United Nations Environment Programme

UNEP/CHW.11/CRP.19/Add.1
5 May 2013

English only

Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
Eleventh meeting
Geneva, 28 April–10 May 2013
Agenda item 4 (e) (i)

Matters related to the implementation of the Convention: international cooperation, coordination and partnerships: Basel Convention Partnership Programme

Draft decision BC-11/[ ]: Partnership for Action on Computing Equipment

Submission by the contact group on technical matters

Addendum

Note by the Secretariat

The annex to the present note sets out the final version of the revised guidance document on the environmentally sound management of used and end-of-life computing equipment as adopted and submitted by the contact group on technical matters. The submission has been reproduced as received, without formal editing.

Annex

Basel Convention

Partnership for Action on Computing Equipment (PACE)

Guidance document on the environmentally sound management of used and end-of-life computing equipment

Approved by the PACE Working Group
Revised version: 4 May 2013

Acknowledgements

The efforts of the PACE Working Group in the preparation of this document and of individual PACE project groups in the preparation of reports and guidelines are appreciated. Members of the Working Group are identified on pages 4 and 5 of this document.

In addition, special thanks are extended to the Co-Chairs of the PACE Working Group: Marco Buletti, Federal Office for the Environment, Switzerland; Oladele Osibanjo, Basel Convention Coordinating Centre for the African Region-Nigeria; and the chairs of the various project groups: Michael VanderPol, Environment Canada; Ross Bartley, Bureau of International Recycling; Andy Howarth, United Kingdom Department of Environment, Food and Rural Affairs; Willie Cade, PC Rebuilders and Recyclers; Isabelle Baudin, Switzerland; Joachim Wuttke, Federal Environment Agency, Germany; John Bullock; Renee St. Denis, Sims Recycling Solutions; Patricia Whiting, United States Environmental Protection Agency; Aisha Mahmood, Federal Ministry of Environment, Nigeria; Miguel Araujo, Basel Convention Regional Centre-Central America and Mexico; and Yorg Aerts, Public Waste Agency of Flanders Belgium.

The guidance document, excluding section 3, was adopted, via decision BC-10/20, by the Conference of the Parties to the Basel Convention at its tenth meeting, held in Cartagena, Colombia, from 17 to 21 October 2011. This guidance document, excluding sections 2 and 3, was revised based on changes made to individual guidelines, which have been reviewed to reflect the practical situation. This revised guidance document, excluding section 3, was adopted, via decision BC-11/[], by the Conference of the Parties to the Basel Convention at its eleventh meeting, held in Geneva, from 28 April to 10 May 2013. The guidance document is not legally binding.

The Basel Convention Secretariat would like to express its appreciation to the following companies that were involved in evaluating the guidelines: American Retroworks Inc., United States of America; City Waste Management Company Limited, Ghana; Evcilerkimya, Turkey; Galloometal, Belgium; HP Service Center, Nigeria; InterConnection, United States of America; RDC, United Kingdom of Great Britain and Northern Ireland; R&R Center, El Salvador; Reclaimed Appliances Limited, United Kingdom of Great Britain and Northern Ireland; Recycling Facility, Serbia; Sims Recycling Solutions, India; TES-AMM, Malaysia; Umicore, Belgium; WeRecycle, United States of America; and to all project group chairs who ensured changes have been properly reflected in respective guidelines.

Gratitude is expressed to the Governments of Canada, Germany, Japan, Norway, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America, in addition to industry and non-governmental organizations for supporting PACE financially. Voluntary financial contributions from these countries and organizations made it possible to complete the guidance document and individual project guidelines and to prepare for pilot projects in developing countries and countries with economies in transition.

Finally the PACE Working Group would like to express its deep sadness at the passing of Mr. John Myslicki. John contributed immensely to the work of PACE in general and for the preparation of this guidance document in particular. We have lost a friend and a colleague who always worked towards protecting the environment. His enthusiasm was and remains an inspiration for us to continue this work.

Contents

		Page
1.	Introduction	6
1.1	**Purpose of the guidance document**	**6**
1.2	**Contents**	**6**
1.3	**General provisions of the Basel Convention**	**6**
1.4	**Why computing equipment was selected for the second partnership**	**7**
1.5	**Partnership for Action on Computing Equipment (PACE)**	**9**
2	Environmentally sound management criteria recommendations	13
2.1	**Summary**	**13**
2.2	**Recommendations**	**14**
3	Transboundary movement of used and end-of-life computing equipment	17
3.1	**Summary**	**17**
3.2	**Recommendations**	**18**
4	Testing, refurbishment and repair of used computing equipment	20
4.1	**Summary**	**20**
4.2	**Recommendations**	**20**
5	Material recovery and recycling of end-of-life computing equipment	22
5.1	**Summary**	**22**
5.2	**Recommendations**	**24**
Appendices		
Appendix 1:	**Glossary of terms**	**27**
Appendix 2:	**Basel Convention-Annex IV Disposal Operations**	**30**
Appendix 3:	**Packaging guidelines**	**32**
Appendix 4(a):	**Voluntary notification procedure**	**33**
Appendix 4(b):	**Decision tree procedure**	**35**
Appendix 5:	**Functionality tests for used computing equipment**	**38**
Appendix 6:	**Testing methods for laptop batteries**	**40**
Appendix 7:	Declaration of testing and determination of full functionality and reuse destination of exported used computing equipment	**41**
Appendix 8:	Information accompanying shipments of computing equipment returned under warranty or otherwise excluded from control procedures	**42**
Appendix 9:	Flow diagram of a typical environmentally sound refurbishment and repair process	**43**
Appendix 10:	Donations	**45**
Appendix 11:	Flow diagram of environmentally sound management of used computing equipment	**46**
Appendix 12:	Facility measures to support environmentally sound management	**48**
Appendix 13:	References	**50**
Appendix 14:	Endnotes	**53**
Figure:	Personal computer (PC) sales and projections by regions	**8**

PACE Working Group participants

The following members contributed to the work of the PACE Working Group:

Co-Chairs

1. Mr. Marco Buletti, Federal Office for the Environment, Switzerland.
2. Mr. Oladele Osibanjo, Basel Convention Coordinating Centre for the African Region-Nigeria.

Participants

3. Mr. Aboejoewono Aboeprajitno, Basel Convention Regional Centre-Indonesia.
4. Mr. Adrian Tan, TES-AMM (Singapore) Pte Ltd.
5. Mr. Ahmad A Khan, Basel Convention Regional Centre-Caribbean.
6. Ms. Aisha Mahmood, Federal Ministry of Environment, Nigeria.
7. Mr. Alain Aimé Nyamitwe, Permanent Mission of Burundi, Geneva.
8. Mr. Alberto Santos Capra, Dirección de Residuos Peligrosos, Argentina.
9. Ms. Andrea Allamand, Chile.
10. Mr. Andreas Manhart, Öko-Institute.
11. Mr. Andy Howarth, United Kingdom Department of Environment, Food and Rural Affairs.
12. Ms. Anna Dobrocsyova, Slovakia.
13. Mr. Arab Hoballah, United Nations Environment Programme (UNEP) Division of Technology, Industry and Economics.
14. Mr. Atsushi Terazono, National Institute for Environmental Studies, Japan.
15. Mr. Aya Yoshida, National Institute for Environmental Studies, Japan.
16. Ms. Barbara Toorens, Close the Gap.
17. Ms. Cori Ong, TES-AMM (Singapore) Pte Ltd.
18. Ms. Cynthia Indriani, Basel Convention Regional Centre-Indonesia.
19. Mr. Dadan Wardhana, Secretariat of the Basel Convention.
20. Mr. Damien Scott Hall, Department of the Environment, Water, Heritage and the Arts, Australia.
21. Ms. Dana Lapesová, Basel Convention Regional Centre-Slovakia.
22. Mr. Daniel Rothenfluh, Department of the Environment, Water, Heritage and the Arts, Australia.
23. Mr. David Leyssens, Close the Gap, United Kingdom of Great Britain and Northern Ireland.
24. Mr. David Parker, Oakdene Hollins Centre for Remanufacturing and Re-use.
25. Mr. David Seligson, International Labour Organization.
26. Mr. Diakite Boubacar, focal point for the Basel Convention, Mali.
27. Mr. Dong-Jin Lee, Ministry of Environment, Republic of Korea.
28. Mr. Du Kexiong, Ministry of Environmental Protection, China.
29. Mr. Eric Harris, Institute of Scrap Recycling Industries.
30. Ms. Erica Logan, Information Technology Industry Council.
31. Ms. Fionnuala Walravens, Environmental Investigation Agency.
32. Ms. Francesca Cenni, Secretariat of the Basel Convention.
33. Mr. Guido Sonnenmann, UNEP Division of Technology, Industry and Economics.
34. Ms.Helen Bolton, Ministry for the Environment, New Zealand.
35. Mr. Ibrahim Shafii, Secretariat of the Basel Convention.
36. Ms. Isabelle Baudin, Federal Office for the Environment, Switzerland.
37. Ms. Jacqueline Alvarez, Secretariat of the Stockholm Convention.
38. Mr. James Mulolo, Environmental Management Agency, Zambia.
39. Mr. Jean Claude Salama, Ministry of Environment, Forests and Tourism, Madagascar.
40. Mr. Jean Marie Vianney Minani, Rwanda Environment Management Authority.
41. Mr. Jim Puckett, Basel Action Network.
42. Mr. Jinhui Li, Basel Convention Regional Centre-China.
43. Mr. Joachim Wuttke, Federal Environment Agency, Germany.
44. Mr. John Bullock.
45. Mr. John Myslicki, Consultant, Secretariat of the Basel Convention.
46. Mr. José María Lorenzo Alonso, Secretaría de Medio Ambiente y Recursos Naturales, Mexico.
47. Ms. Julian Newman, Environmental Investigation Agency.
48. Mr. Junya Kikuhara, Asian Network, Japan.
49. Ms. Karen Pollard, United States Environmental Protection Agency.

50. Ms. Katarina Magulova, Secretariat of the Stockholm Convention.
51. Mr. Klaus Tyrkko, United Nations Development Programme.
52. Ms. Laurence Matringe, European Commission.
53. Ms. Leila Devia, Basel Convention Regional Centre-Argentina.
54. Mr. Liu Hao, Basel Convention Regional Centre-China.
55. Mr. Marcos Pimentel, Brazil.
56. Ms. Margareta Appelberg, Swedish Environmental Protection Agency.
57. Ms. Maria Nyholm, Swedish Environmental Protection Agency.
58. Mr. Matthias Kern, Secretariat of the Basel Convention.
59. Ms. Melisa Lim, Secretariat of the Stockholm Convention.
60. Mr. Michael VanderPol, Environment Canada.
61. Mr. Michel Seck, Basel Convention Regional Centre-Senegal.
62. Mr. Michikazu Kojima, Institute of Developing Economies, Japan External Trade Organization, Japan.
63. Mr. Miguel Araujo, Basel Convention Regional Centre-Central America and Mexico.
64. Mr. Mike Watson, Dell Inc.
65. Mr. Mohammed Khashashneh, Ministry of Environment, Jordan.
66. Mr. Mostafa Kamel, Basel Convention Regional Centre-Egypt.
67. Mr. Mushtaq Ahmed Memon, UNEP International Environmental Technology Centre.
68. Mr. Ole Thomas Thommesen, Climate and Pollution Agency, Norway.
69. Ms. Olena Nazarchuk, Ministry of Environmental Protection, Ukraine.
70. Mr. Olivier Vanden Eynde, Close the Gap, United Kingdom.
71. Mr. Oludayo Dada, Federal Ministry of Environment, Nigeria.
72. Ms. Patricia Whiting, United States Environmental Protection Agency.
73. Mr. Paul Hagen, Information Technology Industry Council.
74. Mr. Ramkripal Pandey, TES-AMM (Singapore) Pte Ltd.
75. Ms. Renee St. Denis, Sims Recycling Solutions.
76. Mr. Rick Goss, Information Technology Industry Council.
77. Mr. Ross Bartley, Bureau of International Recycling.
78. Mr. Ruediger Kuehr, United Nations University.
79. Ms. Ruth A Etzel, World Health Organization.
80. Ms. Saki Hikosaka, Ministry of Environment, Japan.
81. Ms. Sanaz Sabeti Mohammadi, Basel Convention Regional Centre-Tehran.
82. Ms. Sarah Westervelt, Basel Action Network.
83. Ms. Semde Idrissa, Ministry of Environment, Burkina Faso.
84. Ms. Shiromi Karunaratne, University of Moratuwa, Sri Lanka.
85. Mr. Shiri Garakami, Basel Convention Regional Centre-Tehran.
86. Mr. Shunichi Honda, Ministry of Environment, Japan.
87. Mr. Sookjin Lee, Korea Environment Corporation.
88. Mr. Soroush Modabberi, Basel Convention Regional Centre-Tehran.
89. Mr. Taelo Letsela, Basel Convention Regional Centre-South Africa.
90. Ms. Tatiana Terekhova, Secretariat of the Basel Convention.
91. Mr. Theo Lehner, Boliden Mineral AB.
92. Mr. Thomas Poelmans, Close the Gap.
93. Mr. Thorsten Brunzema, European Commission.
94. Mr. Wei-Chin Huang, Institute of Environment and Resources.
95. Ms. Wen-Ling Chiu, Institute of Environment and Resources.
96. Mr. Willie Cade, PC Rebuilders and Recyclers.
97. Mr. Yondeok Kim, Korea Environment Corporation.
98. Mr. Yorg Aerts, OVAM, Belgium.

1. Introduction

1.1 Purpose of the guidance document

1.1.1 The objective of the present document is to provide guidance on the environmentally sound management (ESM) of used and end-of-life computing equipment. The document emphasizes reuse and recycling, with the aim of avoiding the final disposal of such used and end-of life products in final-disposal facilities such as landfills or incinerators.

1.1.2 To this end, the present document provides general guidance pertaining to the environmentally sound management of used computing equipment that may not be waste and end-of-life computing equipment that is waste and addresses such matters as ESM criteria; transboundary movement procedures; testing, refurbishment and repair; and material recovery and recycling.

1.1.3 The document complements guidelines prepared by various project groups and approved by the PACE Working Group. It summarizes the information provided in the report prepared by the ad interim project group on environmentally sound management criteria recommendations, the guidance document prepared by the subgroup on transboundary movement and guidelines prepared by project groups 1.1 (environmentally sound testing, refurbishment and repair of used computing equipment) and 2.1 (environmentally sound material recovery and recycling of end-of-life computing equipment).

1.1.4 Together with the report on ESM criteria recommendations, individual project guidelines and procedures for transboundary movement, the document is intended to be used to raise awareness and further the implementation of best-practices associated with various stages of the ESM of used and end-of-life computing equipment. The information provided can be used to transfer current know-how on the refurbishment and repair of used computing equipment and best practices for material recovery and recycling. The document therefore provides a foundation for a training programme (e.g., in the form of workshops) aimed at helping to implement the recommendations and actions developed by the project groups established under PACE. The material found in the document can also be used by Basel Convention regional centres in developing training materials on the topics that it covers.

1.2 Contents

1.2.1 The document reproduces relevant general provisions of the Basel Convention and provides background information on computing equipment and PACE, executive summaries and recommendations from reports, guidelines and their relevant appendices pertaining to ESM criteria recommendations, procedures for transboundary movement, testing, refurbishment and repair and material recovery and recycling.

1.2.2 Throughout the document, references to Annex I, II, III or IV refer to the annexes to the Basel Convention.

1.3 General provisions of the Basel Convention

1.3.1 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. It emphasizes, among other principles, the 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 includes a number of specific objectives, which are obligations for parties, including the following:

a) Reduction of transboundary movements of hazardous and other wastes subject to the Convention;

b) Prevention and minimization of the generation of hazardous wastes;

c) Active cooperation, subject to parties' national laws, regulations, and policies, in the use and transfer of cleaner technology and management systems related to the environmentally sound management of hazardous wastes and other wastes.

1.3.2 These objectives are supported by a regulatory system for the monitoring and control of hazardous wastes set forth in the Convention. Some key elements of the regulatory system are: prior notification and informed consent; prohibition of exports to countries that are not parties to the Convention; provisions governing the duty to reimport; and provisions governing the responsibilities of parties involved in transboundary movements. One obligation of the State of export is to provide advance notification to and obtain consent 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 on their territory.

1.3.3 Countries of export and import are required to assure themselves that wastes destined for disposal (which includes recycling and final disposal) 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 to be transported must be appropriately packaged and labelled, as required by international transport rules such as the United Nations Recommendations on the Transport of Dangerous Goods: Model Regulations.[i]

1.3.4 Article 11 of the Convention pertains to bilateral, multilateral and regional agreements or arrangements regarding the transboundary movement of wastes. Under Articles 4(5) and 11, parties to the Convention may not trade in hazardous wastes destined for disposal with non-parties unless there is an agreement or arrangement of the kind contemplated by Article 11. Under paragraph 1 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 "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. Under paragraph 2 of the same article, the provisions of the Convention shall not affect transboundary movements which take place pursuant to such agreements provided that such agreements are compatible with the environmentally sound management of hazardous wastes and other wastes as required by the Convention.

1.3.5 Article 11 agreements or arrangements should therefore 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 to countries that have prohibited such imports; shipments only by authorized persons; alternate measures for stranded shipments; and the use of tracking documents (in accordance with the annex to decision II/10). A list of recognized Article 11 agreements and arrangements can be found on the Convention website at: http://www.basel.int/article11/multi.html.

1.4 Why computer equipment was selected for the second partnership under the Convention

1.4.1 Computing equipment was selected for the second partnership under the Convention because:

a) People in all countries can relate to this high-visibility product;

b) The technology has global application;

c) Recovery of computing equipment is a highly topical issue;

d) Mismanagement of used and end-of-life computing equipment may pose risks to public health, worker safety and the environment;

e) There are a limited number of computing equipment manufacturers, as compared to all electrical and electronic products, facilitating consensus-based project management.

1.4.2 Over the past three decades, people worldwide have rapidly gained access to computer technology, representing important progress towards the achievement of the Millennium Development Goal[ii] of making available the benefits of new technologies, especially those related to information and communications. As markets continue to expand and more communities gain access to information technology, many countries, especially developing countries and countries with economies in transition, enjoy the benefits of these new technologies but also face new challenges in managing used and end-of-life computing equipment and other electronic products.

1.4.3 All stakeholders have a role in promoting the environmentally sound management of used and end-of-life computing equipment. The technology and skills needed to ensure the proper management of such equipment are available, including in respect of proper refurbishment and repair, which can provide employment and extend the use of valuable equipment, making it available to the people of less-developed countries. Furthermore, those products that cannot be reused can be directed to environmentally sound material recovery and recycling, either domestically or in other countries that can reclaim base and precious metals, adequately treat problematic substances and conserve resources and energy.

1.4.4 From the figure below it can be seen that personal computer (PC) sales have increased significantly in all regions from 2000 to 2010, a trend that is expected to continue at least until 2014. Total units sold globally (calculated by adding up sales from all regions for the years in question) increased from some 170 million in 2000 to around 370 million in 2010. It is projected that total sales globally in 2014 will reach an estimated 470 million units. Sales have more than doubled in the past 10 years, with the largest growth seen in Asia.

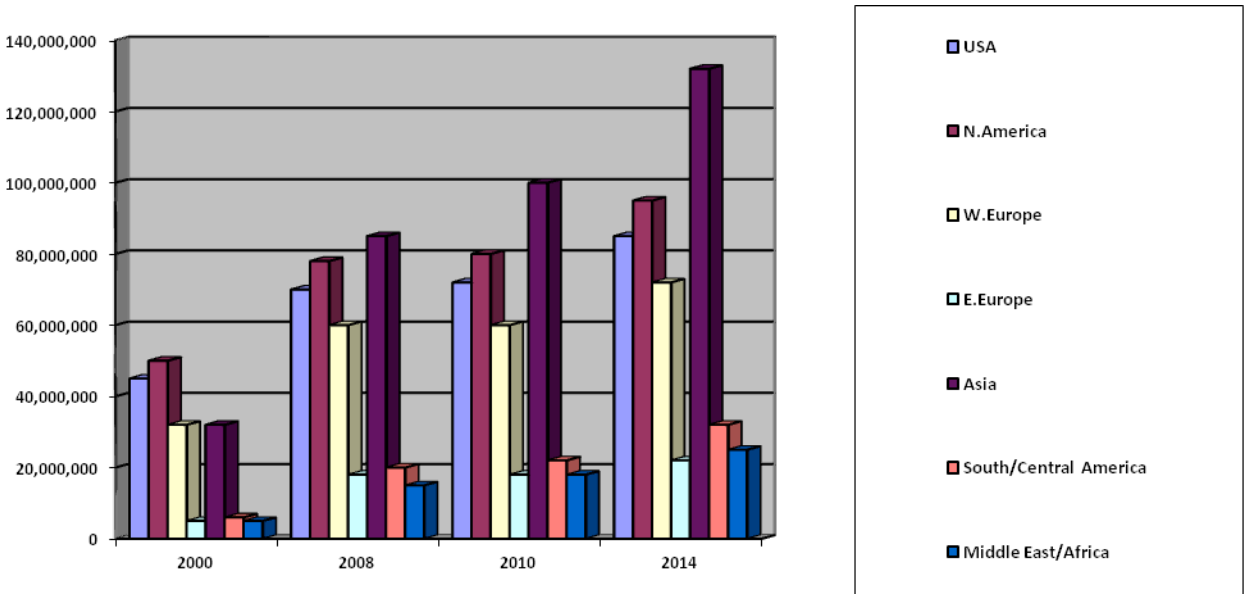


Figure: PC sales and projections by region[iii]

1.4.5 With this growth, it should be remembered that all PCs will eventually be replaced, sooner rather than later in many industrialized countries. PCs are often replaced before they become obsolete or cease working. The United Nations Environment Programme (UNEP) has found that PCs generally have a first-use span of less than four years before they are replaced by new ones because their owners want newer models with more or newer features. As a result of growth in PC sales, second-hand products are available for refurbishment and reuse, or recycling upon becoming electronic and electrical waste (e-waste) at the end of their lives. According to UNEP,[iv] some 20–50 million tons of e-waste are generated worldwide every year, comprising more than 5 per cent of all municipal solid waste. When the millions of computers purchased around the world every year become obsolete, those that are not managed in an environmentally sound manner leave behind lead, cadmium, mercury and other hazardous substances, which have an impact on the environment.

1.4.6 In addition, according to the United States Environmental Protection Agency,[iv] while it is not a large part of the waste stream, e-waste is growing faster than any other category of municipal waste. Overall, between 2005 and 2006, the total volume of municipal waste increased by only 1.2 per cent, compared to 8.6 per cent for e-waste. This shows that personal computers should not be neglected at the end of their lives. They can be refurbished, repaired and reused, or sent to environmentally sound material recovery and recycling facilities where various materials can be recovered and recycled to manufacture new products.

1.4.7 It should also be recognized that fast-growing markets for used and refurbished computing equipment exist in many developing countries, where such equipment is frequently shipped to meet this rising demand. At the same time, in many developing countries and countries with economies in transition there exists an informal sector for the collection, repair, refurbishment and re-use of used and end-of-life computing equipment and the recovery of materials such as copper and gold from e-waste. Material recovery operations in this informal sector are unfortunately not always safe and/or environmentally sound, with the result that highly risky operations expose people to hazardous substances. Furthermore, studies have shown that workers in the informal sector often lack the necessary education and training properly to manage the collection, refurbishment, repair and recovery of materials in an environmentally sound manner. Lastly, most developing countries lack the basic infrastructure and industrial capacity to

recycle end-of-life computing equipment in an environmentally sound manner and must therefore rely on facilities outside their borders.

1.5 Partnership for Action on Computing Equipment

1.5.1 The Partnership for Action on Computing Equipment (PACE) was launched by the Conference of the Parties to the Basel Convention at its ninth meeting, in Bali, Indonesia, in June 2008. PACE is a multi-stakeholder public-private partnership under the umbrella of the Basel Convention that provides a forum for representatives of PC manufacturers, recyclers, international organizations, associations, academic institutions, environmental groups and Governments to tackle the environmentally sound refurbishment, repair, material recovery, recycling and disposal of used and end-of-life computing equipment. PACE is intended to increase the environmentally sound management of used and end-of-life computing equipment, taking into account, among other things, social responsibility, the concept of sustainable development and information-sharing on life-cycle thinking.

1.5.2 For the purpose of PACE, computing equipment is defined as: PCs and associated displays, printers and peripherals; personal desktop computers, including their central processing units (CPUs) and all other parts contained in them; personal notebooks and laptop computers, including docking stations, CPUs and all other parts contained in the computers; computer monitors, including cathode ray tube, liquid crystal display and plasma monitors; computer keyboards, mice and cables; computer printers, including dot matrix, inkjet, laser and thermal printers and any computer printer with scanning or facsimile capabilities, or both.

1.5.3 Some examples of computing equipment follow:

a) CPU and personal desktop computer;

b) Monitor or display;

c) Keyboard and mouse;

d) Printer and scanner.

1.5.4 PACE aims to provide new and innovative approaches to emerging issues. It is also designed:

a) To promote sustainable development in developing countries and countries with economies in transition through the continued use, refurbishment and repair of used computing equipment;
b) To find incentives and methods for diverting end-of-life computing equipment from land disposal and burning to environmentally sound commercial material recovery or recycling operations;
c) To develop guidelines for proper refurbishing, repair and material recovery or recycling, including criteria for testing, labelling of refurbished used equipment and certification of environmentally sound repair, refurbishing and recycling facilities;
d) To end shipments of used and end-of-life computing equipment to countries, in particular developing countries and countries with economies in transition, whose laws prohibit the import of such equipment.

1.5.5 PACE activities include launching pilot demonstration projects to assist developing countries and countries with economies in transition in assessing and improving the management of used and end-of-life computing equipment, raising awareness of PACE and initiating training activities to achieve PACE and Basel Convention objectives.

1.5.6 The PACE Working Group, established by the Conference of the Parties in its decision IX/9, is the operating mechanism for PACE and serves as a forum for sharing information. Members of the Working Group include parties and signatories to the Basel Convention; intergovernmental and non-governmental organizations; Basel Convention regional and coordinating centres for capacity-building and technology transfer; and other stakeholders including: manufacturers, recyclers, refurbishers, industrial associations and academic institutions that have specific expertise and experience required for the activities of this group.

1.5.7 Following its establishment, the PACE Working Group discussed its tasks, developed its terms of reference and decided to set up five project groups and two subgroups to carry out its work programme, with the following objectives:

Ad interim project group on ESM criteria

The objectives of the ad interim project group were:

a) To identify relevant existing international, country-specific, industry and other ESM guidance material that could be used to support other project groups established under the PACE Working Group;

b) To propose recommendations[v] for ESM core criteria for use by PACE project groups in developing guidelines or launching pilot projects. Subsets of criteria for specific operations might also be developed by this project group where required.

Project group 1.1 on environmentally sound refurbishment and repair of used computing equipment

The objective of the project group was to develop tools (such as guidelines) and activities on environmentally sound refurbishment and repair, including criteria for testing, certification and labelling. The project group was to cooperate and coordinate with other PACE project groups working on ESM principles, recycling standards and pilot projects.

Project group 2.1 on environmentally sound material recovery and recycling of end-of-life computing equipment

The objective of the project group was identified as to recognize risks and benefits of collecting, reviewing and disseminating – through a guideline – information on practices for environmentally sound material recovery and recycling of computing equipment. The project group was to cooperate and coordinate with other PACE project groups working on ESM principles, refurbishment standards and pilot projects.

Project group 3.1 on collection and management of end-of-life computing equipment from informal sectors

The objective of the project group was to develop and promote pilot schemes for the environmentally sound management of used and end-of-life computing equipment aimed at the attainment of the Millennium Development Goals; to increase the amount of funds for pilot projects on the collection and management of used and end-of-life computing equipment; and to ensure the long-term financial sustainability of such projects.

Project group 4.1 on awareness-raising and training

The objective of the project group was to develop a list of awareness-raising and training products and to implement them to improve the promotion of PACE and reports and guidelines that have been developed under PACE.

Subgroup on transboundary movement of used and end-of-life computing equipment

The objective of the subgroup was to review rules that might apply to the transboundary movement of used and end-of-life computing equipment, taking into consideration the Guideline on the Transboundary Movement of Collected Mobile Phones developed under the Mobile Phone Partnership Initiative. Participants in this subgroup also recognized the need for continual coordination with the work mandated by the Conference of the Parties in decision IX/6 and BC-10/5 on the development of technical guidelines on transboundary movements of e-waste, in particular regarding the distinction between waste and non-waste.

Subgroup 3.1.1 on resource mobilization and financial sustainability

The objective of the subgroup was to increase the funds available for pilot projects on the collection and management of used and end-of-life computing equipment and to ensure the long-term financial sustainability of such projects.

2. ESM criteria recommendations[vi]

2.1 Summary

2.1.1 This section identifies recommendations for ESM criteria that were developed by the ad interim project group on ESM criteria. The group's report is available on the Convention website (http://www.basel.int/industry/compartnership/documents.html).

2.1.2 The purpose of the group's report is to identify recommendations for ESM criteria for use by other PACE project groups in devising guidelines for use by countries in implementing the principle of environmentally sound management for computing equipment and in PACE pilot projects in developing countries and countries with economies in transition. The report may also be used by national Governments and facilities as an information resource for general guidance on ESM. For the purpose of PACE and as defined in the glossary of terms set out in appendix 1 to the present document, ESM is "taking all practicable steps to ensure that used and/or end-of-life products and wastes are managed in a manner which will protect human health and the environment".

2.1.3 ESM criteria recommendations were modelled on existing relevant guidance of international organizations, national Governments, industry and non-governmental organizations to the fullest extent possible as a means of avoiding duplication and promoting compatibility with existing approaches. Compatibility with ESM criteria and core performance elements under the work of the Basel Convention and the Organization for Economic Cooperation and Development (OECD) was an important consideration in preparing the ESM criteria recommendations. Identifying the needs of developing countries and countries with economies in transition was another key aspect of this work. Such needs include best management practices at the facility level and, often, effective legal systems and infrastructure to protect workers, communities and the environment, which individual facilities must use and rely on to achieve ESM.

2.1.4 It is recognized that ESM capacity varies greatly by country, often dependent upon political, social and economic considerations beyond the scope of PACE. As such, the development of new recommendations for national Governments would require broad consultation with and approval of organizations outside PACE. Consequently, ESM criteria recommendations for national Governments identified herein simply recap existing approved recommendations under the Basel Convention and OECD.

2.1.5 While not diminishing the importance of broad government and societal ESM criteria, efforts focused on identifying facility-specific recommendations, which include ensuring that facilities undertake the following measures:

1. Top management commitment to a systematic approach: Demonstrate commitment of top management to integrating a systematic approach to achieving ESM in all aspects of facility operations, which often includes an environmental health and safety management system;
2. Risk assessment: Identify actual and/or potential hazards and risks to public and worker health and safety and the environment that are associated with activities, products and services;
3. Risk prevention and minimization: Eliminate where possible and in all cases strive to minimize actual and potential hazards and risks to public and worker health and safety and the environment that are associated with activities, products and services;
4. Legal requirements: Identify, gain access to and strive to fulfil applicable legal requirements, including those in respect of legislation, statutes and regulations; decrees and directives; permits, licenses and certificates of approval or other forms of authorization; orders issued by regulatory agencies; and/or judgments of courts or administrative tribunals. Facilities should also take into consideration customary or indigenous law and treaties, conventions and protocols;
5. Awareness, competence and training: Ensure that employees have an appropriate level of awareness, competence and training with regard to the effective management of occupational risks;
6. Record-keeping and performance measurement: Maintain records, monitor, track and evaluate facility performance in achieving ESM.
7. Corrective action: Take appropriate action to tackle significant actual and/or potential risks to public and worker health and safety and the environment and correct identified deficiencies in achieving ESM;
8. Transparency and verification: Put in place provisions to support transparency and verification for each of the above building blocks, subject to appropriate protection for confidential business information. This can help facilities to provide public assurances that operations and activities are compatible with ESM. Such provisions may include participation in third-party audits and inspections.

2.1.6 Lastly, it was recommended that PACE project groups should take into consideration all recommendations set out in the report on ESM criteria recommendations during the design and implementation of their technical guidance and pilot projects.

2.2 Recommendations

2.2.1 Country-specific recommendations

2.2.1.1 Countries should review measures in place to implement their obligations under the Basel Convention and to support the implementation of applicable recommendations in the guidance document on the preparation of technical guidelines for the environmentally sound management of wastes subject to the Basel Convention.[vii]

2.2.1.2 OECD member countries should review measures in place to support the implementation of applicable recommendations in OECD Council Recommendation C(2004)100 on the environmentally sound management of waste (see annex B)[viii] and OECD technical guidance on the environmentally sound management of specific waste streams: used and scrap personal computers (ENV/EPOC/WPWPR(2001)3/FINAL).[ix]

2.2.1.3 Should domestic environmental management systems be employed as part of a national approach to ESM, special consideration should be given to developing an environmental management system (EMS) specifically tailored to small and medium-sized enterprises (SMEs). Whatever system is selected, it is recommended that the Government or large companies have a programme in place to provide support to SMEs in terms of information and know-how sharing.

2.2.1.4 Domestic policies and programmes implemented in accordance with PACE technical guidance should facilitate the ability to meet applicable international agreements and protocols and domestic legal requirements concerning the management of wastes.

2.2.2 Facility-specific recommendations

2.2.2.1 Facilities should ensure that measures are in place to demonstrate conformity with the following ESM criteria:

1. Top management commitment to a systematic approach: Demonstrate commitment of top management to integrate a systematic approach towards achieving ESM in all aspects of facility operations, which often includes an environmental health and safety management system.
2. Risk assessment: Identify actual and/or potential hazards and risks to public and worker health and safety, and the environment that are associated with activities, products and services.
3. Risk prevention and minimization: Eliminate where possible and in all cases strive to minimize actual and/or potential hazards and risks to public and worker health and safety, and the environment that are associated with activities, products and services.
4. Legal requirements: Identify access and strive to fulfil applicable legal requirements, including for example legislation, statutes and regulations; decrees and directives; permits, licenses and certificates of approval, or other forms of authorization; orders issued by regulatory agencies; and/or judgments of courts or administrative tribunals. Facilities should also take into consideration customary or indigenous law and treaties, conventions and protocols.
5. Awareness, competency and training: Ensure that employees have an appropriate level of awareness, competency and training with respect to the effective management of occupational risks.
6. Record-keeping and performance measurement: Maintain records, monitor, track, and evaluate facility performance at achieving ESM.
7. Corrective action: Take appropriate action to address significant actual and/or potential risks to public and worker health and safety, and the environment, and correct identified deficiencies in achieving ESM.
8. Transparency and verification: Provisions to support transparency and verification throughout each of the above building blocks, subject to appropriate protection for confidential business information, can help facilities to provide public assurances that operations and activities are compatible with ESM. Such provisions may include for example participating in third party audits and inspections.

2.2.2.2 Facilities should review measures in place to support applicable recommendations in the Basel Convention guidance document on the preparation of technical guidelines for the environmentally sound management of wastes subject to the Basel Convention.[x]

2.2.2.3 Facilities should review measures in place to support applicable recommendations in PACE guidance documents and other applicable guidance under the Basel Convention.

2.2.2.4 Facilities located in OECD member countries should also review measures in place to support applicable recommendations in OECD Council Recommendation C(2004)100 on the environmentally sound management of waste and OECD technical guidance on the environmentally sound management of specific waste streams: used and scrap personal computers (ENV/EPOC/WPWPR(2001)3/FINAL).

2.2.3 Recommendations for consideration when planning to undertake work pertaining to the management of used and end-of-life computing equipment[xi]

2.2.3.1 All recommendations in the present document should be taken into account.

2.2.3.2 Consideration should be given to the inclusion of a waste management hierarchy in the development of technical guidance documents and pilot projects. The hierarchy is proposed as follows, in descending order of preference: prevention; minimization; reuse; recycling, energy recovery; and disposal. Ideally, all feasible opportunities for waste management will be taken at higher levels of this hierarchy. This does not preclude possible consideration of additional issues linked to the various stages of product life cycles and impacts of facility operations such as the generation and potential release of hazardous wastes and opportunities to reduce and avoid greenhouse gas emissions.

2.2.3.3 The differences between hazardous and non-hazardous wastes and between dangerous and non-dangerous processes should be taken into account.

2.2.3.4 Refurbishing or recycling activities should not be discouraged, recognizing in particular the flexibility required for each country to increase the rate of environmentally sound recovery of low-risk waste.

2.2.3.5 Facility measures and specific actions should be identified. This would include any appropriate verification measures that operators in facilities might carry out for use in demonstrating conformity to each of the ESM criteria.

2.2.3.6 Consideration should be given to the development of tiered checklists of facility measures for each of the eight ESM criteria. A tiered checklist can support the continual improvement of ESM by enabling facilities to identify readily what types of measures they should have in place to graduate from lower to higher tiers of ESM.

2.2.3.7 Realistic options and potential resources available for integrating informal sector operations into local, regional and national programmes of developing countries and countries with economies in transition, with the ultimate goal of facilitating the transition of such operations into the formal sector, should be identified.

2.2.3.8 Self-sustainable and economically viable solutions to support the long-term implementation of PACE pilot project activities designed to collect, refurbish and recycle used and end-of-life computing equipment in a manner consistent with the ESM criteria should be identified.

2.2.3.9 Incentives and relief measures for facilities to support the PACE technical guidance should be developed.

2.2.3.10 The size of an enterprise, especially in respect of small and medium-sized enterprises, the type and amount of waste, the nature of operations and domestic legislation should be taken into account when developing technical guidance and pilot projects.

2.2.3.11 Procedures for achieving any certification/registration and reporting requirements may be simplified for SMEs in comparison with large facilities. Thus, for example, environment, health and safety reports could be made publicly available every three years (rather than annually, as required for large facilities). Such incentives and/or relief measures should not, however, compromise suitable and effective protection of public and worker health and safety or the environment as part of a facility's approach to achieving environmentally sound management. Consequently, it is not appropriate to allow less complicated or fewer facility audits for small and medium-sized enterprise facilities in non-OECD countries.

2.2.3.12 It should be taken into account that small and medium-sized enterprises whose operations present little or no risk need significantly more limited emergency plans.

2.3 For more detailed information on the ESM criteria recommendations and their annexes, see the document entitled "Environmentally Sound Management (ESM) Criteria Recommendations".[xii]

3 Transboundary movement of used and end-of-life computing equipment[xiii]

3.1 Summary

3.1.1 This section pertains to transboundary movement of collected used and end-of-life computing equipment. Once collected, computing equipment should be evaluated or tested, and labelled, to determine whether it is suitable for reuse,[xiv] possibly after repair, refurbishment or upgrading, or whether it is destined for material recovery and recycling (see appendix 2 B) or final disposal (see appendix 2 A).

3.1.2 This section should be of assistance to regulatory agencies and authorities, exporters, importers, manufacturers, repair, refurbishment and recycling facilities, and any organization that is involved:

a) In the export or import of used computing equipment for reuse;

b) In the movement of used computing equipment suitable for reuse, possibly after repair, refurbishment or upgrading in the importing country;

c) In transboundary movements of end-of-life computing equipment destined for material recovery and recycling (see appendix 2 B) or final disposal (see appendix 2 A).

3.1.3 The type of transboundary movement procedure to be applied depends on the constituents and hazardous characteristics and on the disposal operation chosen for collected computing equipment after evaluation or testing and labelling or documentation[xv] of test results. To determine what is and what is not covered under the Basel Convention, the Convention defines the "wastes" to be covered in paragraph 1 of its Article 2, stipulating that wastes are substances or objects that 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 disposal operations listed in Annex IV (see appendix 2). Hazardous constituents and characteristics of such wastes are then defined and classified by a series of technical annexes (I, II, III, VIII and IX). In addition, every Party may, by its own national legislation, define additional substances and objects as wastes and hazardous wastes.[xvi]

3.1.4 It is recommended that Basel Convention transboundary movement controls should be implemented for end-of-life computing equipment destined for material recovery and recycling (see appendix 2 B**)** or final disposal (see appendix 2 A) where the end-of-life computing equipment contains Basel Convention Annex I constituents, unless it can be demonstrated that this end-of-life computing equipment is not hazardous using Basel Convention Annex III characteristics.

3.1.5 Regarding transboundary movements of used computing equipment for repair and refurbishment in the importing country, and subsequent reuse, the following procedures should apply:

3.1.5.1 If, pursuant to paragraph 1 of Article 2 of the Convention or national legislation, at least one of the States concerned involved in a transboundary movement of used computing equipment destined for repair or refurbishment in the importing country has determined[xvii] that such equipment is classified as waste, then the decision tree procedure (appendix 4 (b)) should be used. The Convention control procedure (and applicable controls and trade bans) would then apply where such waste computing equipment is determined to be hazardous waste in accordance:

(a) With paragraph 1 (a) of Article 1 (contains Basel Convention Annex I constituents, unless it can be demonstrated that this used computing equipment is not hazardous using Basel Convention Annex III characteristics); or

(b) With paragraph 1 (b) of Article 1 (considered hazardous waste by the national legislation of one of the parties involved).

3.1.5.2 The Basel Convention control procedure will not apply if, pursuant to paragraph 1 of Article 2 and national legislation, none of the States concerned involved in a transboundary movement have determined that computing equipment destined for repair or refurbishment in the importing country is classified as waste. In such circumstances, however, the States involved should consider using the voluntary notification procedure (appendix 4 (a)) or the decision tree (appendix 4 (b)) to ensure that the movement is monitored and the importing country is afforded an opportunity to react (consent, object or identify conditions) to it.

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

3.1.7 The transboundary movement of collected computing equipment that has been tested and labelled or documented as suitable for reuse without further repair, refurbishment, or upgrading falls outside the scope of the Convention and applicable PACE recommendations, and such equipment can be shipped as products provided that a reuse destination in the receiving country is assured. If such used and functional equipment has been classified as hazardous waste by the States concerned, or is otherwise restricted under applicable national law such as by a prohibition on import of such used goods by States concerned, parties and exporters should take account of these applicable restrictions.

3.2 Recommendations

3.2.1 All used computing equipment that has been collected should first be evaluated to determine whether it is suitable for direct reuse, for reuse following repair or refurbishment or for material recovery. Computing equipment that is suitable for reuse should be further tested for functionality and be labelled or have appropriate documentation, including a declaration of testing results (appendix 7), before any transboundary movement.

3.2.2 Any test of computing equipment destined for reuse is to be tested. The test should utilize at a minimum an effective test method to confirm that the equipment is fully functional (appendix 5) and a battery test (appendix 6) to determine the extent to which it is suitable for reuse with or without repair, refurbishment or upgrading.

3.2.3 Except as provided in paragraph 3.2.7, used computing equipment that has been collected but not evaluated or tested and labelled or documented as suitable for reuse is subject to Basel Convention procedures as hazardous waste, unless it can be demonstrated that the used computing equipment is not hazardous using Basel Convention Annex I and Annex III characteristics.

3.2.4 End-of-life computing equipment destined for material recovery and recycling (appendix 2 B) or final disposal (appendix 2 A) containing Basel Convention Annex I constituents is subject to Basel Convention transboundary movement controls unless it can be demonstrated that the end-of-life computing equipment is not hazardous using Basel Convention Annex III characteristics.

3.2.5 Where used computing equipment has been evaluated and assessed as likely to be suitable for reuse,[xviii] possibly after repair, refurbishment or upgrading in the importing country, and has been classified as waste by at least one of the States concerned involved in its transboundary movement, the decision tree (appendix 4 (b)) should be used.

3.2.6 Where used computing equipment destined for repair or refurbishment in the importing country is not classified as waste by any of the States concerned, a voluntary notification procedure (appendix 4 (a)), or the decision tree procedure (appendix 4 (b)) should be considered by the countries involved in the transboundary movement of the computing equipment to ensure that the movement is monitored and to afford the importing country an opportunity to react (consent, object or identify conditions) to it.

3.2.7 The following shipments are normally considered outside the scope of these procedures and the Convention unless the computing equipment being shipped is defined as or considered to be hazardous waste under paragraph 1 (b) of Article 1 of the Convention or is restricted under applicable national law such as by a prohibition on import of such used goods by the States concerned:

3.2.7.1 Collected computing equipment that has been tested and labelled or documented and declared as being fully functional[xix] and intended for direct reuse[xx] in accordance with appendix 7;

3.2.7.2 Shipments by individual customers of their own defective computing equipment under warranty or subject to a law allowing for a right of the return of the equipment for repair or refurbishment and where the same type or similar product is intended to be returned to the customer. This does not include equipment from take-back programmes;

3.2.7.3 Batches of defective computing equipment or components, under warranty or subject to a law allowing for a right of return of the equipment, that has been collected from individual customers or consolidated by manufacturers, original component suppliers or their contractual agents and sent back to the manufacturer, original component suppliers or their contractual agents, and for which the same type or similar products have been or will be returned to the customer;

3.2.7.4 Shipments of used computing equipment under a documented leasing programme, where such equipment is removed from service, documented and declared, using appendix 7, to be in working condition and returned to the computing equipment owner.

3.2.8 Each shipment mentioned in recommendation 3.2.7 should be accompanied by a customer invoice and/or other shipping document that is completed before the transboundary shipment and includes the information listed in appendix 8.

3.2.9 When hazardous wastes or residues arising from refurbishment, repair, material recovery or recycling in respect of imported used or end-of-life computing equipment are to be sent back to the original exporting country or to a third country, the Convention notification procedures are to be followed. As appropriate, the documents should include references to original documents to ensure effective tracking.

3.2.10 In situations in which hazardous wastes or residues arising from refurbishment, repair, material recovery or recycling in respect of imported used or end-of-life computing equipment 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, including return dates and financial responsibilities.

3.2.11 All transboundary movements of used and/or end-of-life computing equipment should follow applicable transport rules.

3.2.12 Consistent with the PACE guidelines and report on ESM criteria, each importing country should take measures to establish appropriate infrastructure to ensure that computing equipment at the end of its life is collected and recycled in environmentally sound facilities, either within or outside the country.

3.2.13 All used computing equipment intended for refurbishment or repair and subsequent reuse following transboundary movement should be packaged properly to ensure protection of its asset value and protection of human health and the environment during transport (see the packaging guidelines set out in appendix 3).

4 Testing, refurbishment and repair of used computing equipment[xxi]

4.1 Summary

4.1.1 This section provides information on the environmentally sound testing, refurbishment and repair of used computing equipment based on the guideline on environmentally sound testing, refurbishment and repair of used computing equipment,[xxii] which can be obtained from the Convention Secretariat. The guideline promotes greater reuse of such computing equipment and the environmentally sound management of any discarded computing equipment or components. A typical refurbishment and repair process is shown in appendix 9. Extending the life of computing equipment generally results in the best environmental outcome, reducing the demand for natural resources and increasing waste prevention. Refurbishing and repairing used computing equipment using environmentally sound management may require either a broad set of skills or device-specific expertise and operational controls to make the process efficient and to minimize impacts on human health and the environment. Given the complexity of the computing equipment market, the intention is to provide general guidelines that will be useful for years to come and to offer guidance for refurbishment facilities around the globe.

4.1.2 The guideline on environmentally sound testing, refurbishment and repair of used computing equipment is divided into four parts:

(a) Part 1 introduces the background, purpose and use of the guideline. It also sets out a list of ESM criteria that are relevant to the refurbishment or repair of used computing equipment;

(b) Part 2 provides guidance applicable to refurbishment facilities. It covers measures that refurbishment and repair facilities and facility managers may put in place better to ensure the environmentally sound management of used computing equipment, and addresses each of the ESM criteria from the PACE ad interim project group on ESM criteria;

(c) Part 3 provides additional guidance applicable to refurbishment and repair facilities further to support ESM. It includes a flow chart of the refurbishment process and guidance on the sorting of refurbishable and non-refurbishable equipment. It provides guidance on data security and destruction and on disassembly. One of the most important elements is guidance on the testing of used equipment prior to reuse to ensure functionality, including in respect of batteries. Lastly, it offers guidance on labelling and documentation, packaging and storage and handling of refurbished and repaired equipment;

(d) Part 4 includes guidance on the marketing, donation (principles for donors are listed in appendix 10) and redeployment of refurbished and repaired computing equipment and components.

4.1.3 The information should also assist individuals, companies and agencies involved in collection schemes and transportation of used and refurbished computing equipment and consumers who use refurbished computing equipment. Any organization involved in buying or selling computing equipment for reuse should also find this information useful.

4.2 Recommendations

4.2.1 Recommendations relating to facility measures to support ESM

4.2.1.1 Top management of the facility should ensure that a systematic approach is in place to create an environmentally sound operation. This policy should be fully documented and implemented through a plan of action on ESM, which should provide for continual review and improvement. Care should be taken to communicate and document the organization's policies and operational controls on ESM to all staff, subcontractors and visitors.

4.2.1.2 Management should seek to identify hazards and risks to worker health and safety and the environment that are associated with refurbishment and repair activities, products and services.

4.2.1.3 Once top management has assessed the risks, they should seek to minimize or eliminate hazards and risks to worker health and safety and the environment that are associated with refurbishment and repair activities by establishing and maintaining a working environment that is safe and adequate for the welfare of all those engaged in such activities and putting in place high-quality awareness-raising and training systems.

4.2.1.4 Refurbishment and repair facilities should perform evaluations at regular intervals to identify all applicable laws, regulations and authorizations and should determine how they apply to the facility, so as to ensure compliance with all applicable requirements. Refurbishment and repair facilities should seek the best available guidance and training to understand and apply the laws.

4.2.1.5 Records of the inspections, testing and assessment of facility performance in respect of the environmentally sound refurbishment and repair of used computing equipment should be maintained and should be readily accessible to customers, auditors and regulators in compliance with applicable laws and in conformity with ESM.

4.2.1.6 Refurbishment and repair facilities dealing with products that are potentially hazardous to the health and safety of their workers and the environment should have documented procedures in place to ensure scheduled inspection and monitoring of hazards. In addition, there may be regulatory requirements that must be satisfied.

4.2.1.7 A certification of facility conformance with an accredited comprehensive environmental management system and electronics recycling standard is desirable, and will assist Governments and other interested persons in evaluating refurbishment and repair operations and facilities. If possible, this certification should be made by an independent certification body that is accredited to audit to the applicable standards (see appendix 13 for additional information on certification schemes).

4.2.2 Recommendations relating to the refurbishment/repair process

4.2.2.1 Facility managers should establish a policy specifying what used computing equipment is accepted into their facility for refurbishment or repair based on their technical capacity.

4.2.2.2 Facilities that refurbish or repair used computing equipment should take steps to identify and sort used computing equipment that is to be refurbished or repaired from that which should undergo recycling and materials recovery.

4.2.2.3 Refurbishers should sell, transfer or transport only computing equipment that is evaluated to be refurbishable or that is appropriately tested to assess its functionality (appendix 5).

4.2.2.4 Refurbishment and repair facilities should store and handle used computing equipment before refurbishment in a manner that protects the computing equipment and reduces the potential for hazardous releases to the environment and injuries to workers.

4.2.2.5 Refurbishers should prevent the release of data stored on used computing equipment that they receive and process, and should seek to destroy such data through electronic means.

4.2.2.6 Refurbishment and repair facilities should ensure that proper labelling or documentation of refurbished or repaired equipment is undertaken. The labelling or documentation should cover, where appropriate and possible, the type of equipment, the model and serial numbers, the year manufactured, the refurbishment or repair date, possible evaluation and testing that was performed, and an overall confirmation that the refurbished or repaired equipment is fit for reuse.

4.2.2.7 Refurbishment facilities should use the Convention guidelines to ensure that downstream materials-recovery and recycling facilities operate in a manner protective of the environment and worker health and safety and compliant with the requirements of the Convention. Such recycling facilities should take into consideration chapter 5 of this guidance document, the PACE guideline on material recovery and recycling of end-of-life computing equipment and the International Labour Organization Guidelines on Occupational Safety and Health Management Systems.[xxiii]

4.2.2.8 Refurbishment facilities should ensure that all computing equipment, components (e.g., batteries, cathode ray tube devices, mercury-containing devices and circuit boards) and residuals destined for materials recovery, recycling and disposal are prepared for subsequent shipment and transported in full compliance with all applicable laws, including those pertaining to national implementation of the Convention (see chapter 3 of this guidance document) and other multilateral waste trade agreements.

4.2.3 Recommendations relating to the marketing and redeployment of refurbished or repaired computing equipment

4.2.3.1 Any organization that markets used computing equipment should ensure that such equipment continues to meet all applicable industry and government standards and requirements, including the original product's rated operational characteristics.

4.2.3.2 Documentation accompanying used and refurbished or repaired equipment should certify the testing performed on the equipment to verify that it is in working condition and is fit for its intended end use (appendix 7).

4.2.3.3 Refurbishers exporting refurbished computing equipment to other countries should exercise care to ensure compliance with all applicable laws governing product and used product imports, technical standards, labelling and health and safety requirements.

5 Material recovery and recycling of end-of-life computing equipment[xxiv]

5.1 Summary

5.1.1 This section provides information on the environmentally sound material recovery and recycling of end-of-life computing equipment based on the guideline on the subject,[xxv] which is available from the Convention Secretariat. The guideline provides guidance on best practices for environmentally sound material recovery and recycling of end-of-life computing equipment and pertains to the recycling of all components of computing equipment, which include personal computers and peripherals; central processing units (CPUs), both desktop and laptop; monitors: cathode ray tube and liquid crystal display flat screen technology; keyboards and mice; and printers and scanners. It also discusses the adequacy of current material recovery and recycling infrastructures and their capacity to handle the increasing volume of obsolete computing equipment being directed to material recovery and recycling facilities rather than to landfills, incinerators or other forms of final disposal.

5.1.2 The guideline on environmentally sound material recovery and recycling of end-of-life computing equipment is divided into 11 parts:

(a) Parts 1–4 provide an executive summary and introduction, identifies the type of material covered, and identifies a number of common materials found in computing equipment;

(b) Part 5 provides guidance on initial recycling facility practices, supported by a series of flow charts;

(c) Part 6 explains how materials should be safely stored and how they should be transported when shipped for further processing;

(d) Parts 7 and 8 discuss material recovery processes, plus management and disposal of different types of residues derived from recovery operations;

(e) Part 9 identifies legal requirements for material recovery and recycling facilities and steps to be taken to comply with applicable health, safety and environmental laws and regulations;

(f) Part 10 highlights commercial considerations pertaining to the establishment of economically and environmentally sound material recovery operations;

(g) Part 11 provides recommendations to national authorities regarding programmes and policies that may be implemented to ensure environmentally sound and economically efficient material recovery and recycling of end-of-life computing equipment.

5.1.3 In theory, every part of end-of-life computing equipment can find continued beneficial use through environmentally sound management (appendix 11), from direct reuse as a complete computer to a part of a slag-construction aggregate. In practice, however, there are economic limits to material recovery, and some process residues from all six material recovery steps will require final disposal, with careful attention to protection of the environment.

5.1.4 Computing equipment contains more than 60 types of constituent metals and other materials: primary constituents such as steel occur in large amounts; minor constituents such as silver occur in small amounts; and micro or trace constituents such as gold occur in very minute amounts. Of course, the exact materials differ for each manufacturer and piece of equipment, and change as technologies evolves. Facilities that recover material from end-of-life computing equipment must be prepared for new and old equipment, with new and old technology.

5.1.5 Some of these materials, such as steel, present little or no special hazard or concern. Others may present hazards when they are broken, crushed, shredded or melted, unless environmentally sound management practices are employed. In addition, other substances may be used or produced in recycling, and there are three main groups: of substances that may be released during material recovery and should be of concern: original constituents of computing equipment, such as lead and mercury; substances that may be added in some recovery processes, such as cyanide; and substances that may be formed by recycling processes, such as dioxins and measures should be taken to prevent the release of these substances.

5.1.6 To protect their workers and communities, material recovery facilities should take steps guided by environmentally sound management criteria. These criteria work together to guide and assist material recovery facilities in achieving environmentally sound management of computing equipment and recovery of materials. Facilities will need to obtain more detailed technical information than the guideline can provide to determine accurately the most appropriate and effective technology and practices, but should find that the guideline provides an overview of many material recovery steps and how they work together.

5.1.7 When applying these environmentally sound management criteria, material recovery facilities should first collect end-of-life computing equipment, but only the kind that they are prepared, qualified and licensed to accept and process. Next, they should carefully remove and separate the most problematic constituents – those that contain hazardous substances that may contaminate other materials – such as mercury, batteries and CRTs, which usually need additional processing and/or environmentally sound final disposal. Material recovery from the remaining computing equipment then generally consists of a long series of steps and processes, some lasting a number of months, with each step adding value. All these processes may also result in the release of hazardous substances, and careful worker training and protection, in addition to community protection, are necessary parts of sound facility management. The general intent at each step is that complex materials should be sorted and separated according to specifications and quality demands of ESM downstream processors to optimize value and material recovery, including quality specifications determined between ESM facility buyers and sellers. At each step, a more concentrated output material becomes a more valuable input for another process, until a material is ready for the market as a new material. What is more, material recovery from computing equipment not only minimizes waste disposal but can also be much more environmentally sound than mining the same raw materials.

5.1.8 Material recovery facilities sometimes use manual labour in recovery processes and sometimes use mechanized and advanced sorting processes. Many facilities use both, depending on which is most efficient for a particular step. In developing countries and countries with economies in transition, where costs of manual labour are relatively low, the manual disassembly path is more often taken and generates employment opportunities. Even in developed countries, experience shows that manual disassembly and sorting with proper precautions is likely to be a beneficial complementary step to mechanical processing to maximize material recovery rates.. Certain technological skills and, most importantly, knowledge of parts that may contain harmful substances (e.g., mercury-containing switches, PCB-containing and other capacitors and plastics containing brominated flame retardants) are essential in manual disassembly and the associated treatment and disposal. Worker training and education on the risks should be part of the initial induction that all employees receive before working on the disassembly of materials with on-going continual assessment and professional development. It can produce clean sorted materials and working components, such as electronic chips and wires or cables to be sent to other mechanized facilities for additional recovery of materials. These steps are not, however, without risk of exposure to hazardous substances, making health, safety and the environment important considerations.

5.1.9 Mechanized material recovery processes, using shredders, grinders and separation technology, are more likely to be high-speed and high-volume operations, with several shredding steps followed by modern, sophisticated identification and separation of plastics and metals by optical and X-ray technology, electromagnets (for ferrous metals) and eddy current (for copper and aluminium).

5.1.10 When concentrated streams of metals are produced they are usually further refined in metal-specific pyrometallurgical and/or hydrometallurgical processes. Scrap steel can be used in electric arc furnaces to produce new steel. Scrap aluminium can be used in secondary aluminium furnaces to produce new aluminium. Scrap copper, scrap precious metals and some other special non-ferrous metals are commonly recovered from computer circuit boards and other components or fractions through pyrometallurgical processing and/or by metal-specific hydrometallurgical refining. Informal recovery operations on circuit boards and other precious metal-bearing materials, such as acid leaching, are inefficient and expose workers, communities and the environment to cyanides, strong acids, hazardous gases and other dangers.

5.1.11 Some functional CRTs may be reused without change or may be used to produce televisions or other electronic displays. If they cannot be reused, clean and sorted CRT glass may be used in CRT manufacturing facilities to produce new CRT glass. New and different display technologies, however, have caused demand for recovered CRT glass to decline, and will continue to do so in the future. At the same time, the traditional material recovery options for used CRT glass, particularly in lead smelters, are gradually disappearing. The alternative use of CRT glass fractions (mixed glass, separated panel or funnel glass) or safe disposal in compliance with applicable environmental law is required. New manufacturing applications for used CRT glass are emerging. In these applications, the lead-containing funnel glass should be separated from the panel glass that may contain lead, to guarantee the safe use of the fractions in the recycling processes. The addition of front glass cullet in glass wool insulation and building material production are examples of such new recycling options. The use of front glass cullet as abrasives and reflective material are other recovery options that, however, do not lead to recycling. There are also other uses under development, but options for lead-containing funnel glass are very limited. Phosphor coatings should be removed in all cases and handled in an environmentally sound manner. Nevertheless, new applications should be scrutinized to ensure that leaded CRT glass is not used in applications where hazardous materials, could leach into the environment or harm human health or the environment. If lead-containing funnel glass cannot be recycled or recovered, it should be otherwise disposed of in an environmentally sound manner.

5.1.12 Screens with liquid crystal displays (LCD) may contain mercury lamps as backlights, which should be carefully and manually removed before processing or managed in closed, highly mechanized systems (emerging technologies). The mercury lamps should be properly packaged and sent to specialized mercury recovery facilities. Atmospheric and environmental levels of mercury in work areas should be regularly monitored.

5.1.13 Plastics may be recycled if they are separated by type and are mostly free of metals and other contaminants; they should also be free of certain hazardous brominated flame retardants, unless they can be removed or can legally continue to be used as flame retardants. Plastics can be used in smelting operations as fuel and as reducing agents, if smelter emissions are well controlled, especially for dioxins and furans.

5.1.14 Batteries derived from computing equipment, which are now almost always based on lithium and nickel metal hydride chemistry, should be evaluated for continued use as batteries, if they meet criteria in the PACE guideline on environmentally sound testing. refurbishment and repair of used computing equipment for battery testing and minimum performance.. If a battery is no longer useable, it should be processed only in specialized facilities that are authorized to safely manage hazardous characteristics such as corrosivity and toxicity. Electrical contacts on individual batteries should be physically covered or separated to prevent the risk of fire from unintentional electrical discharge or explosion during transportation and handling. The primary metals of interest are cobalt, nickel and copper, and lithium may also become a valuable target for recovery.

5.1.15 Residues from processing and pollution control systems that cannot be recovered efficiently are likely to contain metals and other substances of concern, which should be carefully managed, often as hazardous waste. These include baghouse filters and dust, sweepings, glass fines, phosphors, plastics and slags. Because these waste residues are likely to contain metals, plastics and halogens, disposal in an incinerator that has no efficient pollution control systems is unsuitable. Similarly, because process residues may leach hazardous constituents, disposal in an uncontrolled landfill is also unsuitable.

5.1.16 Many residues generated in the material recovery chain are intended for further recovery processes or for final disposal and will be classified as hazardous waste. It is therefore important that material recovery, energy recovery and disposal facilities used to process hazardous waste be properly authorized and licensed and comply with all applicable local, national, regional, multilateral and international laws. Such laws may include laws to implement the Basel Convention if transboundary movement is involved, as is often the case with end-of-life computing equipment.

5.2 Recommendations

5.2.1 Goals and objectives

5.2.1.1 Material recovery, energy recovery and disposal facilities should be properly authorized and licensed and should comply with all applicable laws – local, national, regional, multilateral and international. Such laws will include national laws implementing the Basel Convention whenever transboundary movement is undertaken, as is often the case with end-of-life computing equipment and residuals.

5.2.1.2 Parties and signatories to the Convention are encouraged to implement policies and/or programmes that promote environmentally and economically sound material recovery and recycling of end-of-life computing equipment.

5.2.1.3 Consistent with the Basel Declaration on Environmentally Sound Management, used computing equipment should be diverted from disposal practices, such as landfilling and incineration, by robust collection programmes, to the more environmentally sound practices of reuse, refurbishment, material recovery and recycling.

5.2.1.4 It is important that end-of-life computing equipment be collected effectively (which is usually not the case today, even in industrialized countries). Funding for collection should be provided where necessary.

5.2.1.5 Environmentally sound material recovery and recycling of end-of-life computing equipment requires setting up an effective recycling chain, comprising the steps of robust collection of used computing equipment, evaluation, testing/refurbishment/reuse if appropriate, preparation/dismantling of non-reusable computing equipment or parts, separation into material streams, final recovery of marketable raw materials and disposal of non-recyclable fractions and processing residues. Some hazardous fractions should be sent to facilities for destruction of the hazardous substances to ensure that they are taken out of use. All those involved in each step should understand and communicate with persons involved in the entire chain. ESM recycling facilities should ensure that hazardous fractions and materials derived from processing computing equipment are sent to ESM facilities that are licensed and permitted to manage these materials**.**

5.2.1.6 A number of components and materials of concern, such as batteries and mercury lamps, may release hazardous substances when being processed for material recovery; such materials and components should be identified and carefully removed to avoid their entry into more intensive processing such as shredding.

5.2.1.7 Environmentally sound material recovery and recycling of computing equipment is not simple, and can cause exposure to hazardous substances if not handled correctly. It should be well understood, managed and performed consistent with the practices set out in this document to protect workers, communities and the environment. All steps should be taken to ensure that unsound computing equipment material recovery and recycling practices are avoided, such as those where proper worker and environmental protections are not implemented (e.g., informal backyard operations) and those where there is no attempt to maximize material recovery.

5.2.1.8 Priority should be accorded to material recovery processes that adhere to and increase the benefits of the waste management hierarchy: waste prevention, waste minimization, reuse, recycling, energy recovery and disposal. Such processes result in high-efficiency recovery from computing equipment; minimize loss and final disposal of valuable materials; and reduce the use of energy, generation of greenhouse gases and other negative environmental and health impacts.

5.2.2 Development of recycling infrastructure

5.2.2.1 The Basel Convention general obligations related to national self-sufficiency, proximity, least transboundary movement, and ESM, in addition to the need for economic efficiency, should be taken into account when choosing computing equipment material recovery and recycling facilities or operations and when developing domestic policies for environmentally sound material recovery and recycling. However, there are currently many countries that do not possess material recovery facilities, that meet the criteria for environmentally sound management. In these cases, it may be preferable to export some components that may be hazardous or require specialized processes to achieve high material recovery rates. These materials (e.g. , CRT glass, mercury lamps and switches, LCD screens, batteries, plastics containing brominated flame retardants or circuit boards should be exported for treatment in an ESM facility, in compliance with the Basel Convention,.

5.2.2.2 Because conformance with this guideline may mean an increase in recycling costs, parties, industry, including producers, importers and other stakeholders should collaborate to ensure that there is adequate financing for computing equipment material recovery and recycling. As certification and auditing can be very expensive, the procedures needed for recovery and recycling facilities to achieve certification need to be affordable and achievable for facilities worldwide. The support of multilateral and regional development banks and bilateral donors would be highly valuable in setting up significant and attractive investment programmes in developing countries aimed at the development of recycling infrastructure compliant with ESM.

5.2.2.3 Parties should be prepared to grant timely consents and other approvals for legal exports or imports of waste computing equipment to environmentally sound managed facilities.

5.2.3 Facility-level guidelines

5.2.3.1 Top management should systematically plan and execute environmentally sound material recovery and recycling operations and facilities. Without the continuing commitment of top management, it is unlikely that a facility will consistently and increasingly perform in ways that minimize its impacts on human health and the environment. Facilities are encouraged to develop and use certified comprehensive systems of environmental, health and safety management to plan and monitor their environmental, health and safety practices. Such systems should include specific elements for environmentally sound material recovery and recycling in respect of used and end-of-life computing equipment (appendix 12).

5.2.3.2 Certification of facility conformance with an accredited comprehensive management system is desirable and will assist Governments, material recovery facilities and other interested persons in evaluating and approving environmentally sound material recovery operations and facilities. If possible, such certification should be made by an independent and qualified auditor and an accredited certification body.

5.2.3.3 Facilities should develop procedures for identifying and complying with applicable legal requirements. Such requirements might be found in many places, such as national and local statutes and regulations, as well as in permits and licenses, and special professional expertise may be needed. Regulatory agencies, government publications and news releases, legal advisers, legal journals and commercial databases and industry associations may help to identify applicable legal requirements. Facilities should also take into consideration customary or indigenous law and international treaties, conventions and protocols.

5.2.3.4 Recycling facilities should dismantle and separate, through manual and mechanical processing, computing equipment that is not directed to reuse and should direct it to properly equipped material

recovery facilities, to ensure that the loss of valuable material is minimized. Facilities should send potentially hazardous items and substances (such as batteries and items containing mercury) to processing, recovery or treatment facilities that are properly licensed to receive them and use technology designed to manage them safely and effectively. Facilities should not attempt to recover components or materials if they lack the proper capabilities.

5.2.3.5 Recycling facilities should, before beginning operations and systematically thereafter, identify hazards and assess occupational and environmental risks that exist or that could reasonably be expected to develop. This practice of hazard identification and risk assessment should be incorporated into the facility management system, and employees should have an appropriate level of awareness, competency and training with regard to the effective management of such hazards and occupational risks. Environmental, health and safety measures should then be adopted. Such measures could include the use of engineering controls (substitution, isolation, ventilation, dust control, emergency shut-off systems, fire suppression), administrative and work practice controls (regular, documented health and safety training, job rotation, safe work practices, medical surveillance, safety meetings) and personal protective equipment (respirators, protective eyewear, cut-resistant gloves). Such facilities should take into consideration the International Labour Organization Guidelines on Occupational Safety and Health Management Systems.[xxvi]

5.2.3.6 Facilities that dismantle, process, smelt, refine or perform other steps in computing equipment material recovery and recycling should identify themselves to their relevant regulatory authorities. Permit issuing and inspecting authorities with jurisdiction should inspect and verify that these companies are complying with health, safety and environmentally sound management requirements.

5.2.3.7 Material recovery facilities that process electronic equipment should perform due diligence in the selection of downstream vendors to assure themselves that such downstream vendors (handlers and processors) are practising environmentally sound management. Due diligence should include verification of the existence of a documented management system encompassing hazard identification, risk assessment and corrective action, environmental permits, compliance with applicable legal requirements and other general principles included in the guideline.

5.2.3.8 Facilities should monitor, track and evaluate their performance and maintain records of their activities. Record-keeping and performance measurement enable facilities to make better-informed decisions as to whether they are achieving desired results and whether it is necessary to implement corrective actions. In some cases, record-keeping and performance measurement may be legally required.

5.2.4 Design for recycling

5.2.4.1 The material recovery and recycling phase of end-of-life computing equipment should be taken into account by manufacturers during product design by considering the issues of toxicity and recyclability.

5.2.4.2 A number of materials used in the manufacture of new computing equipment, such as: beryllium, mercury and brominated flame retardants, have been identified in this document as substances of particular concern during the processing of end-of-life computing equipment. Manufacturers can aid the recycling industry by providing more information on the hazardous substances in their products and how they can be safely dismantled, while also substituting in less hazardous substances that perform the same function. Manufacturers should also strive to use substances that reduce risks to human health and the environment throughout the product life cycle.

5.2.4.3 Computing equipment manufacturers should work together to improve the recyclability of plastics in computing equipment. Specifically, consideration should be given to greater consistency in material selection during the design stage for all computing equipment, which would allow plastics recyclers to eliminate sorting steps necessary to achieve compatibility of plastics types.

5.2.5 Future collaborative steps

5.2.5.1 Parties to the Convention are encouraged to extend the role of the Basel Convention regional centres to develop training and technology transfer regarding environmentally sound material recovery and recycling of end-of-life computing equipment, in order to assist developing countries and countries with economies in transition in implementing regulatory frameworks for the environmentally sound management of end-of-life computing equipment, including regulations on transboundary movements.

5.2.5.2 Audit checklists or similar tools should be developed to assist parties and others in performing inspections and due diligence audits based on the guideline.

Appendix 1

Glossary of terms

Note: *These terms were developed for the purpose of the report on ESM criteria recommendations, individual project guidelines, and the overall guidance document developed under PACE, to assist readers to understand PACE documents*.

Assemblies: Multiple electronic components assembled in a device that is in itself used as a component.

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

Charitable donation: Transfer of **computing equipment** or its **components that are not waste for their intended direct reuse** for purposes of charity without any monetary rewards, or benefits, or barter.

Cleaning: Removal of dirt, dust and stains and making of cosmetic repairs.

Component: Element with electrical or electronic functionality connected, together with other components and usually by soldering, to a printed circuit board to create an electric or electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator).

Computing equipment: Computing equipment includes personal computers (PCs) and associated displays; printers and peripherals; personal desktop computers, including the central processing unit and all other parts contained in such computers; personal notebooks and laptop computers, including any docking station, the central processing unit and all other parts contained in such computers; computer monitors, including cathode ray tube monitors, liquid crystal display monitors and plasma monitors; computer keyboards, mice and cables; computer printers, including dot matrix printers, inkjet printers, laser printers, thermal printers and any computer printers with scanning or facsimile capability.

Defective/Defect: Defective **computing equipment** is equipment that is delivered from the last manufacturer in the supply chain in a condition that is not as it was designed to be sold, or equipment that breaks or malfunctions due to a condition that was not intended as part of the equipment's design. Defective equipment does not include equipment that loses functional or cosmetic value as a result of normal wear and usage or consumer negligence.

Direct reuse: Using again, by a person other than its previous owner, **computing equipment** and **components** that is not waste for the same purpose for which it was conceived without the necessity of **repair, refurbishment** or hardware **upgrading**.

Dismantling: Taking apart **computing equipment**, **components** or **assemblies** to separate materials and/or increase options for **reuse, refurbishment or recycling** and to maximize recovery value.

Disposal: Any operations specified in Annex IV to the Basel Convention (paragraph 4 of Article 2 of the Convention, and appendix 2 to this document).

End-of-life computing equipment: Computing equipment that is waste and no longer suitable for use and is intended for **dismantling** and recovery of spare parts or is destined for **material recovery** and **recycling** or final disposal. It includes off-specification or new **computing equipment** that has been sent for **material recovery** and **recycling** or final disposal.

Engineered landfills: Engineered landfills are disposal sites that are selected and designed to minimize the chance of release of hazardous substances into the environment, for example through the use of plastic landfill liners and leachate collection systems.

Environmentally sound management (ESM): The taking of all practicable steps to ensure that wastes are managed in a manner that will protect human health and the environment against adverse effects which may result from such wastes.

Essential key function: The originally-intended function(s) of a unit of equipment or **component** that will satisfactorily enable the equipment or component to be reused.

Evaluation: The initial assessment of used **computing equipment** to determine whether it is likely to be suitable for **refurbishment, repair, material recovery** or **recycling.**

Final disposal: Disposal operations specified in Annex IV A to the Basel Convention (appendix 2 A to this document).

Fully functional/Full functionality: Computing equipment or **components** are **fully functional** when they have been tested and demonstrated to be capable of performing the **essential key functions** that they were designed to perform.

Hydrometallurgical processing: The uses of aqueous chemistry for the recovery of metals from ores, concentrates or recyclable wastes or products. Typically, hydrometallurgy consists of three steps:

i) Leaching of an intermediate product with acid, caustic, or a complex forming solvent, often combined with oxidation to dissolve the desired element(s) at ambient or elevated pressures and temperatures;

ii) Purification of the solution by:

a) precipitation of insoluble compounds,

b) cementation of unwanted metals (using another metal to precipitate the metal in solution); or

c) solvent extraction;

iii) Precipitation of desired product, either as an insoluble compound or as a metal either by chemical or electrochemical methods.

Recycling reagents and treatment and disposal of effluents and residues are further important steps that occur throughout the process. Hydrometallurgical operations in authorized industrial-scale facilities are distinct from unauthorized and illegal environmentally harmful practices in the informal sector.

Incineration: A thermal treatment technology by which wastes, sludge or residues are burned or destroyed at temperatures ranging from 850° C to more than 1,100° C.

Labelling: The marking of **computing equipment, individually or in batches,** to designate its status according to the PACE guidelines.

Landfilling: The deposit of waste into land (i.e. underground), or onto land.

Material recovery: Relevant operations specified in Annex IV B to the Basel Convention (appendix 2 B to this document).

Mechanical separation: Using machinery to separate **computing equipment** into various materials **or components**.

Potential for reuse (reusable): Computing equipment and its **components** that possess or are likely to possess the quality necessary to be directly reused or reused after they have been refurbished or repaired.

Pyrometallurgical processing: Thermal processing of metals and ores, sludges and residues including roasting, smelting and remelting with the aim of recovering metals as marketable products. Pyrometallurgical operations in authorised industrial scale facilities are distinct from unauthorised and illegal environmentally harmful practices in the informal sector.

RoHS: Directive of the European Parliament and the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (http://ec.europa.eu/environment/waste/weee/index_en.htm).

Recycling: Relevant operations specified in Annex IV B to the Basel Convention (appendix 2 B to this document).

Redeployment: Any action of new deployment or use by the owner of used **computing equipment** or its **components.**

Refurbishable: Computing equipment that can be refurbished, returning it to a working condition performing the essential functions it was designed for.

Refurbishment: Modification of **used computing equipment** to increase its performance and functionality or to meet applicable technical standards or regulatory requirements**,** including through such activities as **cleaning, data sanitization and software upgrading.**

Remarketing: Any action, including marketing activities, necessary to sell previously used **computing equipment** or its **components** directly or indirectly to customers.

Repair: Fixing specified faults in computing **equipment** and/or replacing defective components of computing equipment to bring the computing equipment into a fully functional condition**.**

Reuse: Using again, by a person other than its previous owner, used **computing equipment** or a functional **component** from used **computing equipment** that is not waste for the same purpose for which it was conceived, possibly after **refurbishment, repair or hardware upgrading.**

Segregation: The sorting of **computing equipment** from other electronic wastes for possible **reuse** or for **treatment** in downstream processes that may include **recycling,** reclamation**, refurbishment, repair, reuse** or **disposal**.

Separation: The removal of specific **components** (e.g., batteries), constituents or materials from **computing equipment** by manual or mechanical means.

Small and medium-sized enterprises (SMEs): According to the European Commission, small and medium-sized enterprises are those businesses that employ fewer than 250 persons and have an annual turnover not exceeding 50 million euros or an annual balance sheet total not exceeding 43 million euros.

States concerned: States that are States of export, import or transit, whether or not parties to the Convention.

Testing: The testing of used **computing equipment** through an established protocol to determine whether it is suitable for **reuse**.

Transport of dangerous goods recommendations: United Nations recommendations on the transport of dangerous goods, which deal with classification, placarding, labeling, record keeping and other matters relating to the protection of public safety during the transport of such goods.

Treatment: Any physical, chemical or mechanical activity in a facility that processes computing **equipment,** including **dismantling**, removal of hazardous components, **material recovery, recycling** or preparation for **disposal**.

Upgrading: Modification of fully functional **computing equipment** by the addition of software or hardware to increase its performance and/or functionality.

Used computing equipment: Computing equipment that is or has been used, either by its first owner or otherwise. Used computing equipment may or may not be a waste, depending upon the waste definition and its characteristics, intended destination, and fate.

WEEE Directive: Directive of the European Parliament and the 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 law (paragraph 1 of Article 2 of the Basel Convention**).**

Working condition: See **Fully functional.**

Appendix 2

Basel Convention – Annex IV Disposal Operations

A. Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct reuse or alternative uses

Section A encompasses all such disposal operations which occur in practice.

D1	Deposit into or onto land, (e.g., landfill, etc.)
D2	Land treatment, (e.g., biodegradation of liquid or sludgy discards in soils, etc.)
D3	Deep injection, (e.g., injection of pumpable discards into wells, salt domes of naturally occurring repositories, etc.)
D4	Surface impoundment, (e.g., placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill, (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6	Release into a water body except seas/oceans
D7	Release into seas/oceans including sea-bed insertion
D8	Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations in Section A
D9	Physico chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations in Section A, (e.g., evaporation, drying, calcination, neutralization, precipitation, etc.)
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g., emplacement of containers in a mine, etc.)
D13	Blending or mixing prior to submission to any of the operations in Section A
D14	Repackaging prior to submission to any of the operations in Section A
D15	Storage pending any of the operations in Section A

B. Operations which may lead to resource recovery, recycling reclamation, direct re-use or alternative uses

Section B encompasses all such operations with respect to materials legally defined as or considered to be hazardous wastes and which otherwise would have been destined for operations included in Section A.

R1	Use as a fuel (other than in direct incineration) or other means to generate energy
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases
R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Used oil re-refining or other reuses of previously used oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Uses of residual materials obtained from any of the operations numbered R1-R10
R12	Exchange of wastes for submission to any of the operations numbered R1-R11
R13	Accumulation of material intended for any operation in Section B

Appendix 3

Packaging guidelines

1. The following guidelines may be used to distinguish proper packaging for computing equipment and components destined for direct reuse or reuse from improper packaging.

2. For shipments,[xxvii] the following packaging guidelines should be followed to help to preserve the value and reusability of equipment; they represent only one criterion among others by which to distinguish waste from non-waste:
   - Each piece of computing equipment should be protected with cushioning material appropriate to preserve its asset value (e.g., bubble wrap, packaging foam).
     - **Laptops** and their chargers should be packed together in boxes reasonably fitted to them.
   - **Batches of cables, keyboards and mice** should be packed in separate boxes.
   - Stacked layers of **computing equipment** should be separated by appropriate intermediate packaging to preserve asset value (e.g., cardboard, bubble wrap, packaging foam), and shrink wrap should be used to secure shipments to pallets.
   - Stacks of equipment should not exceed:
     - **Display devices** – four layers only, unless 17" (43.2 cm) or larger, in which case 2 layers; flat panel displays should be stacked vertically;
     - **Desktop PCs** – 15 layers;
     - **Laptops** – five layers stacked vertically;
     - **Printers** – five layers.
   - **Batteries** should be packaged in a way that prevents contact with their terminals that could cause short circuits and fires;
   - **LCD backlights** – Because they are fragile LCD backlights when removed should be individually packaged in rigid containers and sealed in foil-laminated bags to prevent breakage during transport. In general, removal and packaging of LCD backlights for reuse is a specialist activity that should be undertaken by professionals with detailed knowledge and experience in handling hazardous components.
   - Each load should be properly secured to a pallet (e.g., with plastic shrink wrap).

3. Small individual items of computing equipment should be packed in boxes, properly encased with cushioning material and surrounded by sufficient fill to prevent movement. For multiple items within the same box, each part should be separated with appropriate intermediary packaging. Boxes should be suitable for the length and type of shipping being used. Where pallets are used, boxes should be secured to pallets using shrink wrap or other means.

Appendix 4 (a)

Voluntary notification procedure

1. In cases in which used computing equipment is 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 of concerned States of import and export, the exporter will provide a statement of evaluation and intent to reuse to the government authorities[xxviii] of the States of export and import (and transit, if any) by e-mail, fax or other agreed method before the departure of the shipment from the State of export. One statement is sufficient for shipments within a period of up to one year or other period as agreed by the parties involved.

2. In the case of single shipments of greater than five units of used computing equipment, 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 probably suitable for reuse, the exporter will provide a statement to the governmental authorities of the States of export and import (and transit, if any) by e-mail, fax or other agreed method before the departure of the shipment from the State of export. In such 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, should include the following:

(a) A commitment by the exporter that PACE guidelines will be followed and assurances that such shipments will be managed in an environmentally sound manner;

(b) A description of the shipment, including in particular content, maximum count and packaging;

(c) An indication of whether the information is for a single shipment or multiple shipments and if multiple the estimated frequency at which additional shipments are to be made;

(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 telephone number) for the importer and exporter;

(g) A description of the evaluation used to determine that the used computing equipment in the shipment is suitable for reuse, possibly after repair, refurbishment or upgrading;

(h) Identification of and contact information (name, address, and telephone number) for 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 computing equipment, individually or in partitioned batches, should 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 three calendar days, or other agreed time period, and should send such 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 shall be deemed to be 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 begin for the single shipment or multiple shipments within the period of time defined in the statement. An updated statement may be submitted at any time. However:

(a) If further information[xxix] is requested by the governmental authority of the State of export or import (or transit, if any) the shipment must not begin until the requested information has been provided;

(b) If the response indicates that there is no objection but suggests conditions the shipment may begin only after the necessary conditions have been satisfied.

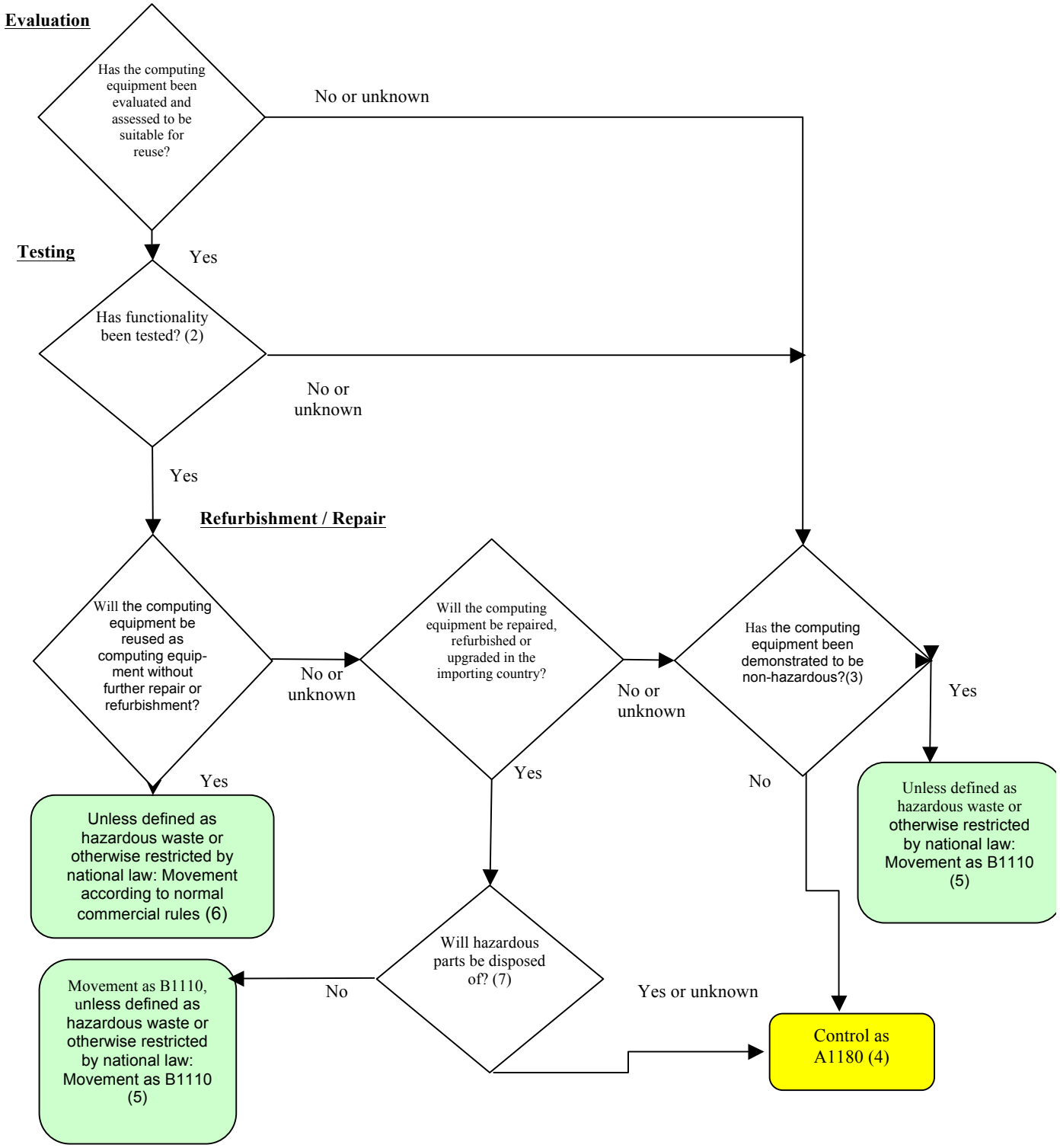
7. A statement that is marked “business confidential” is provided solely for use by governmental authorities and should not be disclosed to third parties.

8. This procedure should be reviewed at specific time intervals to ensure that the objective of environmentally sound management is upheld and to reflect the knowledge and experience gained, including knowledge and experience from proposed PACE pilot projects.

Appendix 4 (b)

Decision tree procedure

Decision tree for transboundary movements of collected used and end-of-life computing equipment (1)



Further recommendations and explanations

Movement of computing equipment within OECD or among European Union countries, which is subject to

(1) bilateral agreements or those defined-, as products under national legislation, may not be subject to this procedure.

(2) Results of evaluation and testing should be available through labelling or appropriate documentation (serial number referencing or other suitable methods).

(3) End-of-life computing equipment 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).

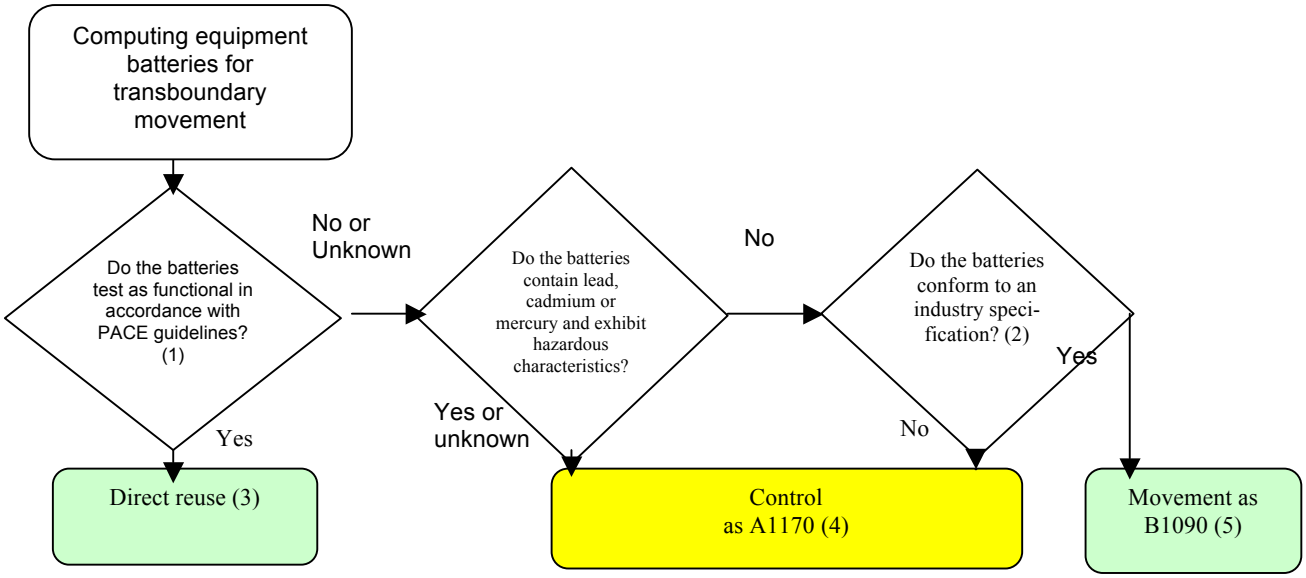
(4) The material should be controlled as hazardous waste under the Basel Convention. The code refers to the Annex VIII category. If one of the States concerned is not a party then a valid Article 11 agreement must be in place.

(5) The material should not be controlled as hazardous waste under the Basel Convention unless it is considered as a hazardous waste under Article 1.1.b by a party or is otherwise prohibited from import by a State concerned. The code refers to Annex IX of the Convention. Exporters should nevertheless ensure that there are neither export restrictions in place from the country or region of export nor import restrictions from the country of import applicable to used computing equipment.

(6) The material should not be considered to be waste, but rather a commodity, unless it is considered to be hazardous waste under Article 1.1.b by a party or is otherwise prohibited from import by a State concerned. Has the equipment or its constituents been defined as hazardous waste by the importing country under Article 1.1.b of the Basel Convention? Is there knowledge of other applicable national or regional restrictions? If so, then the equipment should be managed as A1180. Otherwise, such equipment should be recorded and declared as being fully functional and intended for direct reuse utilizing Appendix C. Subsequently, it can be shipped using the commercial shipping codes found under the Harmonized Commodity Description and Coding System, including those codes listed under section 8471 for computers and accessories and those codes under section 8443 32 for printers. For computing equipment with batteries, the batteries should have been tested to determine whether they can hold an appropriate charge (see Appendix 6).

(7) If the repair, refurbishment or upgrading will not be conducted in compliance with the PACE guidelines or if components or parts of used computing equipment involved in a transboundary movement contain Annex I constituents and are untested, non-functional or are expected to be replaced, or are 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 to be controlled hazardous waste shipments, unless it can be shown that the components or parts do not exhibit Annex III characteristics. The Governmental Authorities should make a determination as to 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 computing equipment) destined for direct reuse are not considered wastes.”
2. “Reuse can include repair, refurbishment or upgrading, but not major reassembly” in the importing country.

Decision tree for transboundary movements of collected computing equipment batteries



No.	Further recommendations and explanations
(1)	To determine whether a battery should be considered suitable for reuse and be considered non-waste, it should be tested as described in the PACE guidelines to determine whether it can hold an appropriate charge (see Appendix 6).
(2)	All computing equipment battery shipments should be sorted and/or pretreated to meet appropriate national or internationally recognized specifications.
(3)	If a battery has been tested, as described in the PACE guidelines, to determine whether it can hold an appropriate charge and has passed the test (see Appendix 6), then it is considered a commodity and not waste. Such batteries should be recorded and declared as being fully functional and intended for direct reuse utilizing Appendix C.
(4)	If a battery 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 the applicable 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 applicable Basel Convention Annex IX hazardous waste category. Exporters must nevertheless ensure that neither export restrictions in the country or region of export nor import restrictions in the country of import apply to that Annex IX category.

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

Appendix 5

Functionality tests for used computing equipment

Computing equipment	Functionality tests	Test results
Central processing units (CPUs), including desktop PCs	**Power on self test (POST)**[1] Switching on the computer and successfully completing the boot-up process. This will confirm that the principal hardware is working, including power supply and hard drive. • A working monitor should be supplied for testing if none is present. • Ensure that cooling fans are functioning.	**Computer** should boot up successfully. **Computer** should respond to keyboard and mouse input. **Cooling fans** should operate normally.
Laptops/notebooks	**Power on self test (POST)**[2] Switching on the laptop and successfully completing the boot-up process. This will confirm that the principal hardware is working, including power supply and hard drive. • Test screen. • Test battery functionality. • Ensure that the display is fully functional. • Ensure that cooling fan(s) is(are) functional.	**Laptop** should boot up successfully. **Laptop** should respond to keyboard and mouse input. **Display** should turn on during boot up. Image should be clear and colours, contrast and brightness correct with no screen-burned images, scratches or cracks (see also below for display devices). **Laptop battery** able to retain a minimum of 1 hour[3] of run time; alternatively the battery should be tested to determine that it has a full charge capacity in watt-hours of at least one hour (see Appendix 6, testing of laptop batteries).
Keyboards	Connect to computer and ensure that computer and keyboard successfully interface. Test keys for functionality.	Computer should respond to **keyboard** input. **Keyboard** should have no missing or non-functioning keys.
Mice	Assess mouse casing, cable and parts. Plug into desktop or laptop to assess functionality.	**Mouse** should have all parts present (e.g., the rollerball). Computer should respond to **mouse** input. Visible cursor on screen should not shudder.
Cables and power cords	Assess cable insulation and inspect plugs.	**Cabling and plugs** should be complete and free of damage, e.g., have no cracked insulation.
Display devices	Plug in display and test the picture quality for pixels, colour, contrast and brightness.	**Display devices:** the picture should not be fuzzy, have damaged pixels or be too dark.

[1] The power on self test (POST) is automatically engaged when a PC or laptop is switched on. POST is a software-based system integral to all PCs and laptops. POST will check that the hardware systems of the computer are functioning, including the hard drive, computer ports, the motherboard and video cards. POST will deliver an audible beep or set of beeps to the refurbisher or operator should any of the hardware systems be faulty. Online guidance exists for better understanding of the beep codes (for example, see www.poweronselftest.com/ and www.computerhope.com/beep.htm).

[2] Ibid.

[3] One hour is the minimum charge that a battery should hold, although some laptop users may request more usable run-time. It should be noted that some end-users will also be able to make use of batteries with less capacity, for example a battery able to hold 40 minutes capacity need not be discarded and could be adequate for user who will normally connect his or her laptop to a reliable electricity supply. For the purposes of this guidance and for export, however, batteries must hold at least a one-hour charge.

Computing equipment	Functionality tests	Test results
	Software-based diagnostic testing for display devices are readily available online,[4] and should be used. Visual inspection for screen burn (in the case of CRTs) or image persistence (in the case of flat screens) and scratches or other damage to screen or housing. Cabling should be inspected and present.	LCD backlights should all function. Colours, brightness, hue and straightness of lines should be considered. The software diagnostic test should be positive. Cabling should be free from damage.
Laser and inkjet printers	Print a test page with the printer in stand-alone mode or connected to a computer or local area network to assess connectivity. On inkjet printers, check that the ink heads are not clogged with dry ink.	**A printer** should successfully print a test page without jamming or producing smudged or incomplete copy.
Components (removed from equipment) including motherboards, other circuit boards, sound cards, graphics cards, hard drives, power supplies and cords/ cables	Components should be tested for functionality either before removal from the host computer or laptop or by insertion in a test bench computer using diagnostic software or a known working device, as applicable.	**Components** should be fully functional. **Power supplies and cords/ cables** should be complete and free of damage, e.g., have no cracked insulation.

[4] See, for example, www.softpedia.com/progDownload/Nokia-Monitor-Test-Download-464.html.

Appendix 6

Testing methods for laptop batteries

Method 1: Demonstration

1. This is the most commonly used method and represents a simple test, able to be undertaken by all refurbishers. The system/battery combination is tested to ensure that it can hold an appropriate charge[5] and meet the minimum run-time charge of one hour. The laptop battery should be inserted into the laptop and then fully charged. The system[6] should be started with the screensaver disabled and allowed to run functions to demonstrate the capability of operating off the power grid. The time for the battery to drain fully is recorded, with one hour of run-time being the minimum acceptable time. Some end-users may request longer-lasting batteries, according to their needs.

Method 2: Self-managing the smart battery

2. This more sophisticated test requires some expertise and knowledge and applies to newer batteries. All new laptop batteries now incorporate smart battery technology that enables them to be assessed using a battery check programme provided by the manufacturer. For a laptop powered by a smart battery, the calculated method may be used to determine run-time. The power used[7] by the laptop should be determined in watts (W). The battery should be interrogated or tested to determine the full charge capacity (FCC)[8] in watt-hours (Wh). The run-time[9] is determined by:

Run-time in hours (h) = FCC (Wh)/power used (W).

[5] "Hold an appropriate charge" means that a battery, when used in a particular system, is capable of powering the system for a time period that meets the needs of a target user, and for at least one hour. "Time period that meets the needs of a target user" is the end-user expected operational time for the mode of operation expected. Users may be using a computer system predominantly when connected to the grid, with the battery serving as a backup to allow the work product to be saved in the event of a power outage. One hour is regarded as the minimum acceptable time for this function. Other users may use the system in a portable manner demanding additional run-time.

[6] A "system" is a laptop, notebook, netbook or other portable computer.

[7] The "power used" is the actual power used by the system when the system is operating.

[8] "Full Charge Capacity" is the energy storage capacity of a battery, measured in watt-hours (Wh). This value is obtained from the microcontroller, which is part of a smart battery, from design specifications, or through measurement using equipment capable of determining the full discharge capability of a battery.

[9] One hour is regarded as the minimum acceptable time.

Appendix 7

Declaration of testing and determination of full functionality and reuse destination of exported used computing equipment

Information to be provided on testing

Consignor/holder (responsible for testing): Name: Address: Tel.: E-mail**:**	**Exporter (if different from consignor):** Name: Address: Tel.: E-mail:	**Carrier** Name: Address: Tel.: E-mail:
Importer Name: Address: Tel.: E-mail:	**User, retailer, consignee (if different from importer):** Name: Address: Tel.: E-mail:	**Country of export:** **Country of import:**

Declaration:

I, the legal holder of the used computing equipment listed below, hereby declare that prior to export the used computing equipment in this shipment, listed below, was tested after it was removed from service, or after it was repaired/ refurbished, and is in good working condition and fully functional.[10] I confirm that the equipment is being imported for the purpose of direct reuse[11] and not for recycling or final disposal.

Name: Date: Signature:

Type of equipment[12]	Model No.	Serial No. (if applicable)	Year of manufacture	Date of testing	Type of tests and comments

[10] **Fully functional/Full functionality: Computing equipment** or **components** are "fully functional" when they have been tested and demonstrated to be capable of performing the essential key functions that they were designed to perform.

Essential Key Function: The originally intended function(s) of a unit of equipment or component that will satisfactorily enable the equipment or component to be reused.

[11] Continued use of **computing equipment** and **components** by another person without the necessity of repair, refurbishment, or hardware upgrading, provided that such continued use is for the intended purpose of the **computing equipment** and **components**.

[12] List all equipment in the shipment and identify types of whole equipment, such as PC, laptop, printer and scanner. Component parts, such as circuit boards, memory, hard drives, power supplies or batteries, can be sent in a batch without the details required in columns 2 and 3 but still will need to be tested.

Appendix 8

Information accompanying shipments of computing equipment returned under warranty or otherwise excluded from control procedures

(Recommendations 3.2.7.2, 3.2.7.3 and 3.2.7.4)

<table>
<tr><td>1. Person who arranges the shipment/exporter:
Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:</td><td>2. Importer

Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:</td><td>3. Consignee/receiving facility
(if different from importer)
Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:</td><td>4. Description of the shipment/reasons for shipments:
☐ Warranty returns or subject to a law allowing for a right of return (3.2.7.2)
☐ Batches under warranty or subject to a law allowing for a right of return (3.2.7.3)
☐ Shipments of used computing equipment under a documented leasing programme (3.2.7.4)</td></tr>
<tr><td colspan="2">5. Actual quantity/volume:</td><td colspan="2">6. Actual date of shipment:</td></tr>
<tr><td>7 (a) First carrier[1]
Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td><td>7 (b) Second carrier
Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td><td colspan="2">7 (c) Third carrier
Name:
Address:
Contact person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td></tr>
<tr><td colspan="4">8. Countries/States concerned:</td></tr>
<tr><td>Export/dispatch</td><td colspan="2">Transit</td><td>Import/destination</td></tr>
<tr><td colspan="4">9. Declaration of the owner of the equipment: I hereby declare that the used computing equipment in this shipment is defective equipment being returned to the manufacturer or original component supplier or its contractual pursuant to the terms of a warranty, a law allowing for a right of return or a documented leasing programme.

Name: Date: Signature:</td></tr>
<tr><td colspan="4">10. Declaration of the person arranging for the shipment: I hereby declare that the above information is complete and correct to the best of my knowledge.

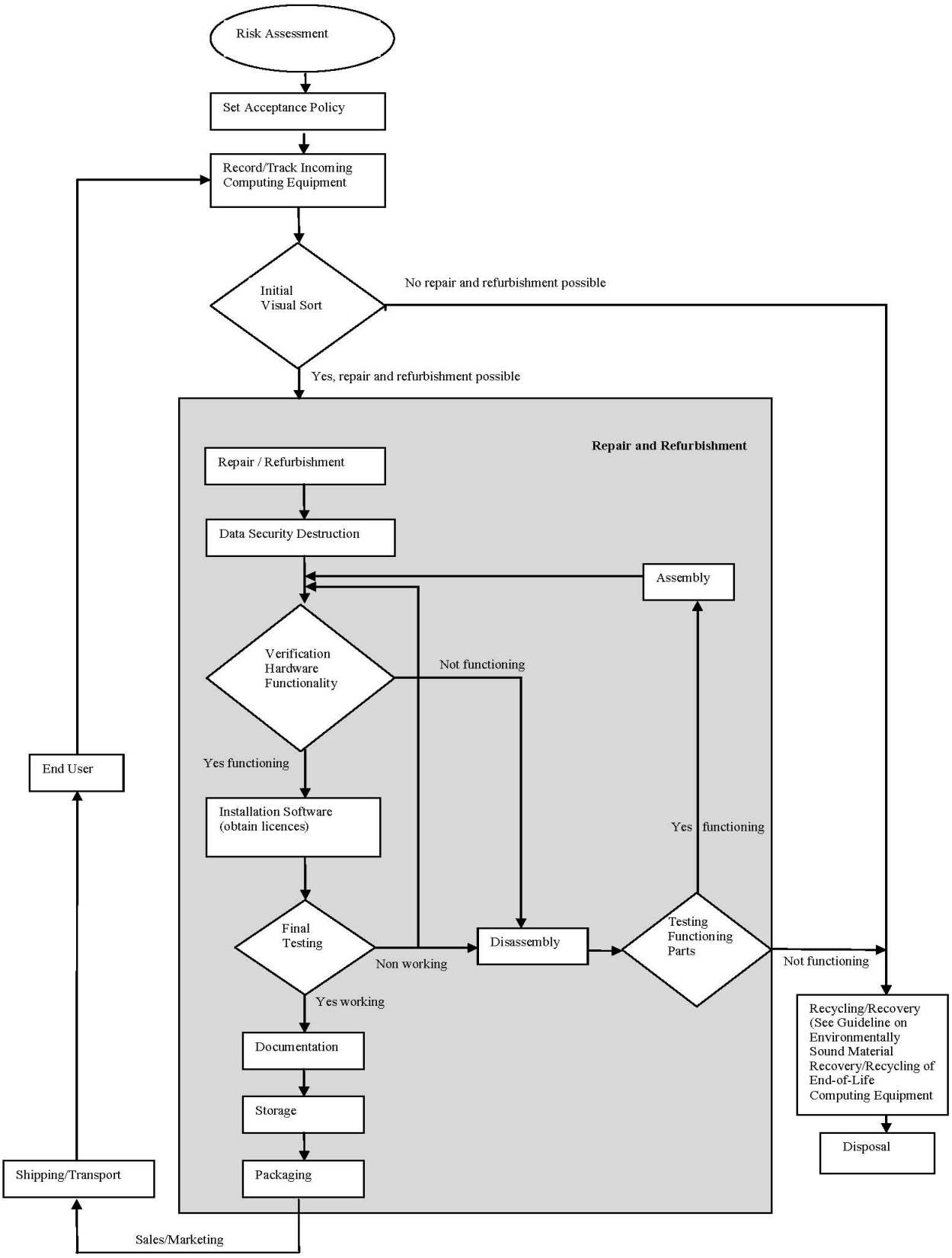
Name: Date: Signature:</td></tr>
<tr><td colspan="4">TO BE COMPLETED BY THE RECEIVING FACILITY</td></tr>
<tr><td colspan="4">11. Shipment received at the receiving facility: ☐ Quantity/volume received:

Name: Date: Signature:</td></tr>
</table>

[1] If there are more than three carriers attach a separate sheet providing the information required in blocks 7(a), (b) and (c) for the additional carriers.

Appendix 9

Flow Diagram of a Typical Environmentally Sound Refurbishment and Repair Process



Appendix 10

Principles for donors of functional used computing equipment

1. **Provide a useful product:** Donors will provide only equipment that is expected to have a significant lifespan and is functional under the expected conditions and needs in recipient countries and communities.

2. **Provide an appropriate product:** Donors will ensure that hardware and software is operable within the limitations and conditions of recipient countries and communities.

3. **Ensure and verify availability of technical support:** Donors will encourage the introduction of maintenance and technical support in recipient communities, either from the donor or in the recipient community.

4. **Test, certify and label functionality:** Donors should provide proof of testing for functionality.

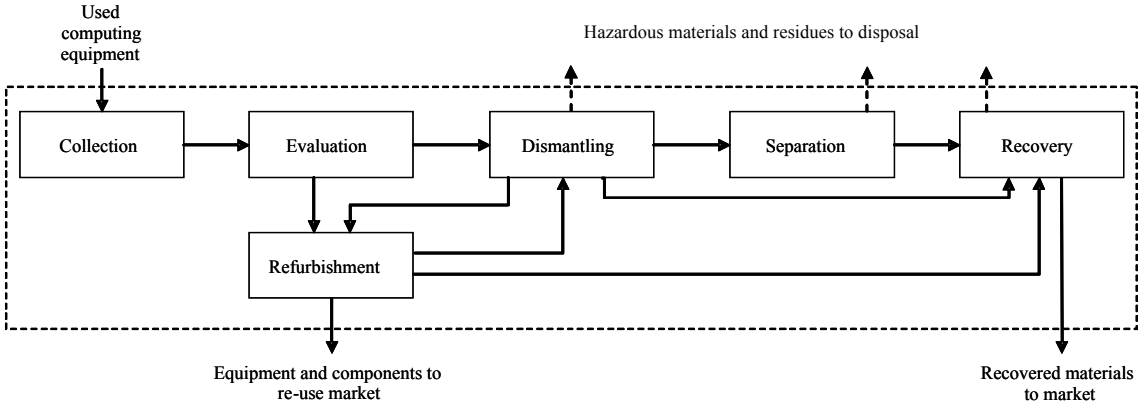
5. **Ensure availability of training:** Donors may support recipients with training programmes.

6. **Ensure full transparency, contract and notification and consent before delivery**: Donors will ensure that recipient communities consent in writing to receiving equipment in accordance with the terms and conditions of the contract entered into between the donors and the receiving communities.

7. **Export controls:** Donors should export in accordance with applicable national and international controls (see also chapter 3 of the PACE guidance document).

Appendix 11

Flow Diagram of Environmentally Sound Management of Used Computing Equipment



Step one:**Collection:** This critical step can be challenging, but is critical. Computer equipment that is discarded in household trash may never reach the next steps, may be lost for further beneficial use or may be mismanaged. In some countries, informal scavengers may look at everything before it is finally discarded and used and end-of-life computer equipment often has enough value to be collected by them. These scavengers, and informal and second-hand markets, are important sources of electronic scrap. In other countries, greater efforts and expenditure are needed to collect computers, and it may be necessary to find ways to subsidize collection systems.[xxx] Formal sector and governments should consider opportunities to engage, employ, and empower the informal sector and help transition them into formal systems, which are consistent with applicable legal and other requirements including provisions that support protection of human health, worker safety and the environment. Special collection events are often organized, or collection may take place regularly in retail stores or by mail-in collection. Charities sometimes collect computers for reuse. Collection of computers from large businesses provides an important opportunity due to both the large volumes of equipment available from one source, and the fact that a lot of this equipment is retired early and thus has significant value in the refurbishment. Step two**: Evaluation**: Once collected, computing equipment should be evaluated to determine whether it is suitable for reuse after refurbishment or repair or for material recovery depending on its potential for reuse, facility capabilities, economics and other factors. Initial evaluation of each device can be done at the initial collection site or some other point before repair, refurbishment or dismantling. Evaluation of individual components, on the other hand, will occur within both refurbishment or repair and dismantling to determine which components are suitable for reuse after refurbishment repair or material recovery. Continued use of computing equipment preserves the high value added in original manufacture, conserves resources and energy needed to manufacture new computing equipment and makes relatively inexpensive computing technology available to those who cannot afford to purchase new computers. The methods of such evaluation are outside the scope of this guideline (see guideline produced by PACE Project Group 1.1), but an experienced, knowledgeable person can often decide swiftly – based on model, age, condition and appearance – whether computing equipment has potential market value in continuing use or should be scrapped for material recovery either straight to recovery or through the dismantling and separation steps first.

Step three: **Refurbishment or repair**: Computing equipment that can still be used as computing equipment after evaluation may need to be refurbished or repaired. This includes replacement of hardware and software as needed and cleaning, labelling and distribution, with the intent of bringing a useful computer or component back on the market for continuing use. Depending on the type of component or part, those that cannot be repaired or reused should be sent to either ESM dismantling or recovery. For refurbishment activities or standards, reference should be made to PACE Project Group 1.1 for its refurbishment guideline.

Step four: **Dismantling:** Computing equipment often needs to be opened to see if its components are still working and can still be used in computing equipment, or submitted to the material recovery processes. Dismantling should be performed manually if it is intended to keep a used or end-of-life computer in working condition. Computers are usually held together by screws and simple fasteners that can be easily removed, although some parts are welded or soldered and are more difficult to separate. Dismantling can also be the

beginning of material recovery. Manual dismantling can recover not only working components, but also clean materials for recovery, such as steel cases. This type of manual separation is distinguished here from automated separation which occurs in the next step. It may also involve powerful mechanical separation of parts and components, such as shredding, which may release substances as dust and vapours.. It will be necessary to first manually remove components such as mercury lamps and batteries, etc, and their containedsubstances, some of which are hazardous, so they are not processed together with the whole device in the mechanical dismantling step so they are not released or mixed with other materials. In the case of the LCD it is well documented that mercury emission occurs, exposing the workers to high risk. Toner cartridges should also be removed unless recycling or shredding equipment has been specifically designed to handle environments where high dust concentrations in air might occur. Like many organic materials in powdered form, toner can form explosive dust-air mixtures when finely dispersed in air.. Protection of worker health and safety and the environment is necessary in such conditions, including engineered control systems, personal protective equipment such as gloves and eye protection, and more complex measures such as respiratory masks.

Step five: **Separation:** Separation is the process of sorting materials into batches and consolidating them for specialized material recovery. Computing equipment that has been evaluated to have no continuing value through refurbishment and no remaining valuable working components will be taken apart, manually or mechanically, and separated into steel, plastics and circuit boards, among other things. Relatively high levels of worker and environmental protection are needed, depending on the separation process and the materials being processed. Some materials can be swiftly returned to markets (e.g., steel cases may readily be sold on the scrap steel market), while others . may have to pass through several separation processes before they are adequately consolidated. At the end of separation, finding the appropriate ESM recovery facilities for separated waste streams is a critical part of ESM, as this final link will largely determine the ultimate material recovery achieved in the chain, as well as the magnitude of environmental impact.

Step six: **Recovery:** Recovery takes the separated batches of materials into more specialized processes, often in a series; circuit boards, for example, first go through copper recovery, followed by specialized refining of the residues to recover other metals, while engineered thermoplastics are subjected to size reduction and granulation processes. Recovery processes often involve high temperatures (e.g., smelting and other pyrometallurgical processes), or very strong chemicals (e.g., hydrometallurgical processing by acids or cyanide), or hazardous emissions and require very high levels of process technology, monitoring and worker and environmental protection.

Appendix 12

Facility measures to support environmentally sound material recovery and recycling of end-of-life computing equipment

To protect workers and communities, material recovery facilities should take steps that are guided by the following ESM criteria:

1. Top management commitment to a systematic approach
2. Risk assessment
3. Risk prevention and minimization
4. Legal requirements
5. Awareness, competency and training
6. Record-keeping and performance measurement
7. Corrective action
8. Transparency and verification

1. *Top management commitment to a systematic approach*: A material recovery facility should have the clear commitment of top management to a systematic policy approach to achieving and continually improving environmentally sound management in all aspects of facility operations, including pollution prevention and environmental health and safety. Adequate financial and human resources should be made available. The policy should be documented, implemented and communicated to all personnel, as well as to contractors and visitors as appropriate. Policy performance should be reported and reviewed periodically by top management. In larger material recovery organizations, a specific management representative or representatives should be appointed to oversee implementation of the policy through the design, implementation and maintenance of a management system.

2. *Risk assessment*: Material recovery facilities conduct heavy industrial operations involving powerful machinery, very high temperatures and hazardous chemicals. While facilities vary according to their operations and locations, they all present multiple risks to worker health and safety and potential environmental impacts both within and beyond the facility's location. Material recovery facility management should seek to identify and document hazards and risks to worker health and safety and to the environment that are associated with their existing and planned material recovery activities, products and services. It is especially important to identify potential emergency situations and accidents and how to respond to them. Response procedures should be tested and reviewed periodically, especially after accidents or emergency situations have occurred. The hazards and risks of site decommissioning and closure should be identified in advance and decommissioning plans should be prepared, including remediation and financial mechanisms to secure long-term site management if necessary.

3. *Risk prevention and minimization*: Once material recovery facility management has assessed the hazards and risks of facility activities, products and services, it should systematically seek to minimize or eliminate them. This systematic approach should first address significant existing environmental and health and safety risks, in addition to non-compliance with applicable legal requirements. It should consider technological, operational and business changes, including improved procedures, improved equipment and alternative business practices. Beyond significant existing hazards and risks, material recovery facilities should seek continually to improve the design of the workplace, process, installations, machinery, operating procedures and work organization with the aim of eliminating or reducing Environmental Health and Safety (EHS) hazards and risks at their source. All these improvements should be documented and communicated to all personnel, as well as to contractors and visitors as appropriate. It is particularly important to have good communication with suppliers and buyers of recovered materials about the content and risks associated with those materials in the very specific circumstances of material recovery processing.

4. *Legal requirements*: Material recovery facilities dealing with used and end-of-life computing equipment are required to have all operating permits, licenses or other authorizations that apply to their operations, especially if the equipment is defined as waste under the law of the countries in which they operate, as is often the case. A facility should always be in compliance with such permits, licences and authorizations. A systematic approach to environmentally sound management includes regular evaluations to identify applicable laws, including amendments and new laws, and to determine how they apply to a facility and its operations. A systematic approach also includes periodic communication and a sound working relationship with the competent authorities. Because material recovery operations may involve transboundary movement of supplies, wastes and products, a material recovery facility should also take care to ensure compliance with

applicable international laws, including the Basel Convention, and to respect laws of other countries concerned.

5. *Awareness, competency and training*: Facility managers should ensure that all those engaged in material recovery operations are trained to carry out their responsibilities safely. This means that employees should not only be trained in how to carry out facility operations but also should have an appropriate level of awareness of hazards and risks, and should achieve competence with regard to the effective management of these hazards and risks, including how to respond to and deal with foreseeable emergencies or accidents. This should follow from the risk assessment and risk prevention and minimization steps described above. Worker competence also requires access to special tools associated with material recovery operations, test equipment, materials handling equipment and information such as material safety data sheets for all substances, in addition to training in understanding and using them. Where possible, photographs and diagrams should be added to written instructions used to train workers in material recovery operations.

6. *Record-keeping and performance measurement*: A systematic approach to environmentally sound management includes the creation and maintenance of documents that record the details of such management. When an operating procedure has been documented, it can be properly executed in a consistently safe manner, and regularly improved. Documents that record the training of employees can be reviewed to ensure that training is complete and appropriate to the tasks assigned to those employees. Inspection, testing and assessment of used computing equipment can be reviewed to ensure that efficient and environmentally sound management is taking place in accordance with facility and legal requirements. There is little or no activity at a material recovery facility that will not be improved by appropriate records of such activity, accompanied by periodic review with intent to improve.

7. *Corrective action*: A material recovery facility should take appropriate action to respond to risks to worker health and safety and the environment that it identifies in risk assessments or that are brought to its attention by others, such as competent authorities or third parties. Failings in achieving ESM should also be addressed. Preventive and corrective actions should be appropriate and proportionate, and should be documented. The need for corrective action should be presented to senior management, in addition to the results of such action.

8. *Transparency and verification*: Material recovery facilities deal with end-of-life computing equipment that may be hazardous to the health and safety of their workers and the environment. They should therefore have regular, scheduled inspections and monitoring of all hazards, following documented procedures. If possible, such inspections and monitoring should be conducted by persons not involved in environmental management within the facility operations or by third parties. Such documented inspection and monitoring procedures may be required by law, but should in any case constitute part of a systematic approach to environmentally sound management. A facility's environment, health and safety policy, and its inspection and monitoring schedule and results, should be available to the public and to customers and clients who perform due diligence investigations of facility activities and operations.

Appendix 13

References

These documents were considered during the working period of the project groups. Some of these documents may have been revised, updated or substituted.

United Nations

1. Draft technical guidelines on the environmentally sound recycling/reclamation of metals and metal compounds (R4). Basel Convention (http://www.basel.int/meetings/cop/cop7/docs/08a3e.pdf).
2. E-waste Take-back System Design and Policy Approaches. Solving the E-waste Problem (StEP). (January 28, 2009) (http://www.step-initiative.org/pdf/white-papers/StEP_TF1_WPTakeBackSystems.pdf).
3. Guidance document on the environmentally sound management of used and end-of-life mobile phones. Basel Mobile Phone Partnership Initiative (Sep 15, 2008) (http://www.basel.int/industry/mppi/MPPI%20Guidance%20Document.pdf).
4. Guidance Document on the Preparation of Technical Guidelines for the Environmentally Sound Management of Wastes Subject to the Basel Convention (http://www.basel.int/meetings/sbc/workdoc/framewk.doc) .
5. Guideline on Material Recovery and Recycling of End-of-Life Mobile Phones (Approved Draft). Basel Mobile Phone Partnership Initiative Project 3.1. (March 25, 2009) (http://www.basel.int/industry/mppiwp/guid-info/guidmaterial.pdf).
6. Guideline on Awareness Raising-Design Considerations (Revised and Approved Draft). Basel Mobile Phone Partnership Initiative Project 4.1. (March 25, 2009) (http://www.basel.int/industry/mppiwp/guid-info/guiddesign.pdf).
7. Guideline for the Transboundary Movement of Collected Mobile Phones (Approved Final Draft). Basel Mobile Phone Partnership Initiative Project 2.1. (March 25, 2009) (http://www.basel.int/industry/mppiwp/guid-info/guidTBM.pdf).
8. Guideline on the Collection of Used Mobile Phones (Approved Draft). Basel Mobile Phone Partnership Initiative Project 2.1. (March 25, 2009) (http://www.basel.int/industry/mppiwp/guid-info/guidcoll.pdf).
9. Guideline on the Refurbishment of Used Mobile Phones (Revised and Approved Draft). Basel Mobile Phone Partnership Initiative Project 1.1. (March 25, 2009) (http://www.basel.int/industry/mppiwp/guid-info/guidrefurb.pdf).
10. One Global Understanding of Re-Use - Common Definitions. Solving the E-waste Problem (StEP). (March 5, 2009) (http://www.step-initiative.org/pdf/white-papers/StEP_TF3_WPCommonDefinitions.pdf).
11. The Entrepreneur's Guide to Computer Recycling. United Nations Educational, Scientific and Cultural Organization (UNESCO) (http://www.ticethic.com/guide).

OECD

12. Council Recommendation C(2004)100 on the Environmentally Sound Management of Waste (9 June 2004) (http://webdomino1.oecd.org/horizontal/oecdacts.nsf/linkto/C(2004)100).
13. Guidance Manual for the Implementation of the Council Recommendation C(2004)100 on the Environmentally Sound Management of Waste. (2007) (http://www.oecd.org/dataoecd/23/31/39559085.pdf).
14. Technical Guidance for the Environmentally Sound Management of Specific Waste Streams: Used and Scrap Personal Computers (18 Feb 2003) (http://www.olis.oecd.org/olis/2001doc.nsf/LinkTo/NT000009E2/$FILE/JT00139462.PDF).

North America

15. .Basel Action Network (BAN) e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment (http://e-stewards.org/certification-overview/the-e-steward-standard/)
16. Best Management Practices for Electronic Waste. California Integrated Waste Management Board (April 2004)(http://www.ciwmb.ca.gov/Publications/electronics/63004005.pdf).
17. Canada: Electronics Recycling Standard / Electronics Recycler Qualification Program www.epsc.ca/
18. Canada: Electronics Reuse and Refurbishing Program (ERRP) www.estewardship.ca/
19. Closing the Loop. Electronics Design to Enhance Reuse/Recycling Value. Green Electronics Council (January 2009) (http://www.greenelectronicscouncil.org/documents/0000/0007/Design_for_End_of_Life_Final_Report_090208.pdf).
20. Creating a Successful Computer Reuse Programme – a guide (http://www.computersforclassrooms.org/Building%20Successful%20Manual%202-18-10.pdf).
21. Dell's Recovery and Waste Disposition Channels. Environmental Guidelines (December 2005) (http://www.dell.com/downloads/global/corporate/environ/Disposal_Guidelines.pdf).
22. e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment (http://www.e-stewards.org/documents/e-StewardStandard_ExcerptedVersion.pdf).
23. Hewlett-Packard Standard 007-2 Vendor Requirements for Hardware Recycling (October 13, 2008) (http://www.hp.com/hpinfo/globalcitizenship/environment/recycle/finalrecstds.pdf).
24. Implementation Guide for Information Technology Equipment Disassembly and Sorting Centres. Centre québécois de développement (http://www.nrcan-rncan.gc.ca/mms-smm/busi-indu/rad-rad/pdf/cfe-imp-eng.pdf).
25. Ifixit step by step repair guide (www.ifixit.com).
26. Plug-In To eCycling: Guidelines for Materials Management. USEPA (May 2004) (http://www.epa.gov/epawaste/partnerships/plugin/pdf/guide.pdf).
27. Recycler Vendor Qualification Standard. Electronic Product Stewardship Canada (Mar 2006) (http://www.epsc.ca/pdfs/March2006_RVQP_standard.pdf).
28. Recycling Industry Operating Standard (RIOS), Institute of Scrap Recycling Industries (ISRI) (http://www.firstenvironment.com/html/environmental_management_syste7.html).
29. Recycling Vendor Qualification Guidance Document. Electronic Product Stewardship Canada (March 2006)(http://www.epsc.ca/pdfs/March2006_RVQP_GD.pdf).
30. Recycling Vendor Qualification Process. Electronic Product Stewardship Canada (March 2006) (http://www.epsc.ca/pdfs/March_2006_FINAL_Recycler_Qualification_Proce_ss.pdf).
31. Responsible Recycling "R2" Practices for use in Accredited Certification Programs for Electronics Recyclers (October 30, 2008) (http://www.decideagree.com/R2%20Document.pdf).
32. US EPA guide on what to do if a CFL breaks in the home (transferable to refurbishment operations) (www.epa.gov/cfl/cflcleanup.html).
33. USA e-Stewards http://e-stewards.org/
34. USA R2 (Responsible Recycling Practices for Use in Accredited Certification Program for Electronics Recyclers) http://www.r2solutions.org
35. USA RIOS (Recycling Industry Operating Standard) http://www.isri.org/rios
36. USA R2/RIOS http://www.CertifiedElectronicsRecycler.org
37. Waste Diversion Ontario's Draft Waste Electrical and Electronic Equipment Diversion Standard (October 2007) (http://www.ene.gov.on.ca/envision/land/WDA/electronics/finalWEEProgramPlan-appendices.pdf).

Europe

38. Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE). Consolidated version (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2002L0096:20080321:EN:PDF).
39. European Eco-Management Audit Scheme(EMAS) (http://ec.europa.eu/environment/emas/index_en.htm).
40. EU WEEE Forum WEEELABEX scheme (http://www.weee-forum.org/index.)
41. France FEDEREC's CERTIREC http://www.federec.org/qualification-certification/certirec.html
42. Germany Efb www.gesetze-im-internet.de/bundesrecht/efbv/gesamt.pdf
43. HB 10194 *Code of Practice for in-service inspection and testing of electrical equipment*. The Institutionn of Engineering and Technology (http://www.theiet.org/publishing/books/wir-reg/cop.cfm).
44. Reuse of waste and used electrical and electronic equipment, UK Publicly Available Specification (PAS 141) to be published January 2011 (http://shop.bsigroup.com/Navigate-by/PAS/)
45. United Kingdom PAS 141 (Publicly Available Specification) on Reuse of Used and Waste Electrical and Electronic Equipment (to be published 2011) http://shop.bsigroup.com/Navigate-by/PAS/
46. UK Government National technical Authority for Information Assurance(CESG) Directory of Infosec Assured products, Section 7 for information on approved data destruction systems (http://www.cesg.gov.uk/publications/media/directory.pdf).

Developing countries and countries with economies in transition

47. E-waste assessment in Uganda: A situational analysis of e-waste management and generation with special emphasis on personal computers. UNIDO, Microsoft. (2008) (http://ewasteguide.info/system/files/Finlay_2008_eWASA.pdf);http://ewasteguide.info/Wasswa_2008_UCPC-Empa).
48. E-waste Assessment South Africa. Hewlett Packard, DSF, EMPA. (November 2008) (http://ewasteguide.info/system/files/Finlay_2008_eWASA.pdf).
49. E-waste Management in Kenya. Hewlett Packard, DSF, Empa. (July 2008) (http://ewasteguide.info/system/files/Waema_2008_KICTANet.pdf); http://ewasteguide.info/Waema_2008_KICTANet).
50. Guidelines for Environmentally Sound Management of E-waste. India Central Pollution Control Board (CPCB) and Ministry of Environment & Forests (March 12, 2008) (http://www.cpcb.nic.in/e_Waste.php).
51. Technical report on the assessment of e-waste management in Morocco. Hewlett Packard, DSF, EMPA. (August 2008) (http://ewasteguide.info/system/files/Laissaoui_2008_CMPP.pdf).

Other

52. Darik's Boot and Nuke which offers a free download (http://www.dban.org/download)

53. ISO 14000 series for environmental management (http://www.iso.org/iso/iso_14000_essentials).

54. ISO 14001 Environmental Management Systems – Requirements with Guidance for Use (second edition 2004-11-15) (http://www.iso.org).

55. ISO 14004 Environmental Management Systems – General Guidelines on Principles, Systems and Support Techniques (second edition 2004-11-15) (http://www.iso.org).

56. Occupational Health and Safety Management Systems – Specification (BSI - OHSAS 18001: 1999)

57. Social and Environmental Responsibility in Metals Supply to the Electronic Industry. Global e-Sustainability Initiative (GeSI). (June 20, 2008) (http://www.gesi.org/files/20080620_ghgm_ser_metalstoelectronics.pdf).

58. Tools for Environmentally Sound Management, Bureau of International Recycling (BIR) (EN 2006 / ES 2008 / FR 2009) (http://www.bir.org/pdf/GuideESM.pdf (English); (http://www.bir.org/pdf/GuideESM_FR.pdf (French); (http://www.bir.org/pdf/GuideESM_ES.pdf) (Spanish).

Appendix 14

Endnotes

[i] United Nations Recommendations on the Transport of Dangerous Goods: Model Regulations, 15th revised edition, 2007, or later version.

[ii] http://www.un.org/millenniumgoals/

[iii] eTForecasts publishes market research reports for the PC and Internet industries.

[iv] Press release, "Basel Conference Addresses Electronic Wastes Challenge", 27 November 2006, UNEP

[v] "Electronic Waste Management in the United States", approach 1, table 3.1, EPA530-R-08-009 United States Environmental Protection Agency, July 2008

Recommendations will take into consideration Principle 11 of the Rio Declaration on Environment and Development.

[vi] PACE Interim Project Group, report on ESM criteria recommendations, March 2009

[vii] http://www.basel.int/meetings/sbc/workdoc/framewk.doc

[viii] http://webdomino1.oecd.org/horizontal/oecdacts.nsf/linkto/C(2004)100

[ix] http://www.olis.oecd.org/olis/2001doc.nsf/LinkTo/NT000009E2/$FILE/JT00139462.PDF

[x] http://www.basel.int/meetings/sbc/workdoc/framewk.doc

[xi] Ad interim group report on ESM criteria recommendations

[xii] Ibid.

[xiii] "PACE Subgroup on TBM, Guidance on Transboundary Movement of Used and End-of-life Computing Equipment", 31 January 2011

[xiv] Reuse: The process of using again used computing equipment or a functional component from used computing equipment, possibly after repair, refurbishment or upgrading (from the PACE Glossary of terms)

[xv] The documentation should accompany the movement and refer to the computing equipment in the shipment.

[xvi] Such determination should be made through parties' obligations under articles 3 and 13 of the Basel Convention. Each party has the obligation to inform the other, through the Basel Convention Secretariat, of its national definitions and of any subsequent changes, which includes any additional substances and/or objects as wastes and hazardous wastes. URL: http://www.basel.int/natreporting/index.html

[xvii] Ibid.

[xviii] Glossary of terms, appendix 1

[xix] Fully functional/Full functionality: Computing equipment or components are "fully functional" when they have been tested and demonstrated to be capable of performing the essential key functions they were designed to perform.

Essential key function: The originally intended function(s) of a unit of equipment or component that will satisfactorily enable the equipment or component to be reused.

[xx] Glossary of terms, appendix 1

[xxi] PACE Project Group 1.1, "Guideline on Environmentally Sound Testing, Refurbishment and Repair of Used Computing Equipment", January 2011

[xxii] Ibid.

[xxiii] http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_PUBL_9221116344_EN/lang--en/index.htm

[xxiv] PACE Project Group 2.1, "Guidelines on Environmentally Sound Material Recovery/ Recycling of End-of-Life Computing Equipment", January 2011

[xxv] Ibid.

[xxvi] http://www.ilo.org/global/publications/ilo-bookstore/order - online/books/WCMS_PUBL_9221116344_EN/lang--en/index.htm

[xxvii] These provisions are in addition to applicable requirements under the United Nations Recommendations on the Transport of Dangerous Goods (i.e., UN Orange Book): Model Regulations, 15th revised edition, 2007, or later version.

[xxviii] 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 computing equipment destined for reuse, possibly after repair, refurbishment or upgrading.

[xxix] The request for such information may indicate that more stringent provisions are to be applied, such as those of the Basel Convention.

[xxx] Examples of funding mechanisms:

- Advance disposal fees – paid by the consumer at sale, either in the form of a visible fee shown on the receipt as a separate item or an invisible fee included without specific mention in the total sale price.
- Levy on import – paid by the importer of a product at the point of entry into the country (either collected and managed by the industry or by the Government)
- Waste arisings – collection and recycling costs are paid for by the producer and importer at the time the product enters the waste stream. The costs can be calculated based on current or historic market share and may or may not include legacy and orphan wastes.
- End-user-pays – the end-user pays a fee for collection and recycling costs at the point of disposal.
- Rate-payer –collection and recycling costs are defrayed by all taxpayers through their rates payments.
- Short-term grant funding – grants can be awarded for short-term projects such as initial collection infrastructure and are available from a variety of sources, including private sector, trusts, Governments, lotteries, landfill taxes and others.