**Appendix C**

**Foreground system and avoided production data sources and data quality**

An overview of foreground system process and avoided production data used and, for each, data source, the results of a data quality assessment are presented in Tables C1 and C2, respectively.

**Table C1**

Recycled material foreground system process data used and data quality rating.

| Waste material group | Waste material type | Name of dataset used | Data source | Geographic coverage | Reference year | Data quality rating |
| --- | --- | --- | --- | --- | --- | --- |
| Glass | Green glass | “Glass cullets, sorted, at sorting plant” | Hischier (2007) | Europe | 1998 | Poor quality |
| Container glass manufacture using recycled glass | Enviros Consulting Ltd (2003) | Europe | 2003 | Fair quality |
| Glass production using glass waste as cullet | Larsen *et al.* (2009) | Europe | 2009 | Fair quality |
| Brown glass | “Glass cullets, sorted, at sorting plant” | Hischier (2007) | Europe | 1998 | Poor quality |
| Container glass manufacture using recycled glass | Enviros Consulting Ltd (2003) | Europe | 2003 | Fair quality |
| Glass production using glass waste as cullet | Larsen *et al.* (2009) | Europe | 2009 | Fair quality |
| Clear glass | “Glass cullets, sorted, at sorting plant” | Hischier (2007) | Europe | 1998 | Poor quality |
| Container glass manufacture using recycled glass | Enviros Consulting Ltd (2003) | Europe | 2003 | Fair quality |
| Glass production using glass waste as cullet | Larsen *et al.* (2009) | Europe | 2009 | Fair quality |
| Mixed glass | “Glass cullets, sorted, at sorting plant” | Hischier (2007) | Europe | 1998 | Poor quality |
| Container glass manufacture using recycled glass | Enviros Consulting Ltd (2003) | Europe | 2003 | Fair quality |
| Glass production using glass waste as cullet | Larsen *et al.* (2009) | Europe | 2009 | Fair quality |
| Paper & card | Paper | “Paper, newsprint, DIP containing, at plant” | Hischier (2007) | Europe | 2000 | Poor quality |
| Card | “Corrugated board base paper, testliner, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| “Corrugated board base paper, wellenstoff, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| Books | “Corrugated board base paper, testliner, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| “Corrugated board base paper, wellenstoff, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| Mixed paper & card | “Corrugated board base paper, testliner, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| “Corrugated board base paper, wellenstoff, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| Yellow pages | “Corrugated board base paper, testliner, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| “Corrugated board base paper, wellenstoff, at plant” | Hischier (2007) | Europe | 2005 | Fair quality |
| Metal | Steel cans | Crude steel production, electric arc furnace | Burchart-Korol (2013) | Poland | 2010 | Fair quality |
| Aluminium cans | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Fair quality |
| “Aluminium, secondary production” | Classen *et al.* (2009) | Europe | 2002 | Fair quality |
| Mixed cans\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| Other scrap metal\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| Aluminium foil | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| “Aluminium, secondary production” | Classen *et al.* (2009) | Europe | 2002 | Poor quality |
| Aerosols\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| Fire extinguishers\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| Gas bottles\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| Bicycles | - | - | - | - |  |
| Plastic | Mixed plastics | Stadler plastic film separation & Titech NIR sorting | Shonfield (2008) | UK | 2008 | Fair quality |
| "Plastic (HDPE) recycling, Linpac" | EA (2010) | UK | 2003 | Poor quality |
| Mixed plastic bottles | Stadler plastic film separation & Titech NIR sorting | Shonfield (2008) | UK | 2008 | Fair quality |
| "Plastic (HDPE) recycling, Linpac" | EA (2010) | UK | 2003 | Poor quality |
| PET | “Plastics (PET) recycling, Delleve” | EA (2010) | UK | 2004 | Fair quality |
| HDPE | "Plastic (HDPE) recycling, Linpac" | EA (2010) | UK | 2003 | Poor quality |
| PVC | "Plastic (HDPE) recycling, Linpac" | EA (2010) | UK | 2003 | Poor quality |
| LDPE | “Agricultural film recycling, BPI Poly” | EA (2010) | UK | 2003 | Poor quality |
| PP | "Plastic (HDPE) recycling, Linpac" | EA (2010) | UK | 2003 | Poor quality |
| Wood | Wood | Composite wood materials recycling, microrelease process | Mitchell and Stevens (2009) | UK | 2008 | Poor quality |
| Chipboard & MDF | Composite wood materials recycling, microrelease process | Mitchell and Stevens (2009) | UK | 2008 | Poor quality |
| Composite wood materials | Composite wood materials recycling, microrelease process | Mitchell and Stevens (2009) | UK | 2008 | Poor quality |
| WEEE | LDAs\* | “Shredding, electrical and electronic scrap” | Hischier *et al.* (2007) | Europe | 2005 | Fair quality |
| Recycling of WEEE appliances | Crowe *et al.* (2003) | Europe | 2000 | Poor quality |
| “Disposal, treatment of printed wiring boards” | Hischier *et al.* (2007) | Global | 2005 | Poor quality |
| SDAs\* | “Shredding, electrical and electronic scrap” | Hischier *et al.* (2007) | Europe | 2005 | Fair quality |
| Recycling of WEEE appliances | Crowe *et al.* (2003) | Europe | 2000 | Poor quality |
| CRTs\* | “Manual depollution, CRT screen” | Hischier *et al.* (2007) | Global | 2005 | Fair quality |
| “Mechanical treatment, shredding, CRT screen” | Hischier *et al.* (2007) | Global | 2005 | Fair quality |
| “Copper, secondary, at refinery” | Classen *et al.* (2009) | Europe | 2003 | Poor quality |
| Pyrometallurgical processing of CRT funnel glass | Xu *et al.* (2013) | USA | 2013 | Fair quality |
| Fluorescent tubes & other light bulbs\* | “Disposal, fluorescent lamps” | Hischier *et al.* (2007) | Switzerland | 2005 | Fair quality |
| Fridges & freezers\* | “Shredding, electrical and electronic scrap” | Hischier *et al.* (2007) | Europe | 2005 | Fair quality |
| Recycling of WEEE appliances | Crowe *et al.* (2003) | Europe | 2000 | Poor quality |
| Batteries | Automotive batteries | Mixed waste batteries sorting | Fisher *et al.* (2006) | UK | 2006 | Fair quality |
| Lead acid battery recycling, Campine | Fisher *et al.* (2006) | Belgium | 2004 | Fair quality |
| Post-consumer, non-automotive batteries | Mixed waste batteries sorting | Fisher *et al.* (2006) | UK | 2006 | Fair quality |
| Hydrometallurgical processing (RECUPYLTM process) of spent alkaline batteries, Recupyl | Fisher *et al.* (2006) | France | 2004 | Fair quality |
| Pyrometallurgical processing of spent alkaline batteries, Batrec | Fisher *et al.* (2006) | Switzerland | 2004 | Fair quality |
| Tyres | Car tyres\* | Tyre recycling, multi-function plant | Eldan Recycling (2014) | UK | 2014 | Poor quality |
| Recycling of end of life tyres | Baeyens *et al.* (2010) | Global | 2010 | Poor quality |
| Van tyres\* | Tyre recycling, multi-function plant | Eldan Recycling (2014) | UK | 2014 | Poor quality |
| Recycling of end of life tyres | Baeyens *et al.* (2010) | Global | 2010 | Poor quality |
| Large vehicle tyres\* | Tyre recycling, multi-function plant | Eldan Recycling (2014) | UK | 2014 | Poor quality |
| Recycling of end of life tyres | Baeyens *et al.* (2010) | Global | 2010 | Poor quality |
| Mixed tyres\* | Tyre recycling, multi-function plant | Eldan Recycling (2014) | UK | 2014 | Poor quality |
| Recycling of end of life tyres | Baeyens *et al.* (2010) | Global | 2010 | Poor quality |
| Furniture | Furniture | Composite wood materials recycling, microrelease process | Mitchell and Stevens (2009) | UK | 2008 | Poor quality |
| Rubble | Rubble\* | “Buiding rubble recycling, Tarmac” | EA (2010) | UK | 2004 | Poor quality |
| Soil | Soil | - | Boldrin *et al.* (2009) | Europe | 2009 | Fair quality |
| - | Bruun *et al.* (2006) | Denmark | 2006 | Poor quality |
| - | Hansen (2006) | Europe | 2006 | Poor quality |
| Plasterboard | Plasterboard\* | Plasterboard recycling | WRAP (2008) | UK | 2007 | Fair quality |
| Oil | Vegetable oil | Biodiesel production, alkali-catalysed transesterification processing of waste vegetable oil | Morais *et al.* (2010) | Europe | 2010 | Fair quality |
| Mineral oil | Biodiesel production, alkali-catalysed transesterification processing of waste vegetable oil | Morais *et al.* (2010) | Europe | 2010 | Poor quality |
| Composite | Composite food & beverage cartons\* | “Waste paper, sorted, for further treatment” | Hischier (2007) | Europe | 2007 | Poor quality |
| Composite packaging waste recycling | Xie *et al.* (2012) | China | 2013 | Poor quality |
| Mattresses\* | Textiles recovery, reclamation and processing, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Paint | Paint\* | “Scrap metal sorting and preparation” | EAA (2008) | Europe | 2002 | Poor quality |
| “Treatment, sewage, to wastewater treatment, class 5” | Doka (2009) | Switzerland | 2000 | Poor quality |
| Textiles | Textiles & footwear | Textiles recovery, reclamation and processing, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles recycling, production of filling fibre, Edward Clay & Sons Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles reprocessing, production of wiping cloths, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles only | Textiles recovery, reclamation and processing, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles recycling, production of filling fibre, Edward Clay & Sons Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles reprocessing, production of wiping cloths, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Footwear only | Textiles recovery, reclamation and processing, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Fair quality |
| Textiles recycling, production of filling fibre, Edward Clay & Sons Ltd | EA (2010) | UK | 2005 | Poor quality |
| Textiles reprocessing, production of wiping cloths, Jmp Wilcox & Co Ltd | EA (2010) | UK | 2005 | Poor quality |
| Carpets\* | Carpet recycling, Blackwater Ltd. | WRAP (no date) | UK | Unknown | Poor quality |
| Other | AHPs\* | “Waste paper, sorted, for further treatment” | Hischier (2007) | Europe | 2007 | Poor quality |
| Nappy recycling, Knowaste | Freyberg (2012) | UK | 2012 | Fair quality |

\*For composite materials, only data sources used for material pre-processing (e.g. dismantlement, disassembly, and sorting) and the recycling (reprocessing) of components particular to that composite material are presented. Data sources used for the recycling of component material types are detailed individually.

PET, polyethylene terephthalate; LDPE, low-density polyethylene; HDPE, high-density polyethylene; PVC, polyvinyl chloride; PP, polypropylene; MDF, medium-density fibreboard; WEEE, waste electrical and electronic equipment; LDA, large domestic appliance; SDA, small domestic appliance; CRT, cathode ray tube; AHP, absorbent hygiene product

**Table C2**

Avoided primary production process data used and data quality rating.

| Secondary product | Avoided primary product | Name of primary production data set used | Data source | Geographic coverage | Reference year | Data quality rating |
| --- | --- | --- | --- | --- | --- | --- |
| Secondary container glass | Primary container glass | Container glass manufacture using recycled glass | Enviros Consulting Ltd (2003) | Europe | 2003 | Fair quality |
| Glass production using glass waste as cullet | Larsen *et al.* (2009) | Europe | 2009 | Fair quality |
| Secondary newsprint | Primary newsprint | “Paper, newsprint, 0% DIP, at plant” | Hischier (2007) | Europe | 2000 | Poor quality |
| Testliner | Kraftliner | "Corrugated board base paper, kraftliner, at plant" | Hischier (2007) | Europe | 2005 | Fair quality |
| Wellenstoff | Semi-chemical fluting | "Corrugated board base paper, semichemical fluting, at plant" | Hischier (2007) | Europe | 2005 | Fair quality |
| Crude steel | Steel | "Steel, converter, unalloyed, at plant" | Classen *et al.* (2009) | Europe | 2001 | Fair quality |
| Aluminium | Aluminium | "Aluminium, primary, at plant" | Classen *et al.* (2009) | Europe | 2002 | Fair quality |
| PET flakes | PET flakes | "Polyethylene terephthalate, granulate, amorphous, at plant" | Hischier (2007) | Europe | 2003 | Fair quality |
| HDPE granulate | HDPE granulate | "Polyethylene, HDPE, granulate, at plant" | Hischier (2007) | Europe | 2001 | Fair quality |
| PVC pellets | PVC pellets | " Polyvinylchloride, suspension polymerised, at plant" | Hischier (2007) | Europe | 2001 | Fair quality |
|  |  | "Polyvinylchloride, emulsion polymerised, at plant" | Hischier (2007) | Europe | 2001 | Fair quality |
| PP granulate | PP granulate | "Polypropylene granulate (PP), production mix, at plant" | JRC (2008) | Europe | 2001 | Fair quality |
| LDPE pellets | LDPE pellets | "Polyethylene, LDPE, granulate, at plant" | Hischier (2007) | Europe | 2001 | Fair quality |
| Recycled MDF | Virgin MDF fibre | - | Shonfield (2008) | UK | 2008 | Fair quality |
| Zinc | Zinc | "Zinc, primary, at regional storage" | Classen *et al.* (2009) | Europe | 2003 | Fair quality |
| Manganese | Manganese | "Manganese, at regional storage" | Classen *et al.* (2009) | Europe | 2003 | Poor quality |
| Mercury | Mercury | "Mercury, liquid, at plant" | Classen *et al.* (2009) | Global | 2000 | Poor quality |
| Ferromanganese  | Ferromanganese | "Ferromanganese, high-coal, 74/5% Mn, at regional storage" | Classen *et al.* (2009) | Europe | 2003 | Poor quality |
| Lead | Lead | "Lead, primary, at plant" | Classen *et al.* (2009) | Global | 2005 | Fair quality |
| Copper | Copper | "Copper, primary, at refinery" | Classen *et al.* (2009) | Europe | 2003 | Fair quality |
| Rubber granulate <3 mm | Bitumen | "Bitumen, at refinery" | Jungbluth (2007) | Europe | 2000 | Poor quality |
| Rubber crumb <20 mm | Synthetic rubber | "Synthetic rubber, at plant" | Hischier (2007) | Europe | 2003 | Poor quality |
| Aggregate  | Gravel | "Gravel, unspecified, at mine" | Kellenberger *et al.* (2007) | Switzerland | 2001 | Poor quality |
| Gypsum | Mineral gypsum | "Gypsum, mineral, at mine" | Kellenberger *et al.* (2007) | Switzerland | 2003 | Poor quality |
| - | WRAP (2008) | UK | 2007 | Fair quality |
| Biodiesel | Fossil diesel | - | DEFRA *et al.* (2014) | UK | 2013 | High quality |
| Mattress filling fibre | Flocking material | "Polyurethane, flexible foam, at plant" | Hischier (2007) | Europe | 1997 | Poor quality |
| Natural fibre wiping cloths | Paper wiping cloths | "Kraft paper, bleached, at plant" | Hischier (2007) | Europe | 1993 | Poor quality |
| Artificial fibre wiping cloths | Artificial wiping cloths | - | DEFRA *et al.* (2014) | UK | 2013 | High quality |

PET, polyethylene terephthalate; LDPE, low-density polyethylene; HDPE, high-density polyethylene; PVC, polyvinyl chloride; PP, polypropylene; MDF, medium-density fibreboard

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