FULL REGULATORY IMPACT ASSESSMENT (RIA) FOR THE DEPARTMENT OF TRADE AND INDUSTRY'S REGULATIONS TRANSPOSING DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL ON THE RESTRICTION OF THE USE OF CERTAIN HAZARDOUS SUBSTANCES IN ELECTRICAL AND ELECTRONIC EQUIPMENT IN THE UK

PURPOSE AND INTENDED EFFECT OF MEASURE

The Objective

1. The Department of Trade and Industry is responsible for implementation of Directive 2002/95/EC of the European Parliament and of the Council on the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment, ("the RoHS Directive"), into UK law. The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations ("the RoHS Regulations") gives effect to the Directive.

2. The objective of the RoHS Regulations is to reduce the environmental impact of Electrical and Electronic Equipment (EEE) in the UK during the manufacture of EEE, and after EEE becomes waste. Given the trans-boundary nature of these impacts, the SI is also intended to contribute to environmental protection at the European level more widely. The RoHS Directive has the legal basis of a Single Market Directive[1], and hence the SI aims to maintain and facilitate the European Single Market in relation to the free movement of EEE.

The Background

3. The production of EEE continues to be one of the fastest growing manufacturing sectors in the world. Technological advancements and market expansion have resulted in increasing levels of product replacement and increasing levels of waste. Waste electrical and electronic equipment (WEEE) is a priority waste stream of the European Community[2], because of the estimated growing volume of WEEE and because of the potential hazardous nature of EEE following its disposal. This means that WEEE can have a disproportionate negative impact on the environment and on human health and animal health in relation to the volume of waste discarded and disposed of subsequently. Directive 2002/96/EC ('the WEEE Directive') deals with the problem of WEEE in Europe[3].

[1] Under Article 95 of the Treaty establishing the European Community.

[2] The Community programme of policy and action in relation to the environment and sustainable development ("Fifth Action Programme") contains an entire chapter dedicated to waste management issues, in which WEEE is mentioned as a 'target' area.

[3] The Waste Electrical and Electronic Equipment Directive ('The WEEE Directive').

4. The RoHS Directive (Directive 2002/95/EC) complements the WEEE Directive and takes its scope from the WEEE Directive. The RoHS Directive restricts the use of lead, mercury, cadmium, hexavalent chromium, and two brominated flame retardants, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), in the manufacture of new EEE to be put on the European Market from the 1st of July 2006.

5. On 18 August 2005 the Commission adopted a Decision amending the RoHS Directive (Commission Decision 2005/618/EC) pursuant to Article 5 (1) (a) of the RoHS Directive. Accepting that it is virtually impossible to ensure that no trace of materials or substances exist in products, the Decision sets limits to amounts of lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE to be tolerated in new EEE put on the market. These maximum concentration values (MCVs) are 0.1 per cent by weight in homogenous materials[4] for lead, mercury, hexavalent chromium, PBB, and PBDE, and 0.01 per cent for cadmium.

6. The RoHS Directive applies to the following categories of EEE covered by the WEEE Directive:

Category 1 - Large household appliances
Category 2 - Small household appliances
Category 3 - IT and Telecommunications equipment
Category 4 - Consumer equipment
Category 5 - Lighting equipment
Category 6 - Electrical and electronic tools
Category 7 - Toys, leisure and sports equipment
Category 10 - Automatic dispensers

7. The RoHS Directive also applies to electric light bulbs and luminaires used in households.

8. The two categories of EEE not included within the scope of the RoHS Directive but covered by the WEEE Directive are: Medical Devices (Category 8) and Monitoring & Control Instruments (Category 9)[5].

9. The RoHS Directive provides a limited number of exemptions from its provisions in terms of both equipment and parts, and in terms of certain applications of the restricted materials and substances.

10. Exemptions for equipment and parts are: large-scale stationary industrial tools (within category 6); spare parts for the repair of EEE first placed on the European

[4] Homogeneous materials are defined as those that cannot be mechanically disjointed into different materials.

[5] Article 6 of the RoHS Directive asks the European Commission to present proposals for including EEE falling within these categories within the scope of the RoHS Directive, once scientific and technical evidence has demonstrated that such proposals are feasible.

market before 1 July 2006[6]; EEE which is re-used and was first placed on the European market before 1 July 2006.

11. Exemptions for certain applications are for: the use of mercury in certain applications in fluorescent lamps (4 exemptions); the use of lead in the glass of Cathode Ray Tubes (CRTs), fluorescent tubes and electronic components and electronic ceramic components, and in certain soldering applications (3 exemptions); the use of cadmium in plating (1 exemption); and the use of hexavalent chromium in cooling systems in absorption refrigerators (1 exemption).[7]

12. Given that the RoHS Directive takes its scope from the WEEE Directive, the DTI view is that certain provisions in the WEEE Directive may also apply to the RoHS Directive. Thus as well as the exemptions outlined above the DTI considers the following could also be outside the scope of the RoHS Regulations: EEE intended specifically to protect national security and/or for military purposes; EEE that is part of another type of equipment that is not within the scope of the RoHS Directive; and products where electricity is not the main power source or electricity is not needed to fulfil the primary function. The DTI view is only an interpretation of the RoHS Directive and not legally authoritative but is consistent with that of the Commission.[8]

Risk Assessment

13. The materials and substances restricted by the RoHS Regulations have been identified as having the potential to adversely affect human health, animal health, and the environment from the manufacture of EEE and following the disposal of EEE as waste (WEEE).

14. The Commission's Explanatory Memorandum (EM) to the WEEE and RoHS Directives[9] and a report for the Commission in 2002[10] outline the risks from a range of materials and substances, which are used in the manufacture of EEE. These include:

- **Lead**. For the adult population the major exposure pathway is via food and water. For children lead in dust and soil is also a major exposure pathway. Lead can result in a wide range of biological effects depending upon the level and duration of exposure, but the main concern is often considered in terms of the negative impact on the central nervous system. In terms of animal health, lead does not bioaccumulate in most organisms, but may accumulate in bones and can result in deformities.

[6] Following discussions at the Commission's Technical Adaptation Committee (TAC) this has been extended to include spare parts that expand the capacity of and/or upgrade EEE placed on the market before this date provided the EEE concerned is not put on the market again as a new product.

[7] The Commission is currently reviewing the status of lead used in lead-bronze bearing shells and bushes, and a number of additional requests for exemption it has received from industry.

[8] See *Frequently asked questions on the RoHS and WEEE Directives* – European Commission.

[9] COM (2000) 347 final, June 2000.

[10] *Heavy Metals in Waste,* Final Report – European Commission DG Environment.E3, February 2002

- **Mercury**. Mercury is a volatile element, which may be transported over long distances by air. In terms of human exposure the main exposure pathways are via the inhalation of vapours and via ingestion in food. Mercury is toxic and possibly carcinogenic. In terms of animal health, mercury can have adverse impacts on the central nervous system and kidneys of birds and mammals, and negative impacts on the reproductive systems of fish.

- **Cadmium**. Cadmium tends to bioaccumulate. The major route through which humans are exposed is via the food chain. The main risk to human health is kidney damage. In terms of animal health, cadmium can produce a wide variety of negative effects on birds and mammals similar to those seen in humans.

- **Hexavalent Chromium**. Hexavalent chromium (Cr(VI)) can have a wide range of adverse effects on humans ranging from irritation to cancer. In terms of animal health, Cr(VI) is toxic to micro-organisms and can accumulate in aquatic species.

- **PBB and PBDE**. PBBs, tetra-BDE, penta-BDE and octa-BDE are toxic and dangerous to human health.

OPTIONS

15. The UK Government agreed to the adoption of the RoHS Directive at the beginning of 2003, and the Directive entered into force on its date of publication in the *Official Journal* on 13 February 2003. Member states were required to transpose the Directive by 13 August 2004.

16. The UK has been awaiting a Commission Decision on the maximum concentration values (MCVs) allowable for lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE in EEE in order to effectively implement the RoHS Directive. . The Commission Decision of 18 August 2005 on MCVs (published in the *Official Journal* on 19 August 2005) will enable implementation of the RoHS Directive in the UK that is proportionate, effective and dissuasive. This Decision and the Commission's *Frequently Asked Questions* document should also facilitate consistent implementation of the RoHS Directive across member States and help promote the Single Market in EEE.

17. The UK has played an active role in the Commission's Technical Adaptation Committee (TAC) for the WEEE and RoHS Directives to ensure that the RoHS Directive is interpreted in a consistent and proportionate manner across member States.

COSTS AND BENEFITS

18. The costs and benefits from the DTI's RoHS Regulations transposing the RoHS Directive are estimated in this full RIA against a base case of 'business as usual', i.e. of the Directive not being transposed into UK law and current practices in relation to the use of materials and substances in the production of EEE continuing in the future.

<u>Benefits</u>

19. The main benefit of the RoHS Regulations will be a reduction in harm to human health and animal health, and a reduction in environmental damage from the restriction on the use of lead, mercury, cadmium, hexavalent chromium, PBB and PBDE in EEE. Whilst these benefits exist, they are extremely difficult to quantify given that the use of the relevant materials and substances in EEE is only one means through which these materials and substances can accumulate in the environment and adversely affect human health and animal health.

Lead

20. Lead in EEE is estimated to account for around 3 to 4 per cent of lead consumed in the UK annually, though there is little data to provide robust estimates. Of this, lead used in the glass of CRTs is estimated to account for the majority, at around 3.5 per cent, and lead used in solder is estimated to account for the remaining 0.5 per cent. Total annual use in the UK of lead in electronic solder is estimated to be in the range of 1400 to 4300 tonnes. The exemptions in the RoHS Directive mean an estimated 1000 to 3000 tonnes could be restricted from use in EEE.

21. This restriction in use will reduce the risk of lead entering the environment either at the manufacturing stage of EEE or following disposal of EEE as waste (WEEE). In terms of disposal of EEE, the restrictions on the use of lead in EEE will reduce the risks of lead leaching from landfills and of lead being emitted to air from waste incineration.

22. It is difficult to quantify the benefits that will result from the reduction in such risks. They will contribute to reducing further blood lead level in the UK, and given the toxicity of lead will contribute to protection of human health and animal health and to protection of the environment over the medium and longer term.

Cadmium

23. The vast majority of cadmium is used in batteries, which are outside the scope of the RoHS Directive. Estimates for the EU are that batteries may account for as much as 73 per cent of cadmium use. Cadmium use in pigments, stabilisers, plating and alloys is estimated to account for the remaining 27 per cent, representing an estimated total of some 700-800 tonnes in the EU. The UK is approximately one-sixth of the EU and if we assume cadmium use is proportional to size this would imply cadmium consumption in the UK of around 120-130 tonnes per annum.

24. Of this consumption, around 9 per cent is estimated to be used in EEE. Of this 9 per cent, an estimated 8 per cent is used in plating, which has an exemption under the RoHS Directive. The remaining 1 per cent is used in EEE solder alloy and other minor applications.

25. The restriction on cadmium use in EEE under the RoHS Directive will have the effect of reducing cadmium in landfill, therefore reducing the risk of cadmium leaching into soil and groundwater, as well as reducing cadmium emissions to air

following waste incineration. However, it is difficult to quantify the benefits that will accrue from this.

Hexavalent Chromium (CrVI)

26. Little robust data exists on the extent of use of hexavalent chromium in EEE in the UK. The EEE industry itself has been moving away from the use of CrVI, where it can, given the hazardous nature of the substance.

27. Though the restrictions on CrVI use in EEE from the RoHS Directive will bring benefits it is not possible to quantify these benefits with any level of accuracy at this time.

Mercury

28. The Commission's Explanatory Memorandum estimated that 22 percent of mercury consumption is used in EEE. However, worldwide demand for mercury has been declining for many years, and its use in EEE products is estimated to be declining at an even greater rate. Mercury is used in EEE in switches, measuring and control equipment, in fluorescent tubes, and in batteries. The scope and exemptions of the RoHS Directive mean that mercury can continue to be used in EEE in many cases, and this means that the benefits from restrictions in mercury use under the RoHS Regulations may be somewhat limited.

PBB and PBDE

29. PBB and octa-PBDE and penta-BDE are no longer used in the manufacture of EEE in the UK. PBB, octa-BDE, and penta-BDE may still be produced in Asia and so could occur in EEE imported into the UK or potentially in products where recycled plastics are used. Deca-BDE is believed to be widely used in plastics in EEE but the extent of use is not known with certainty. The RoHS Regulations should produce benefits from a reduction in the risk of such substances entering the environment or having a negative impact on human health and animal health in the future.

Costs

30. It is not straightforward to estimate the costs following transposition of the RoHS Directive in the UK. This is because there is relatively limited data available on the extent to which the restrictions imposed by the Directive will impact on businesses producing EEE and the number and type of products that will be affected. The RoHS Directive does not impact on all EEE. It takes its scope from the WEEE Directive. The WEEE Directive provides an indicative, but not exhaustive, list of products to which it applies. The RoHS Directive is narrower in scope than the WEEE Directive, as it does not apply to medical devices and monitoring and control equipment. Much of this equipment is specialised equipment in which the UK is a significant market player.

31. Moreover, the RoHS Directive provides for a number of exemptions for certain applications using lead, mercury, cadmium, and hexavalent chromium in the manufacture of EEE. These exemptions have been granted because it is currently not technically or scientifically practical to eliminate or substitute these materials. These exemptions will limit cost impacts but the extent of this is not known with certainty. The recent Commission Decision on the establishment of maximum concentration values (MCVs) for the relevant materials and substances will also limit cost impacts in comparison to no traces being allowed. But again this is not easy to value with certainty.

32. On top of this it is difficult to estimate precisely the number of businesses who will be affected by the RoHS Directive, the extent to which they will be affected, and the level and timing of additional activity they will need to undertake to comply with the restrictions of the Directive. This is further complicated by the presence of multinational companies undertaking activity on a worldwide basis, in the presence of sometimes complex supply chains, and in the presence of industry voluntarily moving away from the use of certain hazardous substances.

33. It is clear that the RoHS Regulations will require additional activity to be undertaken by UK businesses compared to the business-as-usual case of no Directive. This additional activity is expected to consist mainly of: capital expenditure to either up-grade/modify or replace existing machinery; research and development (R&D) expenditure to find, test and employ substitutes to replace the restricted materials and substances; operating expenditure in terms of purchasing alternative materials and substances and in terms of increased energy costs as a consequence of substitution; and expenditure to demonstrate compliance with the RoHS Regulations.

34. The extent to which these additional activities will take place will vary by material and substance, by application, by manufacturing process, and by particular business and business sector affected. Given the exemptions on certain applications, and the scope of the RoHS Directive in relation to the EEE products it covers[11] it is estimated that around 50 per cent of total UK businesses producing EEE will be affected directly by the RoHS Regulations in one form or another.[12]

35. The most significant cost element of the RoHS Regulations relate to the restrictions it introduces on the use of lead in EEE. The use of lead in soldering in EEE has been widely established for many years, and it substitution raises a number of technical issues. The use of mercury, cadmium and hexavalent chromium has been, and is, more limited in the manufacture of EEE. These materials are either used for more specific specialist applications or have been declining in use because industry itself has been moving towards the use of less hazardous materials.

[11] Medical devices, monitoring and control equipment, and military and aerospace equipment are outside the scope, or considered to be outside the scope of the RoHS Directive. The UK is a leading player in the manufacturing of EEE in these sectors.

[12] It is expected that some sectors of the electronics industry manufacturing products outside of the scope of the RoHS Directive may also be affected indirectly as a result of changes in their supply chains.

(a) Lead

36. The RoHS Directive restricts the use of lead in the manufacture of EEE. The most widespread use of lead in EEE is its use in solder and its use in glass in cathode ray tubes (CRTs). The RoHS Directive exempts the use of lead in the glass of CRTs, electronic components, and fluorescent tubes from its restrictions. This leaves the main activity affected by the RoHS Directive as the use of lead in solder.

37. The properties of lead, particularly its relatively low melting point, make it a technically suitable material for soldering. Its substitution raises many challenges both in terms of the higher melting point of other metals which can be used as substitutes, which can have adverse impacts on parts and components during the soldering process, and in terms of the success rate and reliability of solder using alternative metals, which can potentially result in increased failure rates of components and equipment.

38. For these reasons the RoHS Directive provides for a number of exemptions for the use of lead in solder. These are for lead used in high-melting temperature type solders, lead in solders for servers, storage and storage arrays, and lead in solders for networks.

(i) Capital Expenditure

39. There are two main industrial processes for lead soldering. These processes generally use either wave soldering machines (WSMs) or surface mount ovens (SMTs) where respectively the solder is applied either by dipping into molten solder or by heating to above melting point temperature.

40. There is no data on the number of WSMs or SMTs currently in use in the UK. An estimate from survey evidence and from discussions with industry is that there may be around 4,000 WSMs in use in the UK and around 9,000 SMTs in use in the UK.

41. Given the exemptions on certain applications for the use of lead in solder and the categories of EEE excluded from the scope of the RoHS Directive it is estimated that around 50 per cent of total UK businesses producing EEE and using lead in solder may be affected by the RoHS Directive. If we assume that the number of WSMs and SMTs are spread evenly across UK businesses then this implies that 50 per cent of total WSMs and SMTs could be affected.

42. It is not clear the extent to which existing machinery used for lead soldering will either need to be modified/refurbished or replaced as a consequence of the restrictions on the use of lead. Following discussions with industry one estimate is that of the 2,000 WSMs potentially affected 50 per cent may need to be refurbished and 50 per cent may need to be replaced to accommodate lead-free soldering. Of the estimated 4,500 SMTs potentially affected one estimate is that 10 per cent may need to be replaced and 90 per cent refurbished to accommodate lead-free soldering.

43. The cost of new machinery will depend on the specification of the machine and hence there exists a range of prices. One estimate is that a new WSM may cost on average around £25,000, a new SMT may cost on average around £30,000, and

refurbishment of either machine may cost on average around £10,000. However, these estimates can only be seen as being indicative.

44. In estimating the potential capital costs from restrictions on the use of lead we need to compare any investment undertaken with investment that would have been undertaken in the normal business cycle of maintaining the current capital stock. Estimates of the economic life of WSMs and SMTs vary, but for this RIA we use a figure of an average life of 10 years. Assuming that the existing stock of WSMs and SMTs has an age profile such that the stock is spread equally across 10 years it follows that in the business-as-usual case one in ten machines would be replaced each year.

45. As a consequence of the RoHS Directive it is estimated that a number of machines will be replaced prematurely. This is assumed to take place in the year preceding the date when the restrictions on the use of lead come into force. This investment is assumed to be a one-off investment with the new machines having an average life of 10 years.

46. In addition to investment in new capital, there will be a level of investment in upgrading/refurbishing the remaining existing capital stock. This is also assumed to take place in 2005. This investment is assumed not to increase the life of existing machines but rather to enable the machine to be used for lead-free soldering.

47. These estimates and assumptions enable an estimate to be made of the additional costs in terms of capital machinery as a consequence of the restrictions on the use of lead in solder from the RoHS Directive. This estimate is for additional expenditure[13] over the next ten years having a present value of just around £52 million, equating to an annualised cost of around £7 million.

(ii) Research and Development (R&D) Expenditure

48. The restrictions on the use of lead in solder also require expenditure on research and development (R&D) in terms of developing and testing the available substitutes to tin-lead (SnPb) solder. The main substitutes to SnPb solder are generally considered to be tin-silver-copper (SnAgCu) alloys, tin-silver-bismuth (SnAgBi) alloys, and tin-copper (SnAg) alloys.

49. A number of multinational companies have already undertaken significant levels of R&D to replace lead in solder. This has principally been driven by Japanese-based companies who have agreed voluntarily to phase out the use of lead in a range of consumer electronics. However, there is still a level of R&D expenditure that will need to be undertaken by UK companies to achieve lead-free soldering. This R&D is likely to take place both in the consumer electronics industry and in more specialised EEE sectors where the UK has a relatively more significant role.

50. Estimating the level of R&D that may need to be undertaken in the UK is not straightforward. The extent to which R&D will need to be undertaken within and

[13] Over the business as usual case.

across firms, and within and across sectors, is not clear. It is also not clear the extent to which R&D has already been undertaken, nor when the additional R&D required will be undertaken.

51. The DTI produces the UK R&D Scoreboard detailing the level of R&D expenditure across the 700 largest UK companies across a range of industrial sectors. The latest scoreboard is for financial year 2003/04. Two sectors from the R&D Scoreboard, Sector 9 – Electronic and Electrical, and Sector 16 – IT hardware, spent over £1.5 billion on R&D in 2003/04.[14]

52. One estimate obtained from surveys and discussions with industry is that R&D expenditure in relation to lead-free soldering may, at its peak, represent around 5 per cent of total R&D expenditure. There is anecdotal evidence that a significant proportion of this R&D may still need to be undertaken in the UK, and a level of R&D will need to be undertaken even after the RoHS Regulations are in force in the UK, as substitutes and their applications are refined. This additional expenditure is estimated to have the following profile: 5 per cent of total R&D in 2005, 5 per cent of total R&D in 2006, 2.5 per cent of total R&D in 2007, and 0.5 per cent of total R&D in 2008.

53. Given the exemptions on certain applications for the use of lead in solder and the categories of EEE excluded from the scope of the RoHS Directive it is estimated that around 50 per cent of total UK businesses producing EEE and using lead in solder may be affected by the RoHS Regulations. If we assume that R&D expenditure is spread evenly across UK businesses then this implies that we should use 50 per cent of total R&D expenditure as our base figure. Assuming R&D expenditure is constant in real terms to 2008 enables an estimate of R&D expenditure to achieve lead-free soldering to be made. This estimate equates to R&D expenditure over the next ten years having a present value of around £100 million, with an equivalent annualised cost of around £13 million. However, again this estimate can only be seen as being indicative.

(iii) Operating Expenditure

54. The operating costs of using substitute materials to lead in solder are estimated to fall at various points in the supply chain of EEE and relate to the additional costs of the alternative materials themselves for solder, the additional costs from greater energy use from alternative materials in solder, and the additional costs of components generally as a result of the switch to lead-free soldering.

55. Estimated additional costs from substituting tin-lead solder with tin-silver-copper solder are between £7 million and £20 million per annum. The lower estimate is based on one industry source which estimates a total of around 1400 tonnes of lead used in solder in the UK. Of this total, 70 per cent is estimated as needing to be substituted. The higher estimate is based on alternative figures suggesting that lead

[14] Of course, small and medium-sized businesses also undertake R&D, but in this RIA we consider the majority of R&D in the EEEE sector to be undertaken by large firms.

used in the UK in electronic solder could be around 4300 tonnes. Again, of this total, 70 per cent is estimated as needing to be substituted[15].

56. Some research suggests that lead-free soldering using SMTs may result in increased energy requirements of around 12 per cent.[16] Based on an estimated average additional 2.1 kilowatt hour needed for lead-free soldering, compared to lead soldering, at a cost of around 3 pence per kilowatt hour and for some 9,000 SMTs in the UK this equates to additional energy costs of around £2 million per annum.

57. Operating costs may also rise further down the EEE supply chain due to the increased cost of EEE components. This increased cost is estimated to result from a range of factors including: the need for new materials in components as a consequence of the switch to lead-free soldering, particularly for plastics, where different plastics with higher melting points are required; the replacement of lead for use in component terminations with other metals, such as gold; the potential for lower yields, and higher failure rates, in the manufacturing of components as a consequence of a number of technical issues with lead-free soldering[17]; and the expectation of greater levels of re-work and repair of components again as a consequence of technical issues to do with lead-free soldering.

58. Some industry sources suggest that the average increase in the price of components may be between 1 and 2 per cent. The total value of the UK components market is estimated to be around £5.4 billion per annum, of which an estimated 90 per cent is estimated as potentially being affected by the RoHS Directive. This gives an increase in the price of components estimated between £49 million - £97 million per annum.

(b) Cadmium

(i) Capital Expenditure

59. It is not expected that there will be any significant capital costs as a result of the restrictions on the use of cadmium in EEE. Cadmium plating in EEE is exempt from the RoHS Directive and specialist UK manufacturers that use cadmium solder alloy are able to use an alternative solder that is not thought to require additional capital expenditure.

(ii) Research and Development (R&D) Expenditure

60. Industry estimates suggest that UK R&D costs to find alternative substances and processes to replace cadmium are relatively small. Moreover, it is anticipated that most of this R&D may be conducted outside of the UK.

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[15] We assume the substitute is a tin-silver-copper alloy which is estimated to cost around £6600 per tonne more than its tin-lead equivalent

[16] www.speedlinetech.com/docs/lead-free-manufacturing.pdf

[17] For example, the problem of tin whiskers.

(iii) Operating Expenditure

61. One percent or less of cadmium consumption is estimated to fall within the scope of the RoHS Regulations. There are available alternatives for some, but possibly not all, applications using cadmium in specialist low melting point solder alloys. Only a limited amount of this manufacturing is thought to take place in the UK, and thus it is not expected that operating costs will change significantly as a result of the restrictions on cadmium.

(c) Hexavalent Chromium (CrVI)

(i) Capital Expenditure

62. According to industry estimates, capital investment costs for the substitution of CrVI with trivalent chromium (CrIII) for zinc passivation, and the switch to organo-titanium for aluminium passivation are expected to be minimal.

(ii) Research and Development (R&D) Expenditure

63. R&D costs to substitute CrVI in the restricted applications have largely already been undertaken, and many applications are exempt from the Regulations in any case because they are used in military, aerospace and marine equipment.

(iii) Operating Expenditure

64. The main application of CrVI in EEE within the scope of the RoHS Regulations is passivation. CrVI is used for zinc and aluminium passivation. CrVI can be substituted with CrIII for zinc passivation, and organo-titanium for aluminium passivation.

65. The price of these alternatives is higher, but this greater cost is offset by lower waste treatment and health and safety costs from not using CrVI. Cr III and titanium are more expensive materials than CrVI, and a greater quantity of material is required, however this increased cost is offset by a significant reduction in the cost of handling and disposing of residual CrVI. Therefore, no overall change in operating costs is anticipated. Furthermore many manufacturers using passivation processes have already switched to Cr III or organo-titanium due to the costs of handling and disposing of CrVI.

(d) Mercury

66. The majority of mercury used in EEE is found in fluorescent lamps and EEE covered by Categories 8 & 9 of the WEEE Directive. The exemptions and scope of the RoHS Directive thus mean that costs from the restrictions of the use of mercury in EEE are not expected to be significant.

67. Applications of mercury use within the scope of the RoHS Regulations largely relate to switches and relays. Mercury switches are used as components in EEE manufactured in the UK, however, there are few manufacturers of mercury switches

in the UK. The size of the UK mercury switch market is estimated to be between £100,000 and £200,000 per annum.

(i) Capital Expenditure

68. Capital upgrade or replacement costs are anticipated to be minimal in the UK as most mercury-containing switches are manufactured overseas. It is believed that mercury free replacement switches (e.g. gold switches) can be used in the manufacture of EEE using existing equipment.

(ii) Research and Development (R&D) Expenditure

69. Technology for the replacement of mercury in switches and relays is already available for most purposes. EEE manufacturers who use mercury switches in their products are expected to use existing equipment and switches which substitute mercury with gold. However, where mercury wetted relays are substituted with their gold alternatives in high frequency telecom applications, significant technical problems are possible[18]. An exemption has been applied for but some R&D expenditure may be necessary, though it is not possible at this time to estimate the level of R&D that may be required.

(iii) Operating Expenditure

70. The main substitute for mercury in switches and relays is gold. Non-mercury switches are currently cheaper than mercury switches (prices typically range from £1.78 to £10.55 for mercury and £0.46 to £11.71 for similar non-mercury switches and sensors). In addition, as less gold is used than mercury, the substitution costs of mercury are unlikely to be large[19].

71. One application that may not have a technically feasible alternative is mercury in relays found in high frequency digital telecom equipment. An exemption is being sought. It has not been possible to quantify cost increases associated with this individual application.

(e) Polybrominated biphenyl (PBB) and Polybrominated diphenyl ether (PBDE)

72. PBBs and octa-PBDE and penta-PBDE are no longer used in the manufacture of EEE in Europe or the United States. Deca-BDE is believed to be widely used in plastics but alternatives are available and these are thought to be not significantly more expensive. There could be further costs if the substitution of deca-BDE requires the use of alternative plastics to those currently used in EEE but there is little information available to provide a robust estimate of such costs at this time.

[18] Due to “bounce” when the relays are operated.

[19] 1/100th of the quantity is required.

Compliance Costs

73. Producers putting EEE on the UK market are required to demonstrate compliance with the RoHS Regulations by providing the enforcement authority, on request, with evidence of compliance in the form of relevant technical documentation and other information. The enforcement authority intends to accept self-declaration as the basis of the compliance regime. The enforcement authority will carry out market surveillance to detect non-compliant products and may conduct tests for this purpose.

74. There is no single mandatory or required method to demonstrate compliance, but it is expected that the vast majority of producers will require suppliers to provide materials declarations as part of their contractual relationship.

75. The RoHS Regulations require producers to maintain appropriate records for a period of four years after the EEE has first been placed on the UK market. There will be costs to producers in collecting information and maintaining records. Larger producers may require specially tailored software for such systems.

76. EEE producers, component suppliers and distributors may need to undertake analysis of the components or materials used in their products. This action may be undertaken to verify supplier declarations, or be undertaken in the absence of an available declaration. Larger firms may use hand-held or desk-top XRF[20] analysers for testing. XRF machines are able to test for the six restricted substances to differing degrees of accuracy. In the case of lead, cadmium and mercury the device works well up to a certain depth, after which point certain components will require dismantling. Bromine can be identified, although, XRF spectroscopy cannot distinguish between restricted and non-restricted brominated flame retardants. To do this, further identification may be needed in the form of GCMS[21] analysis. For hexavalent chromium (CrVI) further testing may also be required as XRF spectroscopy cannot identify what chemical form the chromium is in. Currently there is no single accepted scientific test for CrVI.

77. There will be a range of factors determining the extent to which individual analysis of equipment and components will take place. This will be influenced by the quantity of product put onto the market, the type of relationships within the supply chain, and the risk of a restricted material or substance being present. It is not possible to provide an accurate estimate of possible compliance costs from industry sources or available information and thus a significant level of judgement is required. One estimate is to assume that compliance costs will represent a percentage of the total costs resulting from the restrictions imposed by the RoHS Directive. A figure of 10 per cent of annual costs may not be unreasonable, with a greater level of costs being incurred in the first year as systems and programmes are established.

[20] XRF means: X-ray Fluorescence.

[21] GCMS means: Gas Chromatography Mass Spectrometer.

BUSINESS SECTORS AFFECTED

78. Given the wide-ranging nature of the RoHS Directive there remains uncertainty about the total numbers of businesses that could be affected. The range of business sectors that could be affected, either directly or indirectly, include:

- Producers of raw or refined materials;
- Component suppliers of EEE;
- Product assemblers of EEE;
- Manufacturers of EEE;
- Professional Importers of EEE;
- Distributors of EEE.

79. One estimate is that there may be around 7,500 EEE manufacturers in the UK. Standard Industrial Classification (SIC) data suggests that there may as many as 15,000 businesses affected by the RoHS Directive. Of these totals, around 50 per cent are estimated to manufacture products affected by the RoHS Directive, which implies some 3,750 – 7,500 UK businesses possibly being affected by the RoHS Directive. However, due to the complex structure of the EEE market and the range of sectors involved it is not possible to identify a typical business that could be affected.

EQUITY AND FAIRNESS

80. The complete supply chain for EEE is likely to be affected, either directly or indirectly, by the RoHS Regulations. How the costs of the Regulations are distributed will depend on the nature of the market for the EEE sector concerned. In the short term component suppliers may bear a majority of costs. However, in the medium to longer term they may pass at least some of these additional costs on to product assemblers and/or manufacturers.

81. The benefits to the UK from the RoHS Directive are likely to be spread evenly across different social and economic classes and different geographical regions. However, those more susceptible to the negative impacts that can result from the materials and substances restricted by RoHS (such as children, the elderly, and pregnant women) may benefit more.

CONSULTATION WITH SMALL BUSINESS: THE SMALL FIRMS' IMPACT TEST

82. The DTI has been keen to engage with small and medium-sized enterprises (SMEs) in transposing the RoHS Directive into UK law. The three separate public consultations on the RoHS Directive undertaken by the Government have produced a number of technical queries from the small business community which the DTI has endeavoured to answer and reflect in the RoHS Regulations and in the non-statutory Guidance accompanying the Regulations. The DTI has also facilitated a number of workshops on the RoHS Directive and attended a wide range of conferences and meetings at which representatives of the small business community have been present.

83. In implementing the RoHS Directive the DTI has sought to minimise the compliance costs on small businesses in the UK, whilst ensuring maintenance of the single market in EEE so enabling small businesses in the UK to compete on a level playing field with businesses in other member States.

COMPETITION ASSESSMENT

84. EEE production is characterised by a large number of firms both domestically and internationally. Within the broad category of EEE, there are a very large number of separate markets each of which may have quite different characteristics. The RoHS Regulations set the same standards for firms already active in EEE sectors and for potential new entrants, and so should not cause barriers to entry.

85. Little or no information has come to light to suggest that the RoHS Regulations will have a significant impact on competition in the EEE market. Within an industry that is noted for its innovation and rapid technological development it is considered that the Regulations will not have a detrimental impact on competition. The RoHS Directive itself is a Single Market Directive aimed at facilitating and promoting the single market in EEE.

ENFORCEMENT AND SANCTIONS

86. The Secretary of State for the DTI has put in place a Memorandum of Understanding with the National Weights and Measures Laboratory (NWML)[22] to enforce the RoHS Regulations on his behalf.

87. Any person who contravenes or fails to comply with the requirements of regulation 7, 8 or 9 of the RoHS Regulations may be guilty of an offence with possible subsequent penalties ranging from a fine not exceeding level 5 on the standard scale, to an unlimited fine on conviction on indictment or a fine not exceeding the statutory maximum on summary conviction.

MONITORING AND REVIEW

88. The DTI will monitor the effectiveness of the RoHS Regulations and it is intended that this monitoring will feed into evaluation of the Regulations. The European Commission intends to review the scope of the RoHS Directive no later than every 4 years from the 1 July 2006.

[22] The NWML is an agency of the DTI.

CONSULTATION

Public Consultation

89. The costs and benefits of the UK complying with the requirements of the specific Articles of the RoHS Directive were outlined in the partial RIA forming part of the DTI's Discussion Paper published on 27 January 2003. A summary of these responses was published on 1st August 2003. DTI also undertook a review of the scientific and technical issues raised by the responses. Very few alternative estimates of the costs or benefits were provided by the responses to this Discussion Paper. An updated RIA was also included with the Consultation Paper published in November 2003. Again very few alternative estimates were provided to this consultation. A further RIA was issued with the consultation of 30 July 2004. No alternative estimates were provided to this last public consultation.

SUMMARY AND RECOMMENDATION

90. This RIA estimates the costs and benefits of the RoHS Regulations. Implementation of the RoHS Directive in the UK will result in a reduction in the use of certain hazardous substances in EEE and therefore should result in reductions in risks to human health, animal health and the environment.

91. Benefits from the RoHS Regulations are extremely difficult to quantify, particularly in monetary terms. However, benefits do exists and these will be quantified as far as possible by DTI evaluation of the SI.

92. Estimates of the costs of the RoHS Regulation are summarised in the table below. They range from a total 700 million to £1.3 billion for a ten-year period between 2005 and 2014. Annualised equivalent costs are estimated to be between £91 and £170 million. The majority of the costs relate to the restriction on the use of lead in EEE. However, these estimates should only be considered as being indicative.

93. The 'bottom-up' cost estimates outlined in this RIA can be compared with a 'top-down' industry estimate of costs of 1-2 per cent of annual turnover of UK businesses directly affected by the RoHS Directive.

94. Total turnover of the UK EEE sector is estimated at some US$ 39 billion. Assuming that 50 per cent of this turnover is produced by 50 per cent of businesses, then around 50 per cent of turnover is expected to be affected by the RoHS Directive. This implies a turnover of around £11 billion per annum and 1-2 per cent of this is £100 million- £200 million per annum.

Table 1: Summary of Costs and Benefits of the RoHS Regulations

Time Period – 10 Years	**2005 – 2014**		
	Present Value of Total	**Annualised Value of Present Value**	**Present Value in 2014**

Costs	£700 million - £1300 million	£90 million - £170 million	£47 million - £97 million
Benefits	Reduction in damage to the environment. Enhanced protection of human health and animal health. Promotion and facilitation of European Single Market. Lower treatment and recycling costs of EEE at end of life.		

MINISTERIAL DECLERATION

I have read the regulatory impact assessment and I am satisfied that the benefits justify the costs

Signed ………………………….

Date

Malcolm Wicks
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Department of Trade and Industry

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