facility should provide employees with periodic training to safeguard the occupational health and safety of the employee. The training should address safe work practices, required safety precautions and required personal protective equipment. Employees should be trained in the proper identification and handling of any hazardous

material that may be present in incoming material. Training should be documented, recorded and updated as conditions merit.

Financial guarantees

15. Material recovery and recycling facilities should establish an appropriate plan for closure and aftercare which ensures that the financial means for such closure are available. A financial instrument should be maintained that will ensure that the facility is properly cleaned up in the event:

- Of major pollutant releases or gross mismanagement of end-of-life electronics equipment, components, and scrap.
- Of closure of the facility.

Appendix 7

Endnotes

- 1 MPPI Project Group 4.1A, Report on Awareness Raising and Training on Environmental Design issues, 2004.
- 2 Nokia Mobile Phones, presentation at IEEE Symposium, Electronics and Environment, Boston, United States of America, 21 May 2003.
- 3 <http://www.motorola.com/testservices/article1.htm>
- 4 <http://www.fuelcellworks.com/Suppage2196.html>
- 5 OECD Environment Directorate, Key Environmental Indicators, 2001.
- 6 *Environment for Europeans*, magazine of the Environment Directorate-General, “E-waste meets its maker”, 2005.
- 7 Swiss Association for Information, Communications and Organization Technology (SWICO) Environmental and Energy Commission, Activity Report, 2002. Electronic waste collected in 2002 was 23,769 tonnes (23,893 reported, less 124 from photo and graphics), of which 29 tonnes (0.12%) was mobile phones. Similar data for Finland from 2000 shows 160,000 tonnes of WEEE collected; mobile phones represented 0.06% by weight.
- 8 See note 4.
- 9 Strategy Analytics, Worldwide Wireless Subscriber Forecasts (2003–2008), April 2003: “The worldwide cellular user base will increase from 1.07 billion at the end of 2002 to 1.87 billion by the end of 2008”.
- 10 http://www.gsmworld.com/newsroom/market-data/market_data_summary.htm
- 11 UNEP, “E-waste, the hidden side of IT equipment’s manufacturing and use”, Jan. 2005. The time of use of a mobile phone varies from person to person, country to country, and there is no consensus on the global data. J.D. Power and Associates has reported that the average life of the mobile phone in the hands of the first user is about 1.5 years, 2002 *U.S. Wireless Mobile Phone Evaluation Study*, Press Release, 24 October 2002. Carl H. Marcussen reported upon a study, *Mobile Phones, WAP, and the Internet*, that economic life was 31 months in 2002, 33 months in 2003. INFORM, Inc., found that economics was a factor – in poorer countries, where cost is a greater factor, the first use is about 2.5 years; in developed countries, it can be one year. www.informinc.org/wirelesswaste.php.
- 12 Uryu T., Yoshinaga J., Yanagisawa Y., 2003. Environmental fate of gallium arsenide: semiconductor disposal. A case study of mobile phones. *Journal of Industrial Ecology*.
- 13 Basel Convention Article 2, paragraph 8.
- 14 www.basel.int/meetings/cop/cop5/ministerfinal.htm.
- 15 Strategic Plan for the implementation of the Basel Convention (to 2010), www.basel.int.
- 16 See UNEP/CHW/OEWG/1/INF/17, 15 April 2003.
- 17 MPPI project group 4.1A, Report on Awareness Raising and Training on Environmental Design issues, 2004.
- 18 Directive 2002/95/EC.
- 19 Decabrominated biphenyl ether is still under study. Directive, annex, para. 10.
- 20 View of the MPPI industry members
- 21 Murphy, Cynthia F. and Pitts, Gregory E., *Alternatives to Tin-Lead Solder and Brominated Flame Retardants*, IEEE Symposium on Electronics and the Environment, 2001, pp. 309–315: “[T]here has been a growing body of research in the past four years centred on the investigation of lead-free solder alternatives.”
- 22 Nicolaescu, Ion V. and Hoffman, William F., *Energy Consumption of Cellular Phones*, IEEE Symposium on Electronics and the Environment, 2001, pp. 134–138.
- 23 The mobile take-back-scheme in the United Kingdom reported collecting 9 tonnes of mobile phones from 1999 to 2001 and 16 tonnes of accessories over the same period. www.mobiletakeback.co.uk/.
- 24 http://ec.europa.eu/enterprise/sectors/rtte/files/chargers/chargers_mou_en.pdf
- 25 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:093:0003:0010:en:PDF>
- 26 See note 2.
- 27 http://www.blauer-engel.de/de/produkte_marken/produktsuche/produkttyp.php?id=166
- 28 MPPI project group 2.1.
- 29 Such determination should be made through Parties’ obligations as per Articles 3 and 13 of the Basel Convention. Each Party has the obligation to inform each other, through the Basel Secretariat, of their national definitions and of any subsequent changes, which includes any additional substances and/or objects as wastes and hazardous wastes.
- 30 Ibid.
- 31 Ibid.

- 32 Consistent with the collection guidelines.
- 33 Reuse: a process of using again a used mobile phone or a functional component from a used mobile phone, possibly after repair, refurbishment or upgrading (from the MPPI glossary of terms).
- 34 MPPI project group 1.1, Guidance Document for the Refurbishment of Used Mobile Phones, 2004.
- 35 Appropriate charge, according to refurbishment and battery recycling industry, is 80 per cent. Once the battery has been charged (either through the phone it accompanies, or by using commercial charging and measuring equipment), it should be tested with a voltmeter to determine whether or not the battery is functional and holds an 80 per cent charge. Another criterion to check batteries is to check for the proper functioning of the internal protection circuit, which protects the lithium--Ion cell from operating outside the recommended ranges. This protection circuit is included inside all OEM manufactured batteries and minimizes the possibility of any type of cell meltdown or explosion. This will ensure good value for the customer and help ensure that importing countries do not end up with unsafe or short-life batteries.
- 36 MPPI project group 3.1, Guidelines on Recovery and Recycling of End-of-Life Mobile Phones, 2004.
- 37 Precious metals in the circuit boards are contained not only in metallic alloys (contacts, solders, etc.), but also in ceramics (ICs, Multi Layer Capacitors) and plastic parts or resins (coatings on the PWB, interboard layers etc.).
- 38 MPPI project group 3.1, Guidelines on Recovery and Recycling of End-of-Life Mobile Phones, 2004.
- 39 Ibid.
- 40 Environment Australia, Hazard Status of Waste Electrical and Electronic Assemblies or Scrap, Guidance Paper, October 1999, paragraph 46.
- 41 “When released to land, lead binds to soils and does not migrate to ground water. In water, it binds to sediments. It does not accumulate in fish, but does in some shellfish, such as mussels.” US EPA, National Primary Drinking Water Regulations, Consumer Fact Sheet on Lead.
- 42 Stewart, E. and Lemieux, P., *Emissions from the Incineration of Electronic Industry Waste*, IEEE Symposium on Electronics and the Environment, 2003, pp. 271–275. This paper describes experiments by the US EPA using controlled combustion but with inadequate afterburner capacity and no other emission controls.
- 43 Institute on Techniques of Production and Automation (IPA), Stuttgart.
- 44 For more details see section 4.4.5 of the MPPI Project Group Guidelines on Recovery and Recycling of End-of-Life Mobile Phones.
- 45 Governmental Authority means a governmental authority designated by a Party or Signatory to be responsible within such geographical area under the legal jurisdiction of the Party or Signatory as the Party or Signatory deems appropriate for implementing relevant rules and regulations and to receive information related to transboundary shipments of used mobile phones destined for reuse, possibly after repair, refurbishment or upgrading.
- 46 The request for such information may indicate that more stringent provisions are to be applied, like those of the Basel Convention.
- 47 “Appropriate charge”, according to the refurbishment and battery recycling industry, is 80% once the battery has been charged (either through the phone it accompanies, or by using commercial charging and measuring equipment), it should be tested with a voltmeter to determine whether or not it is functional and can hold an 80% charge. Another criterion for checking batteries is whether the internal protection circuit which protects the lithium-ion cell from operating outside the recommended ranges is functioning properly. This protection circuit is included in all OEM-manufactured batteries and minimizes the possibility of cell meltdown or explosion. Checking the appropriate charge and internal protection circuit criteria will help ensure that the customer gets good value and that importing countries do not receive short-lived batteries.
- 48 Ibid.
- 49 Ibid.
- 50 MPPI project group 3.1, Guidelines on Recovery and Recycling of End-of-Life Mobile Phones, 2004.
-