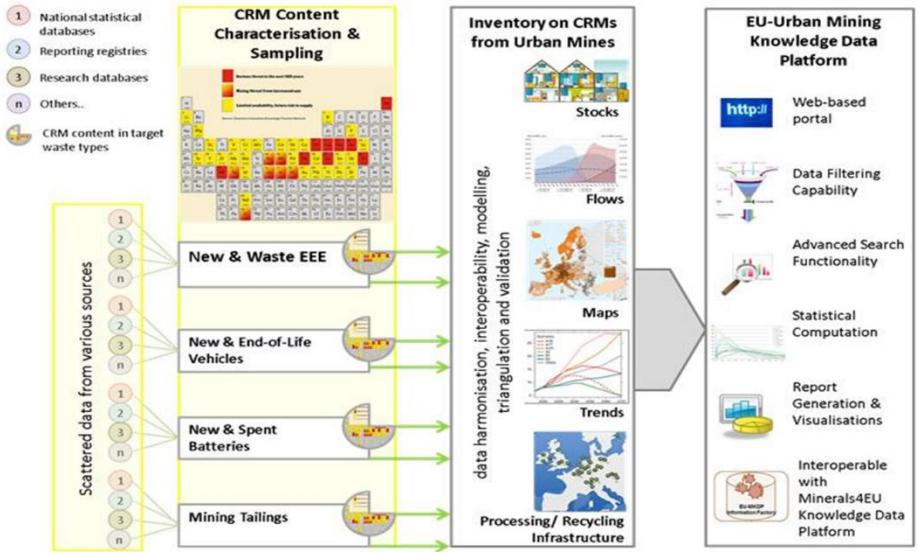
Waste Flow Studies
Deliverable 4.1



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Authors	Vera Susanne Rotter TUB, Paul Maehlitz TUB, Nathalie Korf TUB, Perrine Chancerel TUB, Jaco Huisman UNU, Hina Habib UNU, Lucía Herreras WF, Maria Ljunggren Söderman Chalmers, Anders Hallberg SGU
Reviewed by	Project Management Team
E-mail	Vera.rotter@tu-berlin.de
Scientific Coordinators	Dr Jaco Huisman, Scientific Advisor, UNU – IAS SCYCLE Nikolaos Arvanitidis, Chair of the EGS Mineral Resources Expert Group
E-mail	Huisman@unu.edu Nikolaos.Arvanitidis@sgu.se

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Notice

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PURPOSE

This report, Deliverable 4.1 Waste Flow Studies, documents the investigation and evaluation of data sources offering information to describe end-of-life stocks and flows with special focus on critical raw materials. This document presents an inventory of data sources and formats in line with, and structured according to, the classifications and codifications developed in D5.3 Review and Harmonisation of Data. Since data on waste flows and stocks are often from diverse sources and in various formats with limited access, a harmonised inventory is highly necessary in structuring all available data sources.

Data sources include publicly available reports and informarion and other sources obtained directly from the data or report owner. Data gathering was also undertaken from specific (national) sources such as published academic literature, technical reports, national producer registries, compliance reports or geological surveys. Moreover, data from other EU funded projects and reports, national projects and reports and data held by associations, organisations, and the ProSUM Consortium and Information Network (IN) were also investigated.

Data sources were evaluated using data inventory tables representing the availability and accessibility of information using a traffic light colouring system to indicate suitability.

Furthermore, all data is structured into one bibliographic overview in EndNote where all meta data is kept and stored in harmonised formats for future replication. The data sources are further described and evaluated in an Excel file which is also aligned with the simultaneous deliverables D2.2 and D3.1. Combined, the total inventory forms the project Milestone 4 ‘Existing Data Inventory’.

EXECUTIVE SUMMARY

This deliverable 4.1 utilises and further develops the classification system developed in D5.3 “Review and harmonisation of data” for the end-of-life (EoL) products and wastes to complete the overall ProSUM data inventory. Its main results are the identification, description, compilation, and evaluation of data and information sources for all waste groups covered in ProSUM, i.e. Waste Electrical and Electronic Equipment (WEEE), waste batteries (BATT), end-of-life vehicles (ELV), and mining wastes (MIN). Another important result is the generic EoL system descriptions for WEEE, BATT, ELV, and MIN, depicting material and information sources applicable for all EU28+2.

To achieve this, an essential first step was to describe the EoL system in general as well as the scope for this deliverable. Based on this universal overview, system descriptions for all four waste groups, i.e. WEEE, BATT, ELV, and MIN, were developed using expert information about universal waste and downstream waste flows, as well as reporting requirements and procedures. The system was distinguished by waste generation and collection, different waste-specific treatment steps, and recycling processes, resulting in either recirculation or disposal. European and national governments and authorities, multi-national and national organisations, and industrial stakeholders, were identified as recipients and collectors of relevant information and data from the different actors and stakeholders in the system.

In addition to this, important definitions, terms, and legislation for all matters regarding waste and waste flows, in line with D5.3, are defined and described to develop harmonised understanding and terminology within the EoL community. This unified approach to a coherent and comprehensive terminology facilitates researchers, practitioners, manufacturers and industries, governmental bodies, and recyclers to communicate, collate, and process data in an intelligible way.

In the next step, the required information is derived from the system description, resulting in a questionnaire for each of the three waste groups WEEE, BATT, and ELV (as MIN already had a compilation of required data sources and information flows) to identify and describe data sources. A general outcome is that: information on WEEE is mainly produced and collected in extensive research studies; the major data source for BATT are multi-national industrial associations and national compliance scheme; information about ELV is still scarce and limited to general waste flows; and the main data and information source for MIN are the Euopean and national geological surveys.

Subsequently, data availability and accessibility of the collected data sources were evaluated, regarding scope and content, temporal and spatial granularity, harmonisation, distinction in sub-categories, and public availability. To improve understanding this was done for example country case studies, analysing the data situation for each waste group for a specific country.

This builds a basis and vantage point for a CRM data assessment strategy in Deliverable 4.2, where these waste flow studies in D4.1 form the common groundwork for the end-of-life system to improve the knowledge base for the development of the EU-UMKDP.

Moreover, the developed ProSUM bibliography set up in EndNote is functioning now internally first. It specifically allowed to categorise, filter and manage the continuously growing knowledge base covering 336 relevant documents, likely to be converted via an XML export, to become the basis for the EU-Urban Mine Knowledge Data Platform currently in development. Proper scrutiny of all data sources in an uniform manner is an important step now successfully completed and forming the basis for further expansion in the project as more sources becoming available will continuously be added.

1 Introduction

1.1 Aim and scope of the Deliverable

The aim of this deliverable is the identification and description of relevant and available data sources related to the emergence of waste flows (waste generation). This includes, as far as possible, downstream waste flows emerging from (pre-)processing steps, as well as recycling processes, that are relevant to constructing and reconciling waste generation data for the urban mine data platform. Subsequently, the data inventory will be completed with available data, harmonised using the classification Deliverable 5.3.

The scope of this deliverable encompasses specifically the reported **waste generation** and other available **waste flow studies.** In detail, D4.1 is about the quantification and characterisation of waste streams and deposits arising from end-of-life products and mining waste, secondary waste from treatment and pre-processing, especially if discarded and thus not valorised further. At the same time, the scope of parallel Deliverable 2.2 is available CRM data for **components in these products and stocks**, whereas the scope of the parallel Deliverable 3.1 is the **product market inputs and stocks** of appliances for EEE, BATT, and vehicles leading to **waste generation**. A single inventory has been developed to ensure that data can be tracked and linked properly particularly wher multiple sources may have multiple data points.

This deliverable D4.1 structures existing and available information containing data on waste arising from the treatment of WEEE, Batteries, ELV, and mining waste. “Waste generated” is defined as post-consumer waste and secondary waste, specifically if not further valorised and disposed of in deposits. In comparison to WP 2 and 3, the term “waste generated” includes explicitly mining waste. In contrast to WEEE, Batteries, and ELV, data on mining waste generated is not derived from stock and flow modelling, it already exists as waste and is present in deposits. D4.1 provides the foundation to collate existing information (data itself and metadata) appropriately and to identify flows and deposits of high CRM relevance, in order to: a) evaluate collected data statistically relative to the needs of a European CRM inventory; and b) provide a consolidated CRM data set.

The classification system developed in D5.3 together with a glossary of waste specific terms and definitions has been applied to create a joint framework covering all of the waste groups consdiered. The characteristics of waste arising are described, and available information on waste composition is compiled and reported, using ‘system flow diagrams’.

Combining this information with the end-user requirements identified in D5.5, mass flows, processing steps, and reporting requirements were identified. Moreover, a comprehensive data gathering exercise was undertaken to identify relevant data sources regarding waste arising flows and stocks, and processing and treatment capacity in EU28+2. The task includes: identification and evaluation (availability and accessibility of data) of sources such as Eurostat, national databases, compliance scheme reports, and reporting databases under various EU Directives.

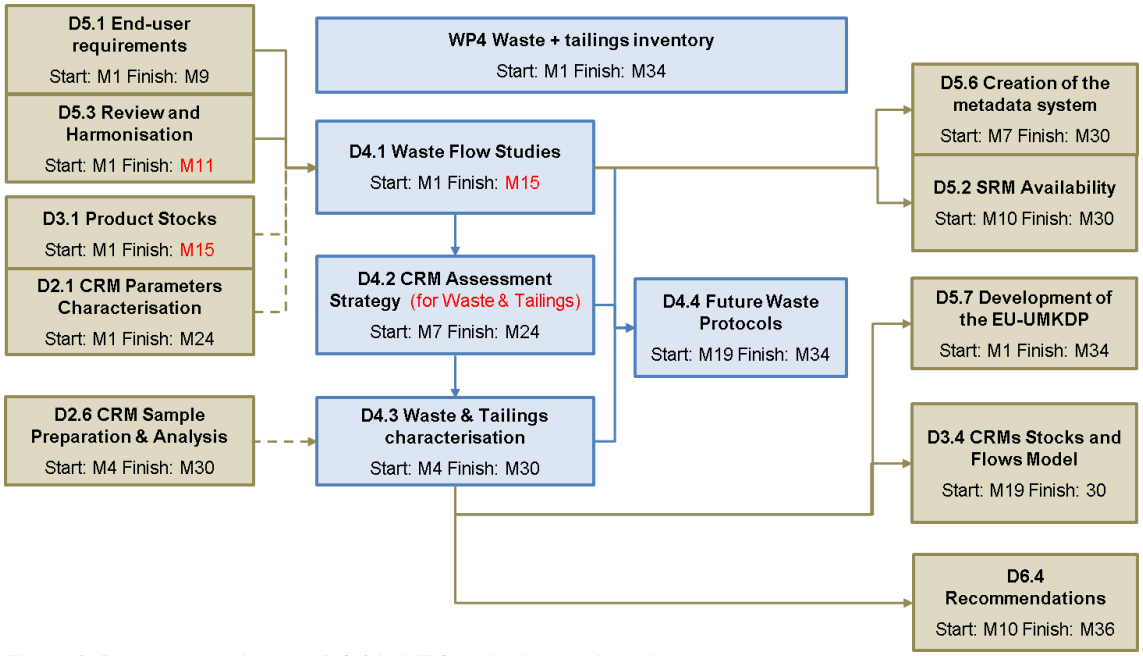

Figure 1: Pert chart positioning D4.1 in WP4 and other work packages

The following linkages are important:

1. D4.1 takes into account the data harmonisation and classification from D5.3 focusing on the identification and description of all data sources for waste flow studies, including mining waste (which is not covered under D2.2 and D3.1).
2. D4.1 takes into account the end-user requirements and Table 6 in D5.1 to identify the waste flow studies in scope. The end-user requirements have been further developed and evaluated by the Project Consortium in undertaking this data inventory work.
3. D4.1 includes data sources identified in D2.1 and D3.1. The bibliography developed for these three deliverables has been used to create one **aligned inventory of information** in Annex 2 of this document. D4.1 also provides the inventory of data sources for further analysis in D3.2 regarding complementary flows.
4. D4.1 provides the **data source inventory** for more sophisticated CRM Assessment strategies in D4.2.
5. D4.1 and the subsequent D4.2 will support D4.3 where **waste flow studies** (D4.1) will be combined with **CRM assessment strategies** (D4.2) to undertake a well-informed and scientifically sound waste characterisation.
6. The combined and updated information from D4.1 to D4.3 will then provide all parameters and **datasets** to D5.2 to be included in future waste protocols (D4.4). They will be used to support SRM assessment in WP5, and for CRM Stocks and Flows model (D3.4).
7. Finally in D4.3, information will be provided to improve harmonisation and updating of the waste flow information for the **EU-UMKDP** by means of developing specific updating protocols (D5.7) and formulating recommendations (D6.4) to improve the knowledge base.

1.2 Definitions and glossary of terms, extension of approach developed in D5.3

Due to the diversity of data sources amongst the EU and the coverage of four different waste groups there was a lack of commonly used terms and definitions. A glossary of terms has been developed by the ProSUM project. This has been adapted form legislation wherever possible.

1.2.1 General terms

Best available techniques
Best available techniques as defined in Article 2(11) of Directive 96/61/EC (Directive 2008/98/EC).

Broker
Any undertaking arranging the recovery or disposal of waste on behalf of others, including such brokers who do not take physical possession of the waste (Directive 2008/98/EC).

Clearing House
A central agency for the collection, classification, and distribution especially of information. Clearing houses may be of public or private nature. In the context of this report, their aim is to coordinate the activities of Compliance Schemes (for batteries and WEEEs) at national level.

Collection
The gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility (Directive 2008/98/EC).

Dealer
Any undertaking which acts in the role of principal to purchase and subsequently sell waste, including such dealers who do not take physical possession of the waste (Directive 2008/98/EC).

Disposal
Any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I sets out a non-exhaustive list of disposal operations (Directive 2008/98/EC).

Distributor
Any natural or legal person in the supply chain, who makes EEE available on the market. This definition does not prevent a distributor from being, at the same time, a producer within the meaning of point (f) (Directive 2012/19/EU).

Non-compliant treatment (complementary flows)
This working definition is used and also aligned with the information from the CWIT project (Huisman, 2015). Recycling with other waste streams involves recycling of WEEE with, for instance, mixed metal scrap. This type of recycling does not always meet the same efficiency and treatment standards as the officially reported amounts, and is financed via other (mainly market) mechanisms. The amount of WEEE treated this way is very difficult to quantify, and if data is available, it is mainly estimated. The term non-compliant does not necessarily imply substandard treatment, but rather refers to these quantities not being declared to national/ EU levels. Other terms commonly used are **complementary treatment** or **unreported treatment**. The term unreported is not utilised here as often these amounts are actually declared to regional authorities under different reporting regimes.

Preparing for re-use
Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing (Directive 2008/98/EC).

Prevention
Measures taken before a substance, material or product has become waste, that reduce: (a) the quantity of waste, including through the re-use of products or the extension of the life span of products (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of harmful substances in materials and products (Directive 2008/98/EC).

Recovery
Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations (Directive 2008/98/EC).

Recycling
Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations (Directive 2008/98/EC).

Registration bodies
National authorities or with national producer responsibility organisations authorised by Member States where the registration of producers of batteries and accumulators shall take place (Directive 2006/66/EC and 2013/56/EU).

Reuse
Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived (Directive 2008/98/EC and Directive 2000/53/EC).

Separate collection
The collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment (Directive 2008/98/EC).

Treatment
Any activity after the end-of life vehicle [or any other product or good] has been handed over to a facility for [mechanical, chemical, thermal, biological pre-processing, such as] depollution, dismantling, shearing, shredding, [sorting], recovery or preparation for disposal of the shredder wastes, and any other operation carried out for the recovery and/or disposal of the end-of life vehicle and its components (Directive 2000/53/EC). It is not the recovery or disposal operation itself but rather the preparation prior to recovery or disposal (Directive 2008/98/EC).

Waste
Means any substance or object which the holder discards or intends or is required to discard (Directive 2008/98/EC). In ProSUM this includes mining waste.

Waste generation
WEEE Generated in a Member State corresponds to the total weight of discarded products (waste) as a result of consumption within the territory of that Member State in a given reporting year, prior to any activity (collection, preparation for reuse, treatment, recovery (including recycling) or export) after discarding. Waste arising from private, business and industrial sector. Waste generated is not the same as waste collected, since other non-compliant waste flows and processing exist. Moreover, a differentiation between excluding und including major mineral waste is made in Eurostat statistics.

Waste holder
The waste producer or the natural or legal person who is in possession of the waste (Directive 2008/98/EC).

Waste producer
Anyone whose activities produce waste (original waste producer) or anyone who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste (Directive 2008/98/EC).

Waste management
The collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker (Directive 2008/98/EC).

1.2.2 WEEE specific terms

Removal
Manual, mechanical, chemical or metallurgic handling with the result that hazardous substances, mixtures and components are contained in an identifiable stream or are an identifiable part of a stream within the treatment process. A substance, mixture or component is identifiable if it can be monitored to verify environmentally safe treatment (Directive 2012/19/EC).

Harvesting or Scavenging
Removal of valuable components, only considering reuse or material value in e.g. compressors from temperature exchange equipment, hard disks, memory and other small IT components. Harvesting implies pre-treatment in a regulated environment. Scavenging implies theft from whole units in storage.

Waste electrical and electronic equipment (WEEE)
Electrical or electronic equipment which is waste within the meaning of Article 3(1) of Directive 2008/98/EC, including all components, sub-assemblies and consumables which are part of the product at the time of discarding (Directive 2012/19/EU). WEEE is grouped in categories outlined in Annexes I to IV of the WEEE Directive.

WEEE from private households
WEEE which comes from private households and WEEE which comes from commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households. Waste from EEE likely to be used by both private households and users other than private households shall in any event be considered to be WEEE from private households (Directive 2012/19/EC).

1.2.3 BATT specific terms

Automotive batteries
Any battery or accumulator used for automotive starter, lighting or ignition power (Directive 2006/66/EC).

BATT
A 'battery' or 'accumulator' is any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (non-rechargeable) or consisting of one or more secondary battery cells (rechargeable) (Directive 2006/66/EC). Waste battery or accumulator' means any battery or accumulator which is waste within the meaning of Article 1(1)(a) of Directive 2006/12/EC and Directive 2006/66/EC At its end-of-life called as spent or waste batteries.

Battery recycling efficiency
The recycling efficiency of a recycling process means the ratio obtained by dividing the mass of output fractions accounting for recycling by the mass of the waste batteries and accumulators input fraction expressed as a percentage (Regulation (EU) No 493/2012).

Battery recycling process
Any reprocessing operation as referred to in Article 3(8) of Directive 2006/66/EC which is carried out on waste lead-acid, nickel-cadmium and other batteries and accumulators and results in the production of output fractions as defined in point 5 of this Article. The recycling process does not include sorting and/or preparation for recycling/disposal and may be carried out in a single facility or in several facilities (Regulation (EU) No 493/2012).

Industrial batteries
Any battery or accumulator designed for exclusively industrial or professional uses or used in any type of electric vehicle and also include batteries and accumulators used in electrical vehicles, such as electric cars, wheelchairs, bicycles, airport vehicles and automatic transport vehicle (Directive 2006/66/EC).

Input fraction
The mass of collected waste batteries and accumulators entering the recycling process as defined in Annex I (Regulation (EU) No 493/2012).

Output fraction
The mass of materials that are produced from the input fraction as a result of the recycling process, as defined in Annex I without undergoing further treatment, that have ceased to be waste or that will be used for their original purpose or for other purposes, but excluding energy recovery (Regulation (EU) No 493/2012).

Preparation for recycling
Treatment of waste batteries and/or accumulators prior to any recycling process, which shall, inter alia, include storage, handling, dismantling of battery packs or separation of fractions that are not part of the battery or accumulator itself (Regulation (EU) No 493/2012).

1.2.4 ELV specific terms

Automotive shredder residue (ASR)
Residues from ELV treatment after de-pollution, dismantling and shredding of the hulk, with or without mechanical post-shredder metal separation (Vermeulen et al., 2011).

De-pollution
Removal or treatment of components listed in ANNEX I of Directive 2000/53/EC, such as batteries, liquefied gas tanks; removal or neutralization of potential explosive components (e.g. air bags), removal and separate collection and storage of fuel, motor oil, transmission oil, gearbox oil, hydraulic oil, cooling liquids, antifreeze, brake; fluids, air-conditioning system fluids and any other fluid contained in the end-of-life vehicle, unless they are necessary for the re-use of the parts concerned; removal, as far as feasible, of all components identified as containing mercury (Directive 2000/53/EC).

Dismantling
Treatment operations in order to promote recycling as listed in ANNEX I of Directive 2000/53/EC, including removal of catalysts, removal of metal components containing copper, aluminium, and magnesium if these metals are not segregated in the shredding processes, removal of tyres and large plastic components (bumpers, dashboard, fluid containers, etc.), if these materials are not segregated in the shredding process in such a way that they can be effectively recycled as materials, and removal of glass.

Economic operators
Producers, distributors, collectors, motor vehicle insurance companies, dismantlers, shredders, recoverers, recyclers and other treatment operators of end-of-life vehicles, including their components and materials (Directive 2000/53/EC).

End-of-life vehicle (ELV)
A vehicle which is waste within the meaning of Article 1(a) of Directive 75/442/EEC (Directive 2000/53/EC).

Hulk
Car body after de-pollution and dismantling.

Producer
A vehicle manufacturer or the professional importer of a vehicle into a Member State (Directive 2000/53/EC).

Shredder
Any device used for tearing into pieces or fragmenting end-of life vehicles, including for the purpose of obtaining directly reusable metal scrap (Directive 2000/53/EC).

1.2.5 MIN specific terms

Aggregates
Any of several hard, inert materials, such as sand, gravel, slag, or crushed stone, used for mixing with a cementing or bituminous material to form concrete, mortar, or plaster; or used alone, as in railroad ballast or graded fill (Neuendorf, Mehl, & Jackson, 2011).

Ballast
Gravel, broken stone, expanded slag or similar material used as a foundation for roads, esp. that laid in the roadbed of a railroad to provide a firm bed for the ties, distribute the load, and hold the track in line, as well as to facilitate drainage (Neuendorf, Mehl, & Jackson, 2011).

Back fill
Earth or other material used to replace material removed temporarily during construction or permanently during mining, such as stones and gravel used to fill pipeline trenches or placed behind structures such as bridge abutments, or waste rock used to support the roof after removal of ore from a stope. The process of refilling an excavation, a mine opening, or the space around a foundation (Neuendorf, Mehl, & Jackson, 2011).

Cobbing
The separation, generally with a hand-held hammer, of worthless minerals from desired minerals in a mining operation, e.g. quartz from feldspar (Neuendorf, Mehl, & Jackson, 2011).

Concentrate
Enriched ore material collected after a removal of waste in a mill or concentrator. The rejected waste material is known as tailings (Neuendorf, Mehl, & Jackson, 2011).

Concentrator / dressing plant
An industrial facility where mineral processing takes place.

Extractive industry
All establishments and undertakings engaged in surface or underground extraction of mineral resources for commercial purposes, including extraction by drilling boreholes, or treatment of the extracted material (Directive 2006/21/EC).

Gangue
The valueless rock or mineral aggregates in an ore; that part of an ore that is not economically desirable but cannot be avoided in mining. It is separated from the ore minerals during concentration (Neuendorf, Mehl, & Jackson, 2011).

Marginal ore
Ore which, at current market value of products from its excavation and processing, just repays the cost of its treatment (Science Dictionary, 2016).

Mineral processing
Treating crude ores and mineral products in order to separate the valuable minerals from the waste rock, or gangue (Encyclopedia Britannica, 2016).

Mine
(a) An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings.
(b) The area or property of a mineral deposit that is being excavated; a mining claim (Neuendorf, Mehl, & Jackson, 2011).

Mining
The process of extracting metallic or non-metallic mineral deposits from the Earth. The term may also include preliminary treatment, e.g. cleaning or sizing (Neuendorf, Mehl, & Jackson, 2011).

Mining waste (MIN)
Waste from extraction and processing of mineral resources. It involves materials that must be removed to gain access to the mineral resource, such as topsoil, overburden and waste rock, as well as tailings remaining after minerals have been largely extracted from the ore (European Commission, Mining Waste, 2016).

Ore
The naturally occurring material from which a mineral or minerals of economic value can be extracted at a reasonable profit (Neuendorf, Mehl, & Jackson, 2011).

Overburden
Barren rock material, either loose or consolidated, overlying a mineral deposit, which must be removed prior to mining (Neuendorf, Mehl, & Jackson, 2011).

Recovery
The percentage of valuable constituent derived from an ore, a measure of mining or extraction efficiency (Neuendorf, Mehl, & Jackson, 2011).

Run-of-mine
Ore in its natural, unprocessed state; pertaining to ore just as it is mined (Neuendorf, Mehl, & Jackson, 2011).

Slag
A by-product of the fusion of ores, metals, flux, and fuel that contains noneconomic constituents of the furnace charge (Neuendorf, Mehl, & Jackson, 2011).

Sorting
Processes that operate on particulate material to concentrate a desired component and separate it from waste material.

Tailings
The waste solids or slurries that remain after the treatment of minerals by separation processes (e.g. crushing, grinding, size-sorting, flotation and other physico-chemical techniques) to remove the valuable minerals from the less valuable rock (Directive 2006/21/EC).

Tailings dam
An earth-fill embankment dam used to store by-products of mining operations after separating the valuable fraction from the uneconomic fraction of an ore (Wikipedia, 2016).

Waste
Any solid or liquid generated by human activity that has little or no economic value, usually the result of the manufacture, mining, or processing of a material to produce an economic product (Neuendorf, Mehl, & Jackson, 2011).

Waste facility
Any area designated for the accumulation or deposit of extractive waste, whether in a solid or liquid state or in solution or suspension, for the following time-periods (Directive 2006/21/EC).

Waste rock
Rock that must be broken and disposed of in order to gain access to and excavate the ore; valueless rock that must be removed or set aside in mining (Neuendorf, Mehl, & Jackson, 2011).

1.3 Waste legislation and reporting requirements
The framework for data gathering and reporting was set with the waste framework directive 2008/98/EC referring to the regulation that define basic rules of data structuring.

Directive 2008/98/EC
Waste framework directive. It provides a general framework of waste management requirements and sets the basic waste management definitions for the EU. It lays down general rules for waste prevention, re-use, recycling, recovery, and disposal as well as e.g. lists disposal (D, ANNEX I) and recovery (R, ANNEX II) operations.

Commission Regulations 2150/2002 and 849/2010
Commission Regulation 2150/2002 on waste statistics and Commission Regulation 849/2010 amending 2150/2002 establish a framework to produce Community statistics on waste generation (according to ANNEX I of 2150/2002), recovery, and disposal (according to ANNEX II of 2150/2002), complying with the mainly substance-oriented statistical nomenclature in ANNEX III of 2150/2002. Additionally, the Commission has to put up a table of equivalence between the latter nomenclature and the list of waste (Commission Decision 2000/532/EC).

1.3.1 WEEE legislation
Legislation concerning WEEE on Member state level is directly linked to the WEEE Directive which is completed by compositional specifications and Commission Decisions 2004/249/EC and 2005/369/EC which lay down a questionnaire for the implementation report that Member States have to submit to the EC.

Directive 2012/19/EU
on waste electrical and electronic equipment (WEEE); known as 'WEEE Directive'. The WEEE Directive sets minimum requirements for the first treatment facilities. Moreover, it defines collection categories according to which data have to be reported.

Directive 2011/65/EU
Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
OJ L 174 of 1 July 2011 (Roh's Directive).

Commission Decision 2005/369/EC
Commission Decision of 3 May 2005 laying down rules for monitoring compliance of Member States and establishing data formats for the purposes of Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment (notified under document number C(2005) 1355).

Commission Decision 2004/249/EC
Commission Decision of 11 March 2004 concerning a questionnaire for Member States reports on the implementation of Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE) (notified under document number C(2004) 714).

1.3.2 BATT legislation

Directive 2006/66/EC is laying down the legislative basis concerning waste batteries on EU level since main aspects, such as minimum treatment requirement, collection as well as recycling rates (refined in Regulation (EU) No 493/2012, and reporting procedures are defined. Limitations of material usage is regulated in Directive 2013/56/EU.

Directive 2006/66/EC
on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC. Also known as 'Battery Directive' that define prohibitions, rules and requirements concerning production, POM and at the end of a batteries life. The overarching objective (Article 7) is, inter alia, to reduce the environmental impact of batteries by ensuring separate collection, reducing disposal and increasing the recycling of batteries and accumulators.
Within this context, the battery directive requires an annual reporting of the MS bodies to the EC containing at least the following content: battery mass collected, collection rate, and recycling efficiency. However, this is only obliged for portable batteries!

Directive 2013/56/EU
Directive on batteries and accumulators and waste batteries and accumulators as regards the placing on the market of portable batteries and accumulators containing cadmium intended for use in cordless power tools, and of button cells with low mercury content, and repealing Commission Decision 2009/603/EC. This Directive amends paragraphs of Directive 2006/66/EC.

Regulation (EU) No 493/2012
Rules regarding the calculation of recycling efficiencies of the recycling processes of waste batteries and accumulators.
This regulation refers to Directive 2006/66/EC and lays down general rules of the calculation of recycling efficiencies. Recyclers are obliged to report, inter alia, the recycling efficiency, input fraction, and output fraction and process design. The recycling efficiency "shall cover all individual steps of recycling and all corresponding output fractions". The composition of input and output fractions shall itemize elemental or component/compound level.

1.3.3 ELV legislation

Legislation on end-of-life vehicles has the aim to prevent and diminish negative environmental consequences caused by ELV, define producer responsibility, and establish rules and regulations for a better recyclability and recycling of vehicles. In addition to this, legislation on vehicles sets a classification system for types of vehicles, some of which are covered by European and MS directives and laws on end-of-life vehicles.

Directive 2000/53/EC
Directive 2000/53/EC on end-of life vehicles (known as "ELV Directive") defines a legislative framework to minimise the impact of ELV on the environment, to harmonise requirements for collection and treatment, and to set reuse/recycling and reuse/recovery targets for end-of-life vehicles.

Commission Decision 2005/293/EC
Commission Decision 2005/293/EC lays down detailed rules on the monitoring of the reuse/recovery and reuse/recycling targets set out in Directive 2000/53/EC on end-of-life vehicles and the minimum data required for reporting.

Directive 2005/64/EC
Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC applies to vehicles belonging to the categories M1 and N1, which are defined in Directive 70/156/EEC, ANNEX II, and to new or reused components of M1 and N1 vehicles. It establishes rules and provisions to make sure vehicles and vehicle components maintain the required safety standards when being reused.

ELV Guidance
Guidance How to report on end-of-life vehicles according to Commission Decision 2005/293/EC describes the scope of the ELV directive and provides guidance to compile a quality report covering the ELV rates for reuse/recovery and reuse/recycling.

1.3.4 MIN legislation
The EU legislation that deals with mining waste (waste from the extractive industry) mainly deals with security (i.e. dam security) and health aspects (pollution of air, soil and water) of the waste. There is no legislation (yet!) similar to those dealing with WEEE, ELV etc., concerning reusability, recyclability and recoverability. Nevertheless, code lists (lexicon tables) derived from the Mining waste Directive (2006/21/EC) will be used in the data model developed for the ProSUM project.

Directive 2006/21/EC
Directive on the management of waste from extractive industries. The directive introduces measures for safe management of waste resulting from the extraction, treatment and storage of mineral resources and the working of quarries.

Decision 2009/335/EC
Technical guidelines for the establishment of the financial guarantee in accordance with Directive 2006/21/EC concerning the management of waste from extractive industries.

Decision 2009/337/EC
Definition of the criteria for the classification of waste facilities in accordance with Annex III of Directive 2006/21/EC concerning the management of waste from extractive industries.

Decision 2009/358/EC
On the harmonization, the regular transmission of the information and the questionnaire referred to in Articles 22(1)(a) and 18 of Directive 2006/21/EC on the management of waste from extractive industries.

Decision 2009/359/EC
Completing the definition of inert waste in implementation of Article 22(1)(f) of Directive 2006/21/EC concerning the management of waste from extractive industries.

Decision 2009/360/EC
Completing the technical requirements for waste characterization laid down by Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from extractive industries.

1.3.5 Classification systems

The following classification and harmonisation systems are of interest and used in the context of EoL data collection, consolidation and publication.

Central Product Classification (CPC)

Product classification for goods and services by the United Nations Statistical Commission to organise and analyse data on industrial production, national accounts, trade, prices etc..

Combined nomenclature (CN)

Classification of goods that provides the means of collecting, exchanging and publishing data on EU international trade statistics. It is also used for the collection and publication of international trade statistics in intra-EU trade.

Decision 2000/532/EC - "List of Waste" (LoW)

Decision 2000/532/EC establishing a list of wastes. This Decision establishes the classification system for wastes, including a distinction between hazardous and non-hazardous wastes. It is closely linked to the list of the main characteristics which render waste hazardous contained in Annex III to the Waste Framework Directive. This Decision has been amended several times. Commission Decision 2001/118/EC of 16 January 2001 amending Decision 2000/532/EC as regards the list of wastes.

Table 1 depicts the LoW codes related to the considered waste groups as well as codes with a relation to end-of life processing (collection, treatment, recycling) that are sometimes applied.

Table 1: List of Waste (LoW) codes related to waste groups (non-exhaustive listing)

Waste group	LoW code	
WEEE	16 02	Discarded equipment and its components
	16 02 09*	Transformers and capacitors containing PCBs or PCTs
	16 02 10*	Discarded equipment containing or contaminated by PCBs or PCTs other than those mentioned in 16 02 09
	16 02 11*	Discarded equipment containing chlorofluorocarbons
	16 02 12*	Discarded equipment containing free asbestos
	16 02 13*	Discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12
	16 02 14	Discarded equipment other than those mentioned in 16 02 09 to 16 02 13
	16 02 15*	Hazardous components removed from discarded equipment
	16 02 16	Components removed from discarded equipment other than those mentioned in 16 02 15
	20 01 21*	fluorescent tubes and other
	20 01 23*	discarded equipment containing chlorofluorocarbons
	20 01 35*	discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components
	20 01 36	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
BATT	16 06	Batteries and accumulators
	16 06 01*	Lead batteries
	16 06 02*	Ni-Cd batteries
	16 06 03*	Mercury-containing batteries
	16 06 04	Alkaline batteries (except 16 06 03)
	16 06 05	Other batteries and accumulators
	16 06 06*	Electrolyte from batteries and accumulators
	20 01 33*	Mixed batteries and accumulators containing batteries or accumulators included in 16 06 01, 16 06 02 or 16 06 03
	20 01 34	Batteries and accumulators other than those mentioned in 20 01 33
ELV	16 01	End-of-life vehicles and their components
	16 01 03	End-of-life tyres
	16 01 04	Discarded vehicles
	16 01 06	End-of-life vehicles, drained of liquids and emptied of other hazardous components
	16 01 99	Wastes not otherwise specified

MIN	01 01	Wastes from mineral excavation
	01 02	Wastes from mineral dressing
	01 03	Wastes from further physical and chemical processing of metalliferous minerals
	01 04	Wastes from further physical and chemical processing on non-metalliferous minerals
	01 05	Drilling muds and other drilling wastes

European Waste Classification for Statistics, version 4 (EWC-Stat codes)
The Regulation (EC) 2150/2002 on waste statistics obliges the Member States to report statistical data on waste generation and waste treatment according to the statistical waste nomenclature EWC-Stat. The EWC-Stat is a mainly substance-oriented aggregation of the waste types defined in the European List of Wastes (LoW). The result is a 1:n-relationship between EWC-Stat and European List of Wastes which allows for the unambiguous conversion of the waste types classified according to the List of Wastes into the EWC-Stat waste categories (Commission of the European Communities, 2010). A guidance on classification of waste according to EWC-Stat categories was published in 2010 by Eurostat.

Table 2 lists the EWC-Stat codes related to the considered waste groups as well as for recycling.

Table 2: EWC-STAT codes related to waste groups (non-exhaustive listing)

Waste group	EWC-Stat code	
WEEE	08.2	Discarded electrical and electronic equipment
	08.43	Other discarded machines and equipment components
BATT	08.41	Batteries and accumulators wastes
ELV	08.1	Discarded vehicles
	08.42	Spent catalytic equipment
MIN	12.3	Waste of naturally occurring minerals
	12.5	Various mineral wastes

Harmonized System (HS)
The HS Nomenclature comprises about 5,000 commodity groups which are identified by a 6-digit code and arranged according to a legal and logical structure based on fixed rules. The Combined Nomenclature (CN) of the European Union (EU) integrates the HS Nomenclature and comprises additional 8-digit subdivisions and legal notes specifically created to address the needs of the Community (European Commission, Harmonized System - General information, 2016).

International Standard Industrial Classification of All Economic Activities, (ISIC)
A standard United Nations Statistics Division (UNSD) classification of economic activities arranged so that entities can be classified according to the activity they carry out.

PRODCOM
Survey for the collection and dissemination of statistics on the production of industrial (mainly manufactured) goods, both in value and quantity terms, in the European Union (EU). It is abbreviated from the French ***Prod****uction* ***Com****munautaire*.

Standard International Trade Classification, Rev. 4 (SITC)
Classification by the United Statistical Commission for the use in the analysis of international merchandise trade by interested countries and international organizations (United Nations Statistical Devision, 2016).

Statistical Classification of Economic Activities in the European Community (NACE)
Classification of economic activities in the European Union (EU). NACE stands for ***N****omenclature statistique des* ***a****ctivités économiques dans la* ***C****ommunauté* ***e****uropéenne*.

Statistical classification of products by activity (CPA)
Classification of products (goods as well as services) at the level of the European Union (EU) regulated in Regulation (EC) No 451/2008.

2 Data sources for waste flow characterisation

This chapter presents an overview of the data sources identified to characterise waste flows within the system boundaries of ProSUM for each waste group. Data sources were identified, investigated and clustered into categories which differ in level of aggregation, update frequency, and spatial coverage.

For each waste group, system flows diagram have been developed: to represent the mass flows and stocks of waste, the bodies or processes involved, such as for collection, treatment, and recycling; and the information and data flows avaialbale from reporting organisatiins and institutions.

2.1 General system description

A product's life time is in principal characterised by four major steps or phases shown in Figure 2:

- The extraction of (primary or secondary) raw materials encompasses the exploitation of natural and anthropogenic resources. The product quality, i.e. grade is defined by both available technology and economic incentives.
- The production phase is characterised by processing, refining, and combination of primary raw materials (PRM), secondary raw materials (SRM), and pre-products in order to build up a complete product. The production phase can also be divided into several sub-steps, such as refining, fabrication, manufacturing, etc.
- In the use phase the products are operated, managed, and used. The products (in use and stored temporarily without use) build up the stock which is determined by the differences between input (I) into the use phase and output (O) out of it, i.e. it can be replenished (I > O), depleted (I < O) or stay constant (I = O) over time.
- With entry into the waste collection system the product becomes waste (by definition of Directive 2008/98/EC) and enters the end-of-life (EoL) phase. Here, waste is collected, transported, treated, recycled, and/or disposed of (cf. chapter 1.2 Definitions and glossary). The output of recycling and recovery is either involved in the production/extraction of a secondary raw material which re-enters the life cycle as input into the production step or lost due to inappropriate waste management.

This EoL phase is the subject of this deliverable and is described in more detail for the four waste groups waste electrical and electronic equipment (WEEE), waste batteries (BATT), end-of-life vehicles (ELV), and mining waste (MIN) in the respective chapters 2.4, 2.5, 2.6, and 2.7.

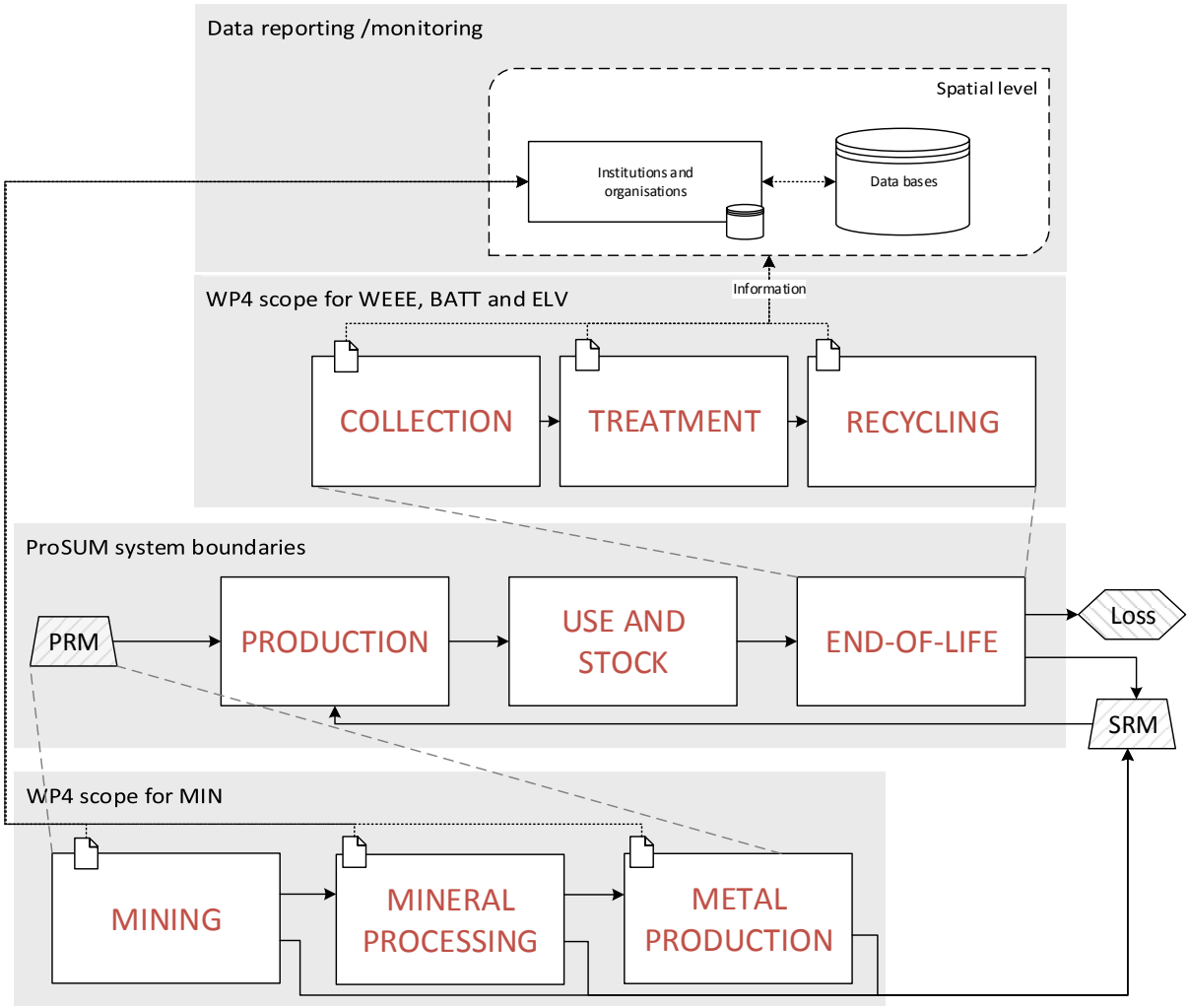

Figure 2: General system description

The first step for data compilation, collation, and provision of data on waste flows and properties is to outline and define existing material information flows; identify and describe information sources; and evaluate data/information availability and accessibility. Data on waste flows is collected, measured, and reported at different levels in the system and with varying robustness.

2.2 Information required

The information required is oriented by two major aspects: a) the ProSUM scope of prospecting SRM in the urban mine and mining waste; and b) the inquiry of end-users (see D5.1 end-user requirements). The information is divided into categories and differentiated between the waste flows. The information is gathered to characterise and describe end-of-life stocks and flows with special focus on critical raw materials.

Using the system diagrams, reported and stored information is investigated and data sources identified. In addition, the survey of additional suppliers of information, as well as literature research, will lead to a data inventory of existing and targeted information covering the pin-pointed questions. The evaluation process carried out assesses the availability and accessibility of data and illustrates the results in red, yellow, green (and grey) to indicate its usability for the ProSUM project, considering inter alia the granularity and spatial coverage of information.

Table 3 to Table 5 show the required information per waste group, using some products as example; a more extensive list is provided in Annex 1B.

Information required for WEEE and BATT

Table 3: Information required for WEEE and BATT

EoL step	Information required	Description (example)
Collection	Officially reported collection	Mass of laptops (UNU 030301) per MS and year
	Complementary and non-compliant processing	Mass of BATT (BATT Key BattLiCoO2) incorporated in WEEE waste flows per MS and year
Treatment	Mass and specification of waste	Mass of laptops (UNU 030301) per MS and year; CRM content based on device or component embedded
	Facility information	Number and capacity of facilities
Recycling	Mass and specification of waste	Mass of laptops (UNU 030301) per MS and year; CRM content based on device or component embedded
	Facility information	Number and capacity of facilities

Information required for ELV

With regards to ELV, a sub-division of treatment processes has to be made in order to meet the requirements of mass flows and stocks considered in the system diagram (Figure 5, page 48).

Table 4: Information required for ELV

EoL step	Information required	Description (example)
Collection	Officially reported collection	Mass of ELV collected per year and MS, sub-classified if feasible
	Complementary and non-compliant processing	Illegal export and illegal sale of ELV per MS and year
Treatment: de-pollution and dismantling	Mass and specification of waste	Mass and material or chemical composition of in- and output fractions, focus on CRM
	Facility information	Number, location and designation
Treatment: shredder and post-shredder treatment	Mass and specification of waste	Mass and material or chemical composition of in- and output fractions, focus on CRM
	Facility information	Number, location and designation
Treatment: other treatment (e.g. energy recovery and landfilling)	Mass and specification of waste	Mass and material or chemical composition of in- and output fractions, focus on CRM
	Facility information	Number, location and designation
Recycling	Mass and specification of waste	Mass and material or chemical composition of in- and output fractions, focus on CRM
	Facility information	Number, location and designation

Information required for MIN

The following issues were identified in Table 5 to be of relevance for the prospection of secondary raw material in mining wastes.

Table 5: Information required for MIN

EoL step	Information required	Description (example)
Mining waste	Location	Spatial information about location of the mine, since waste is often dumped close by
	Amount	Mass of mining waste generated per year and MS or mine
	Grade	Mass fraction of metal of the waste
	CRM	Mass fraction of CRM in mining waste generated
Mineral processing waste	Location	Spatial information about location of the processing waste
	Amount	Mass of mining processing waste generated per year and MS or facility
	Grade	Mass fraction of metals, etc. of the processing waste
	CRM	Mass fraction of CRM in mining processing waste generated
Metal production waste	Location	Spatial information about location of the metal production waste
	Amount	Mass of mining processing waste generated per year and MS or facility
	Grade	Mass fraction of metals, etc. of the production waste

2.3 Overview of data source categories

2.3.1 Pan-European data sources

Eurostat
Eurostat[1] is the statistical office of the European Union. Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions. Eurostat does not collect data. This is done in Member States by their statistical authorities. They verify and analyse national data and send them to Eurostat. Eurostat's role is to consolidate the data and ensure they are comparable, using harmonised methodology. Eurostat is actually the only provider of statistics at European level and the data Eurostat issue are harmonised as far as possible (Eurostat, Eurostat - what we do, 2016).

European Commission
Administrative institution implementing the policies, laws, and treaties of the European Union. Online presence available here: http://ec.europa.eu/

EU-MKDP
European Minerals Knowledge Data Platform, created by the Minerals4EU project to 'house' data on minerals. Accessible here: http://minerals4eu.brgm-rec.fr/

Commercial databases
Industry data might be available (f.i. GfK, Neilsen,...) even if usually not freeware and the classification and granularity of data might vary from source to source.

ProSUM partners and External Experts Advisory Board (EEAB)
The ProSUM Consortium comprises 17 organisations with expertise in WEEE, batteries, ELVs and mining activities, as well as management of data, statistics and IT development. Organisations such as TU Berlin, UNU, WRAP or the WEEE Forum have performed studies that will provide input to the project databases.

In addition to this, the project is supported by an external advisory board made up of experts in their sectors who help us steer the project direction. They may be able to support data provision for the project. For EEAB members see http://www.prosumproject.eu/our-eeab

ProSUM Information Network (IN)
Individuals and organisations from target stakeholder groups are invited to join the Information Network. Members of the IN and its special interest groups (SIGs) are invited to work together: to identify opportunities to enhance data sharing and gathering which meets their needs, uses harmonised methodologies and is presented in consistent interoperable formats. More information on the IN is available at http://www.prosumproject.eu/information-network. Some members of the IN may be able to support the project with their data.

2.3.2 Multi-national data sources

There are a number of Associations with national members which exist at European level such as: the **WEEE Forum**, which gathers 32 WEEE compliance schemes from 22 different countries; and **Eucobat**, an association of 16 batteries compliance schemes from 14 different countries. Usually these kind of organisations provide benchmarking fora for their members, where they may perform studies, collect data and participate in dialogue regarding the regulation of their activities. Other European organisations will be contacted during the project and invited to join the Information Network to support data gathering.

[1] http://ec.europa.eu/eurostat/web/main/home

2.3.3 National data sources

National data may be collected by Producer Compliance Schemes in the case of batteries and WEEE. This may be for a whole country, regions or different product categories dependent upon the way the WEEE Directive has been implemented in that Member State. The Mmeber State has the responsibility ot collate the data ata a national level and provide it to Eurosat as described above. Some of these organisations may also undertake further studies to irmpove their own data for operational purposes. In additional, Member State governments or institutions may commission additional studies to better describe the situation in their country to help improve polcy or legislation.

Collective Take Back Schemes

Across the EU, different arrangements are in place for the organised take back of WEEE, BATT and ELVs. These differences arise due to the EU legislation concerning how these end of life products should be managed and differences in the way such legislation has been introduced in different Member States. In general, collective take back arrangements for WEEE and portable BATT are quite similar but ELV arrangements are more diverse. The way take back schemes are set up, report to national authorities and work together via EU associations, has an impact on data availability including what is collated for monitoring and reporting and what supplementary data may be available which has been collected for 'added value' reasons.

The WEEE Directive allows for the creation of producer responsibility organisations as instruments to comply with the legislation applicable. Producer Compliance Schemes (PCS) are organisations (in some cases founded by producers of EEE and in others operating as commercial entities offering a service) that discharge the obligations of Producers. Usually they do this by recording and reporting data on the products put on the market and making arrangements to ensure the necessary amount of waste is recycled on behalf of the Producers. Such PCSs are regulated by the relevant national authority to which they provide audited data verifying the amount of products put on the market and recycled. This data is held in national registers. Therefore, PCSs monitor and/or collect information about the waste flows: they hold and report data about the waste collected, from collection point to the treatment facility.

PCSs are required to regularly report to the authorities the amounts of waste collected and the origin and destination of it. In the case of WEEE, the CWIT project and several UNU studies showed that currently one third of WEEE in the EU is reported as separately collected and appropriately managed by PCSs (Eurostat, Waste electrical and electronic equipment (WEEE), 2016).

Producers of portable batteries must pay for the collection, treatment and recycling of waste portable batteries. They do this by joining a battery compliance scheme (BCS) which takes on the producer duties. A BCS is a membership organisation, the members are producers of portable batteries. The BCS ensures that they meet their members' obligations to pay for the collection, treatment and recycling of waste portable batteries, and fulfil their data reporting obligations. It gathers data from the producers on the batteries placed on the market, makes arrangements and gathers evidence for the collection, treatment and recycling of BATT, and report to the regulator.

For ELV, Member States shall take the necessary measures to ensure that economic operators set up systems for the collection of all end-of life vehicles and, as far as technically feasible, of waste used parts removed when passenger cars are repaired. Producers and importers of vehicles must register with the national authority stating the brands of vehicles for which they are responsible for meeting recovery and recycling targets. Vehicle producers are required to make a convenient network of facilities available. End-of-life vehicles can be taken to these facilities for dismantling and recycling at no cost to the final owner. Vehicle manufacturers and importers must meet recycling targets for end of life vehicles. They usually set up a network where organisations take back their particular make of vehicles at end of life. If an ELV is returned via this scheme there is no charge to the last owner. For those operating within a network take-back obligations are met by vehicle manufacturers and importers. Vehicle manufacturers are required to report to the national

authority on vehicles put on the market and recycled and recovered through their network. Treatment Facilities operating outside such networks are also required to meet and report on the dismantling, treatment, recycling and recovery requirements.

A list of PCSs for BATT and WEEE, Clearing Houses and European Associations of such compliance schemes is provided in Annex 1A. There are no corresponding organisations at the European level for ELV or MIN. See the relevant waste sections for more information concerning data availability.

Environmental Protection Agency (EPA)

Environmental Protection Agency interchangeable with Ministry of Environment or Government Department. Each Member State has their own arrangements in place concerning which organisations collect and report data concerning Directives on waste. Such organisations gather data from PCSs as described above, and also concerning waste which is managed and licensed and permitted facilities. A list of all Member states EPA, considered for further data invetntory, can be found in Annex 1A.

National databases and registers

National databases and registers may be held by the EPA or National Statistics Offices. They may compile data and produce reports concerning waste management facilities, producer compliance, permitting, sales of products etc.
Some organisations, associations or federal states run their own platforms and data bases comprising regional or national data. The German data base AidA[2] (North Rhine-Westphalia) contain e.g. lists of plants and chemical composition of secondary wastes.

National governments

Any legal body of a Member state that sets and administers public policy and exercises executive, political and sovereign power through customs, institutions, and laws within a state, such as ministries or national authorities. A list of Member State governmental bodies is in Annex 1A.

National Statistical Institutes (NSI)

NSIs are responsible for the development, production and dissemination of European statistics as designated by Member States. In order to provide comparable statistics at EU level the European Statistical System (ESS) was built up. NSI collect data and compile statistics for national and EU purposes (Eurostat, Eurostat - overview, 2016)http://ec.europa.eu/eurostat/web/european-statistical-system/overview?locale=fr. A list of national statistical offices in Eurostat can be found here: http://ec.europa.eu/eurostat/web/links and in Annex 1A.

National Geological Surveys (NGS)

Geological institutes or surveys which act on behalf of the individual Member States to measure, compile, and report data about mining activities and geological inventories. A list of Member States Geological surveys can be found in Annex 1A.

Producer registers

Platform for producers to be registered either voluntarily or by obligation (see 2012/19/EU Article 16 and 2006/66/EC Article 17) in order to put on market products in a Member State. The information stored contains at least name, business sector, and contact information. Moreover, information about product categories or specification can be required. A list of Member States producer registers can be found in Annex 1A.

[2] http://www.abfall-nrw.de/aida/

2.3.4 Other data sources

Universities and research institutes
Universities and research institutes gather or produce data in a variety of quality, granularity, and formats dependent upon the research need. Research studies and projects are often oriented on common (sector-specific) standards and classifications but are often scattered and/or not publicly available.

Facilities
Treatment or recycling facilities also generate and gather information for a variety of reasons: reporting against permit conditions to the regulator, reporting of recovery rates to their customer e.g. the PCS; to better understand their feedstock to optimise plant performance; and to monitor their treated fractions or recycled materials to demonstrate or monitor quality. Only data which is reported to demonstrate compliance with regulations is generally collated and held in national registers. Generally speaking the data quality, granularity, and format of data concerning facilities will vary significantly and is rarely published. Facilities in this context are for example dismantling facilities, collection and sorting plants for BATT, first treatment plants for WEEE, and recyclers e.g. smelters. Where such companies or operators of such faciltiies are members of the IN, they will be asked if they are willing to share data under a non-disclosure agreement.

2.4 WEEE – Waste Electrical and Electronic Equipment

2.4.1 System flow diagram description

The system flow diagram in Figure 3 represents the ProSUM project boundaries for WP4 and considers processes, stocks and flows for mass and information. The diagrams consist of four sections. Three sections visualise the product end-of-life phases: 1) Collection, 2) Treatment, and 3) Recycling. The fourth section, in the upper part, depicts the data management at Member State (MS) and European Union (EU) level.

In cases where the WEEE generated is collected and reported under the producer compliance regime by, public waste management authorities, third parties, retailers or PCSs, the mass collected per WEEE category is officially reported to the national institutes and organisations. No reporting takes place if WEEE is collected via informal routes or in complementary waste flows, like residual waste.

Authorised treatment facilities pre-process the WEEE collected at least according to the requirements set out in Directive 2012/19/EU which demands a reporting of mass treated per WEEE category. Non-compliant WEEE treatment includes products, components or fractions which are scavenged or recycled through metal scrap markets. Products may end up in other flows e.g. to municipal waste incinerators or mechanical, biological, or physical treatment. This is mainly dependent on national waste management activities and regulations.

Pre-processed or downstream waste goes to either metal recycling or other recycling plants producing secondary raw materials and waste.

Material losses in this system are caused by non-compliant and unreported waste collection, export of products, inappropriate treatment or recycling measures, and technical limits of dedicated processes.

Information on collected and treated WEEE through PCSs is reported to the national institutions and organisations (EPAs) are reported to the European Commission via Eurostat. Moreover, industry associations that act on multi-national level, may collect data from their individual members for evaluation and benchmarking purposes.

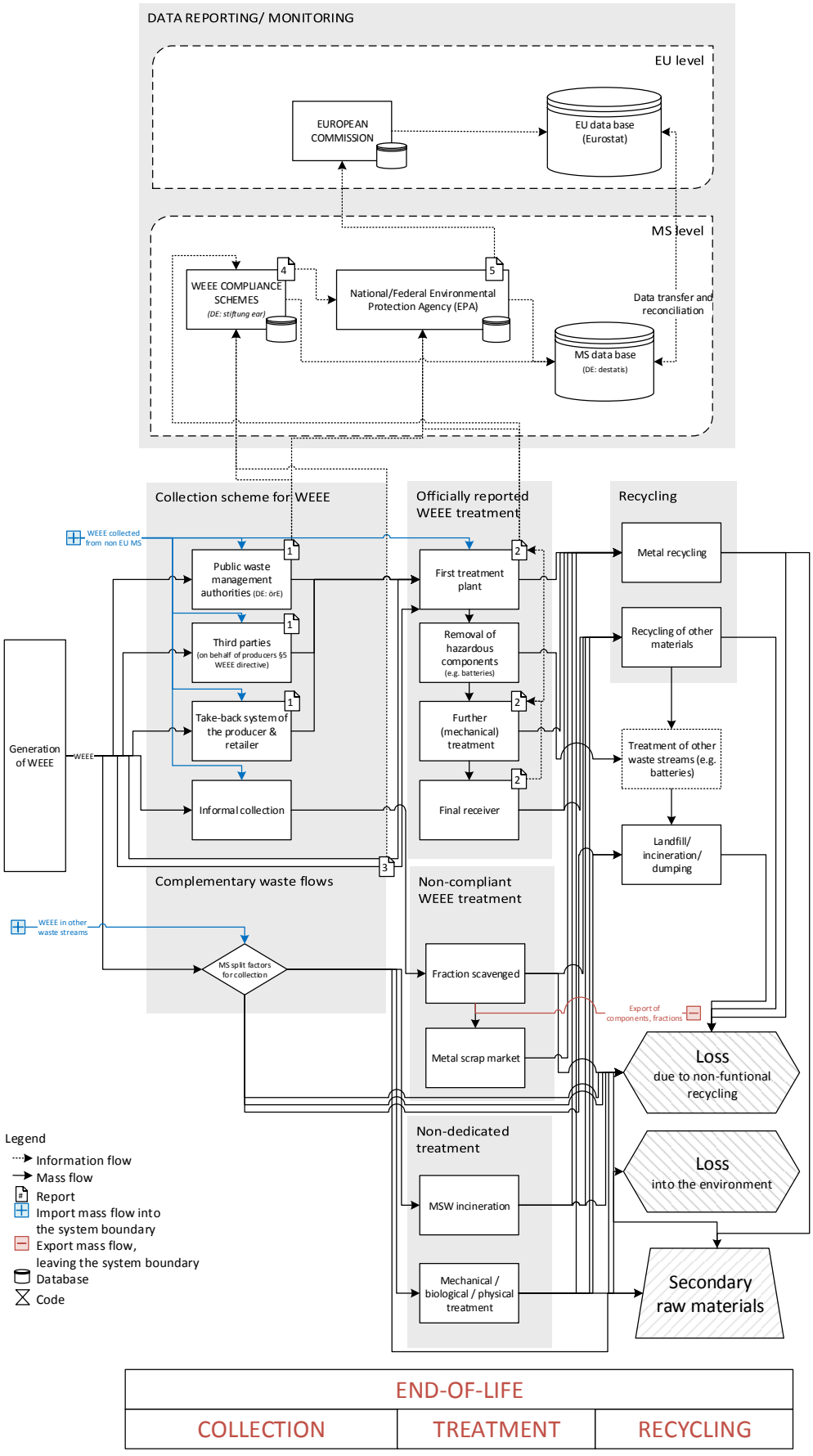

Figure 3: System description for WEEE

Information flows

The results of the investigation of information flows between the different bodies in the system diagram (see Figure 3) is shown in Table 6.

Table 6: Information flows for (W)EEE within the system diagram

Report	Report from	Report to	Obligatory by	Info content	Submission interval
1	WEEE collection scheme	WEEE compliance scheme	Directive 2012/19/EU	Quantities of WEEE collected per category (or other type of categories)	1-year
1	WEEE collection scheme	EPA (National WEEE register)*	Directive 2012/19/EU	Quantities of WEEE collected per category (or other type of categories)	1-year **
1	WEEE (first) treatment plant	WEEE compliance scheme	Directive 2012/19/EU	Quantities of WEEE treated per category according Directive	Variable
2	WEEE (first) treatment plant	EPA (National WEEE register)*	Directive 2012/19/EU	Quantities of WEEE treated per category according Directive	1-year **
3	Undefined	EPA	Directive 2012/19/EU	substantiated estimates: WEEE collected through all routes (e.g. studies)	1-year
4	WEEE compliance scheme	EPA (National WEEE register)*	Directive 2012/19/EU	POM data, quantities of WEEE collected	1-year **
5	EPA	European Commission (EC)	Directive 2012/19/EU	POM, quantities collected and sent for recycling, collection rate (per category).	submission: 3-year***, collection: 1-year

*In some countries such as FR, NL and ES a national WEEE register is being set up. All types of actors handling WEEE will report WEEE collected to this register.
** NOTE: this information is not always publicly available on a yearly basis
*** Latest data set released in 2015. It included data up to 2012.

2.4.2 Identification and description of data sources

2.4.2.1 Pan-European data sources

Eurostat

Annex 1C provides an overview of the data available in Eurostat. Every two years, Member States of the European Union are obliged to report to DG Environment the amount of EEE put on the market and WEEE collected in the 10 categories of the WEEE Directive. The data are typically published 3 months after the submission deadline by Eurostat and contains both odd and even years as separate entries.

The Member States Expert Group on WEEE decided in November 2014, that the data for the reporting period 2013 is due by the end of June 2015, therefore, the period from 2005 to 2013 is covered by this Eurostat (with some exceptions).

2.4.2.2 Multi-national data sources

WEEE Forum (WF)

The WEEE Forum is a not-for-profit association of 32 WEEE producer responsibility organisations (or 'producer compliance schemes') in Europe. The WEEE Forum provides a platform for producer responsibility organisations to take on the challenge of electrical and electronic waste in Europe by fostering ideas and sharing best practice whilst optimising environmental performance through the proper management of WEEE. The WEEE Forum is the largest organisation of its kind in the world. Over the years, producer responsibility organisations within the WEEE Forum have acquired substantial know-how on the technical aspects of collection, logistics and processing of WEEE.

DIGITAL Europe and CECED

DIGITALEUROPE represents the digital technology industry in Europe. Its members include some of the world's largest IT, telecoms and consumer electronics companies and national associations from every part of Europe. Its mission is to foster, on behalf of its members, a business, policy and regulatory environment in Europe that best realises their vision. DIGITALEUROPE's members include 60 Corporate members and 37 National Trade Associations from across Europe[3].

The European Committee of Domestic Equipment Manufacturers (CECED) is a Brussels-based trade association that represents the home appliance industry in Europe. It promotes the industry's general mission to increase product innovation while reducing the environmental impact of appliances. CECED is a member-driven Association. CECED has 19 Direct Members and 26 National Associations covering 25 countries[4].

Producer associations such as CECED and DIGITALEUROPE often issue reports and perform studies that may contain information on the composition of WEEE.

EERA (European Electronics Recyclers Association)

EERA, the European Electronics Recyclers Association, represents more than 38 recycling companies which are based in 17 European countries[5]. Important activities of the association are the dissemination of publications, documents and studies of common interest, the organization of gatherings for the exchange of information and informing the public and relevant organizations. The network of EERA members is a relevant stakeholder for the project, as they are able to provide information on the composition of WEEE.

Other national and European recyclers associations can be mentioned in this point and may join the IN, such as 'The European Recycling Industries' Confederation (EURIC), the European Federation of Waste Management and Environmental Services (FEAD), which represents the European waste management industry, and the European Association of Metals (Eurometaux).

Other projects and initiatives

Projects financed by the European Commission to characterise products and wastes have been identified as providers of valuable information for the ProSUM project. Past projects have published reports which have been considered in developing this inventory where applicable. Current projects are being contacted through the EASME Waste Cluster Group supported by officials in the EC.

The WEEE Forum Key Figures is a benchmarking tool developed by the WEEE Forum. It stores data on WEEE collection and EEEE sales provided by its members.

2.4.2.3 National data sources

National authorities and EPAs

National authorities and Environmental Protection Agencies (EPA) are listed in Annex 1A. These organisations usually collect and monitor data on WEEE, specifically data that will be used to control the achievement of the targets set by the WEEE Directive and national transposition. Therefore, data collected by these organisations comprises amounts of WEEE collected and EEE put on the market. The level of detail and aggregation of the data varies greatly from country to country, which complicates comparability. Data is not always available on an annual basis but certain countries issue annual reports that will be used to complement data on WEEE for ProSUM (some annual reports are listed in Table 6). Other countries provide quarterly data available on line

[3] http://www.digitaleurope.org/Aboutus.aspx
[4] http://www.ceced.eu/site-ceced/about-us.html
[5] http://www.eera-recyclers.com

(such as the Centro di Coordinamento RAEEE from Italy and Stiftung EAR from Germany). In some instances, data are not publicly available or just released with low frequency (often the case for eastern countries). Some databases are only available in the local language which limits inclusion.

National organisations
National organisations such as WEEE Compliance Schemes, Coordination centres, Producer registers, Recycling funds, National statistical institutes (NSI) and Waste management associations are listed in Annex 1A. The availability of data provided by these organisations at member state level is summarised in Annex 1C.

2.4.2.4 Other data sources

Universities and research institutes
A variety of universities and research institutes are dealing with the characterisations and analysis of WEEE related topics, such as United Nations University, Technische Universität Berlin, and Fraunhofer Institutes. Most of the research is linked to regional, national and European projects. A selection of relevant data sources is available in Annex 1A and Annex 2.

2.4.3 Evaluation of data availability and accessibility

Eurostat
Evaluation of the data that are available from Eurostat concerning WEEE considering the aspects of scope, spatial area, and time coverage is depicted in Table 7.

Table 7: Data on Eurostat concerning WEEE (for abbreviations see Table 44 and Table 41 in Annex 4)

Waste step	Scope	Spatial area	Time coverage	Units of Measure	Description
Collection	EE_LHA EE_SHA EE_ITT EE_CON EE_LIT EE_GDL EE_EET EE_TLS EE_MED EE_MON EE_ATD	EU28 + NOR	2005-2013	Tonne	Distinction of collection in: Total, COL_HH COL_OTH
Treatment	See above	EU28 + NOR	2005-2013	Tonne	Distinction of: TRT_NAT, TRT_OEU, TRT_NEU
Recovery	See above		2005-2013		Distinction of: REU, RCV, RCY_REU

Data on complementary flows of WEEE is partially available on Eurostat, although the access to this information is restricted. Annex 1C (page 72) provides an overview of the data available in Eurostat.

WEEE Forum Key Figures

Every year, members are asked to provide their statistics and country data to a web-based software platform on the quantities of electrical and electronic equipment that their client producers have put on the market, and the quantities of WEEE that they have collected.

The classification used by the WF comprises 17 categories for the products put on the market. The groups are a more detailed list based on the 10 WEEE categories defined in the original WEEE Directive. Table 42 in Annex 4 displays the list of KF categories and their correlation with those in the WEEE-Directive. Table 43 in Annex 4 shows the WEEE collection categories.

WEEE Forum members provide data from their own systems and data at country level. When no official country data are available, estimates are provided. Data from public and official sources are sometimes included in the platform such as UK and German data, and Italian data coming from the Centro di Coordinamento RAEE and the ADEME French office. Often, official data sources do not match the structure of the categories provided in the KF platform, therefore, members apply estimated split factors in order to make data compatible with the data structure of the platform.

2.4.4 Selected Country Case studies of data management on MS level

Existing studies performed by the United Nations University

The United Nations University has conducted four studies in 2011 and 2012 for Italy, France, the Netherlands and Belgium. In those country studies, input-output modelling was used to establish EEE sales, stock levels, lifetime parameters, calculated WEEE–generation, and WEEE-collection data for all 54 UNU-keys. At the time these studies were performed, the grouping of the UNU-keys differed slightly compared with the current one, but the data can easily transferred to the latest version of the UNU-keys. In addition, these studies show a rather similar pattern to the complementary flows compared to the CWIT figures.

CWIT project

The Countering WEEE Illegal Trade (CWIT) Project received funding from the European Community's Seventh Framework Programme (FP7/2007-2013, Grant Agreement No. 312605). Two of the outcomes of the project were the libraWEEE and the database of e-waste stakeholders which are maintained and updated by the WEEE Forum, a former project partner. The libraWEEE holds a compilation of studies and reports dealing with WEEE, specifically literature regarding WEEE flows and criminal activities associated to WEEE. The database of e-waste stakeholders provides a European overview of the main actors in the WEEE sector such as producers, treatment facilities and collection points.

A considerable amount of data and data consolidation is available from the CWIT project. However, most WEEE related data and the quantification of the waste flows can generally speaking not be done on UNU key level, nor on the old 10 WEEE categories level but rather per collection category (WEEE6). The data from CWIT and specifically from 2 deliverables (Huisman et al., 2015) in that project on the dynamics of the WEEE streams is complemented with new sources and additional information gathered by the ProSUM partners. Vice-versa, all CWIT deliverables as well as the LibraWEEE information from CWIT are documented and harmonised according to the ProSUM Deliverable 5.3 meta data specification and stored in EndNote. In addition, in the CWIT project the various complementary flows are specifically converted in mass balances for 2010 and 2012 as the years having most information available. For later WP4 stages, it will be attempted to create a more continuous times series when feasible.

Another important remark related to the evaluation of available (official) information, is that the reporting and transparency on waste flows needs to increase. The data from Eurostat or other sources are far from complete and thus additional data gathering, surveying and modelling approaches are needed to create the required time series.

WEEE officially reported

In the CWIT project, a consolidation is made of the reported WEEE collection volumes per country, based on Eurostat, WEEE Forum Key Figures and completed with individual compliance scheme reports such as for Switzerland (SENS, 2013). This information is further expanded with data from Eurostat covering also 2013 and 2014 as well as individual data points from national registers, compliance schemes. An important note is that Eurostat is still being reported in 10 categories, hence a conversion to 6 collection categories is needed. In some cases this creates mismatches as member states for instance did not split IT equipment in Small IT and Screens, or the totals for CRT screens not being split properly between category 3 (monitors) and category 4 (TV's).

Table 8: WEEE reported from different sources 2005 – 2013 (in kt)

WEEE collection	2005	2006	2007	2008	2009	2010	2011	2012	2013
AUT	19,296	62,629	64,525	74,754	75,562	74,256	75,464	77,402	76,835
BEL	68,150	76,187	81,829	89,109	102,977	105,556	114,981	116,458	120,365
BGR			22,166	40,374	33,423	45,056	40,442	38,431	35,162
HRV							17,518	16,187	15,025
CYP	3,487	4,510	2,513	2,397	2,297	2,609	2,725	2,514	2,283
CZE			33,396	45,290	58,206	52,989	55,438	53,685	54,215
DNK		60,245	98,308	*77,629*	84,399	82,931	*84,319*	76,200	72,080
ESP		5,855	6,200	6,163	4,810	5,630	6,615	5,465	4,658
FIN	16,142	39,678	48,634	54,627	53,235	50,867	52,509	52,972	57,919
FRA		15,160	174,777	300,988	393,273	433,959	*470,192*	*470,556*	479,694
DEU		753,900	586,966	693,775	832,236	777,035	*710,250*	*690,711*	727,998
GRC	763	11,342	31,406	47,142	66,106	46,527	42,360	37,235	*38,268*
HUN	15,543	24,048	35,621	44,918	46,733	40,521	37,053	44,262	49,778
IRL			51,530	50,120	44,812	44,431	39,628	41,177	42,629
ITA	*61,210*	*67,330*	*129,201*	*121,921*	*235,617*	*272,978*	*266,330*	*235,621*	*225,931*
LVA			6,508	6,515	4,979	4,287	4,662	4,694	4,827
LIE							158	140	290
LTU	2,680	9,303	11,671	11,786	6,975	8,928	11,835	14,259	16,154
LUX	:	3,848	4,116	4,243	4,817	4,823	4,985	5,010	5,176
NLD	89,827	94,484	98,190	103,319	108,457	128,119	132,197	123,684	117,499
NOR	99,985	101,617	109,680	113,618	115,371	107,767	109,823	104,905	104,927
POL		17,101	*27,174*	56,426	*106,753*	112,246	*143,331*	175,295	171,728
PRT		4,216	25,851	41,231	44,690	46,673	59,282	43,695	50,051
ROU		1,132	3,685	21,828	38,760	26,247	21,008	23,083	
SVK	3,580	8,612	14,524	19,388	22,188	21,916	23,601	22,671	22,584
SVN			5,318	6,922	8,186	8,674	9,344	9,430	8,539
EST			277,792	296,009	137,016	158,099	*153,867*	*157,994*	209,505
SWE	48,774	130,062	155,553	*150,125*	153,706	161,444	176,580	168,612	176,567
CHE		120,000	120,000	135,162	121,098	129,400	134,838	129,100	*127,435*
GBR		100,000	193,993	448,010	471,449	479,356	517,192	503,611	492,490

* Most data is from Eurostat: the data entries in *italic numbers* is complemented by the Danish EPA report, the WEEE Forum Key Figures reports, as well as additional sources for Italy, Greece and Switzerland

WEEE in Waste Bin

For the CWIT project, a literature review and statistical analysis was done to assess the amount of WEEE in the waste bin in the EU28, plus Norway and Switzerland. The goal was to capture all WEEE that is disposed by households, public sector and services in the residual waste bin.

The existing literature review revealed that data is found in different formats covering different years. For rich or large economies, more data is found in literature. The results of the literature review and the analysis of the data are shown in Annex 1C. This information will be complemented with the new studies identified.

All large economies in the EU28 are covered, except for Poland. Approximately 10% of the data for the EU28+2 is determined via estimation. This leads to relatively good quality results for the EU totals. In addition, both estimation methods lead to comparable results, as can be seen in Table 35 (Annex 1C). The estimations based on the kg/inh approach are used in the project as the official data.

The percentage of products quantified by sorting analyses of waste bin differed in the publications reviewed. Where groupings used comparable names they may also have differed in scope. Thus it is not straightforward to obtain a good harmonised dataset on the product composition and research differences per country. Nevertheless, the averaged data for the most extensive data sources of the Netherlands, UK and Denmark are summarised in Table 36 in Annex 1C.

For many countries, the sampling related to WEEE category 05 is often includes both gas discharge lamps as well as fittings and luminaires. Therefore, the extended data set for Denmark, The Netherlands and the United Kingdom provides a consistent average of around 4% of the weight actually being gas discharge lamps. For these countries the sampling is of decent quality, however, the parameter itself is a rather sensitive one for the lamp totals in the waste bin.

For Germany, no study has been found covering the country as a whole. Two reports, performed in the city of Hamburg and the Bayern region, however, revealed that the amount of WEEE in the waste bin is very comparable. The amount per capita is also very comparable to other neighbouring countries. Thus, it is assumed that the outcome is likely representative for Germany as a whole. Data is considerably more scarce in the low-income countries. Moreover, the three countries that have data available, Estonia, Romania and Bulgaria, showed widely deviating results. The reported amount of WEEE in Bulgaria and Romania is very low. Data is retrieved from a Life+ project in which sorting analysis of the residual waste were performed in two seasons [14]. For Bulgaria, this is only done in the municipality of Razlog, which has only 23.000 inhabitants out of a total of 7.5 million in the country as a whole. In Romania, this is done in 6 counties in the North East region, covering 3.7 million inhabitants of the 21.4 million in total. Due the small regional coverage for Bulgaria, the data source is probably not very representative for Bulgaria. However, it is likely though that the amount of WEEE is very small, or at least comparable with Romania. The low presence of WEEE in the residual household waste is interpreted due to the low purchasing power of the population in these countries compared to other EU countries, it can be interpreted that WEEE is simply too valuable to be discarded in the waste bin. For Romania, the sample is representative.

The other extreme, Estonia, indicates that there is a lot of WEEE disposed of in the waste bin. The purchasing power of Estonia is double that of Bulgaria or Romania. It is interpreted that the much stronger economic power and higher market saturation level of Estonia has an influence on WEEE disposal behaviour. The WEEE is relatively less valuable to the disposer, who is also less likely to be more environmentally aware than higher-income countries, such as other Northern European countries, that have a long history of waste separation and stronger environmental awareness. At the same time, handpicking of smaller WEEE items from waste bins is probably not profitable enough to happen on a large scale.

The final extrapolation applied for the low income group of countries is therefore expected to be less accurate compared to the two other higher income groups. Where the different extrapolation methods yielded different results, still the overall volumes affected are only 8% of the total WEEE in the waste bin in the EU28.

WEEE in ferrous metal scrap

The concentration of WEEE in ferrous metal scrap is not sampled in a regular and harmonised manner. In literature, information on this is also scarce. Data available for a few countries, such as the Netherlands, Belgium and France, provides an average value that will be used for the project. This conservative parameter is used later to estimate the amounts of WEEE that is mixed with metal scrap. Further work to refine this value is recommended within the framework of WP4.

The amount of metal scrap in the EU can be obtained from the database holding reported data from Waste Statistics Regulation, which is hosted at Eurostat. This value is supplemented with literature amounts, allowing the calculation of an average concentration of WEEE in metal scrap. This data has to be used with a lot of caution, as the concentration of WEEE in mixed ferrous metal scrap is not expected to be homogenous in the EU. However the results obtained should give a fair description of the WEEE in metal scrap in the whole of the EU, however, on country level, it might not be accurate and deviates from 1.5% to maybe 4% of WEEE in ferrous metal scrap.

Annex 3 (page 92) provides detailed information on the data collected from the CWIT project.

Documented exports

Data from determining export (for reuse) amounts is only available for five countries, and they significantly differ from each other. The Austria study (Kopacek, 2013) focused on the flows of informally collected amounts travelling by road to Eastern Europe. The Belgium study covers only minimum amounts observed to leave the country. The United Kingdom data from WRAP (WRAP, 2011) is mainly based on modelling of discarding behaviour responses and thus covering likely only minimum amounts leaving the country. However, due to the total size of the reuse flows, much higher volumes are likely occurring in practice, which is also observed at receiving ports in Africa. The German study from Ökopol (Sander, 2010) provides a total minimum estimate based on inspection data of 93 kton, which can be even higher, up to 151 kt.

The Dutch Future Flows study is the only source where both inspection data and modelling of the reuse loop of appliances in a highly detailed mass balance is combined and compared with estimates from the inspection agencies and their databases and completed with documented flows from the refurbishment industry. As a result, the identified volume, around 10% of all WEEE amounts, is much higher compared with the other publications.

2.5 BATT - batteries

2.5.1 System flow diagram description

The system flow diagram indicating the scope of battery end-of-life phases is shown in Figure 4. Portable batteries can be either used in business or consumer appliances. Depending on use, lifespan, and consumer behaviour, batteries reside used or unused in the urban stock. If an appliance containing a portable battery stops functioning then the appliance can be checked and repaired. If the product can not be repaired then the battery may be disposed of legally or illegally via: a) a battery collection scheme; b) collection scheme for WEEE; c) collection with other waste streams, like residual waste; or d) direct disposal into the environment. Members of the battery collection network are obliged to report the collected mass per battery chemistry to the battery compliance scheme.

In contrast, industrial batteries, in electric vehicles, are often system-separated and checked by experts concerning their functionality. The collection and transport is either realised by the collection scheme for portable batteries or through individual contractual schemes.

Automotive batteries, e.g. lead acid, are incorporated in vehicles and responsible for starting, lighting and ignition (SLI). The functionality test and removal is often done by the vehicle owner or in garages or automotive retailers. Collection occurs through a take back system for automotive batteries. Sometimes, incentives like deposits (in Germany 7,50 EUR per battery according to German BattG § 10) are in place leading to high collection rates.

Exports and loss of batteries, either incorporated or as single cells, are possible at all of the depicted stages in the system.

Batteries collected via battery compliance schemes, go to a sorting plant if present in a mixture or directly to the respective recycling facility if separated. The sorting plants report the sorting efficiency and sorted mass per chemistry to the battery compliance scheme. Where batteries are collected in a WEEE collection system, Directive 2012/19/EU requires the removal of batteries in the first treatment plant. The removed waste batteries go into a sorting plant or directly to the respective recycling facility. If collected with other waste streams, dedicated recycling is not feasible. Only fractions may be recycled after this treatment, such as incineration, mechanical, biological, or physical treatment. If sent to illegal incineration or landfill, the resources are lost and hazardous substances may be released to the environment.

The secondary raw materials produced are subsequently recirculated to manufacturing.

The battery recycling processor reports on the recycling efficiency (calculation based on Commission Regulation (EU) No 493/2012) and process design to the national EPA.

Information collected by the battery compliance scheme and national EPA are fed to the Member states data bases. On a yearly basis, information about the quantities collected and sent for recycling, as well as collection rate, are sent to the European Commission and made available via the Eurostat database.

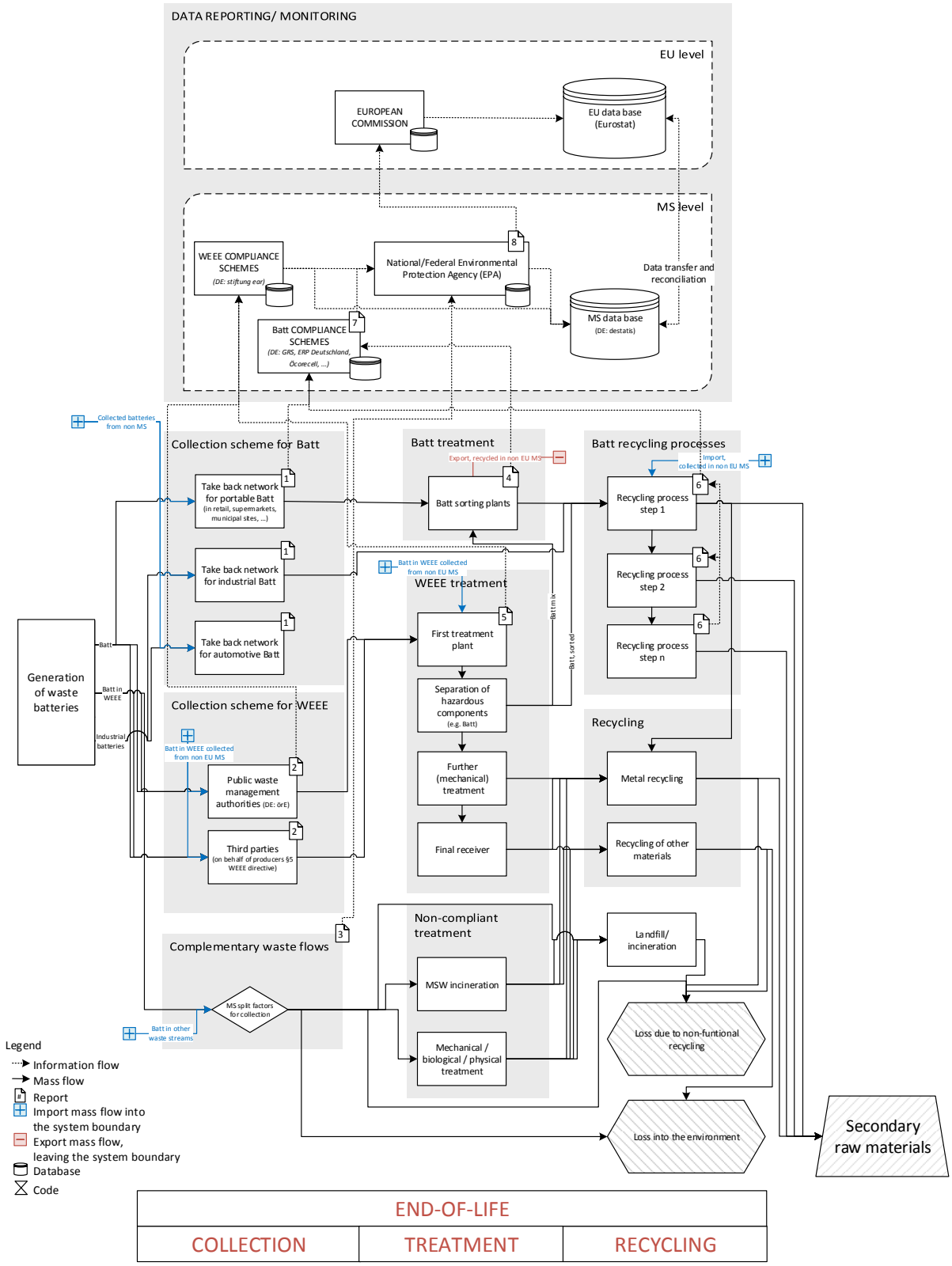

Figure 4: System description for Batteries

Information flows

The investigation of information flows between the different bodies in the system diagram (see Figure 4) is shown in Table 9.

Table 9: Information flows for batteries within the system diagram

Report	Report from	Report to	Obligatory by	Information content	Submission interval
1	Batt collection scheme	Batt compliance scheme	Directive 2006/66/EC	Quantities per battery chemistry	1-year
2	WEEE collection scheme	WEEE compliance scheme	Directive 2012/19/EC	Quantities WEEE collected per category	1-year
3	Undefined	EPA	-	Mass fraction of Batt in other waste streams (studies)	n/a
4	Batt sorting plant	Batt compliance scheme	Directive 2006/66/EC	Sorting efficiency, composition of battery waste stream (level of detail undefined)	n/a
5	WEEE (first) treatment plant	WEEE compliance scheme	Directive 2012/19/EC	Quantities of WEEE per category according Directive	1-year
6	Batt recycling process	EPA	Directive 2006/66/EC	Recycling efficiency; treatment design; mass per year; share battery chemistries; recovery rate on elemental base	1-year
7	Batt compliance scheme	EPA	Directive 2006/66/EC	Quantities, collected and send for recycling; collection rate	1-year
8	EPA	EC	Directive 2006/66/EC	Quantities, collected and send for recycling, collection rate	1-year

2.5.2 Identification and description of data sources

Basically, five types of organisation have and partly publish data on stocks and flows of waste batteries. Table 10 lists the organisations and describes the types of data they may have. The table also indicates whether the data is confidential or public, the level of granularity of the data (i.e. differentiation according to the different battery types) and whether and how methods to collect and classify the data are harmonised. A more detailed description of the data is provided in section 2.5.3 as well as in the Annex 1A.

Table 10: Organisations having data on stocks and flows of waste batteries, type of data collected, confidentiality, harmonisation and level of detail of the data

Data source	Collected data	Confidentiality of the data	Level of granularity	Harmonisation of the data
Eurostat	Aggregated data on the total weight of batteries POM and collected as waste	Data on waste generation publicly available on the Eurostat webpage, no data available on recycling efficiencies	Very low, e.g. no differentiation according to the chemical system	Aggregated and harmonised data from the member states, which may have used different methods to collect them
National EPA	Data on the weights of batteries POM, collected as waste and on the recycling efficiency	Depends on the country – some countries publish the data, others do not	Depends on the country. Usually aggregated data	Data classification and methods to collect the data depend on the country
Compliance schemes	Data on the weights of batteries POM and collected as waste, as well as data on the recycling efficiency compiled on the basis of the data provided by the operators, including data on the products produced by the recycling facilities	Depends on the compliance schemes and on the national legislation. Some publish the data, other do not	Depends on the compliance schemes and on the reporting requirements of the authorities	Depends on the compliance schemes and on the reporting requirements of the authorities

Operators of sorting and recycling facilities	Raw data on the weights of input waste batteries sorted/treated, on the output (sorted fractions and/or products) and the composition of the fractions (data to calculate the recycling efficiency)	Confidential	Potentially high, data are with the reporting requirements of the compliance schemes or authorities	Data format depends on the reporting requirements of the compliance schemes or authorities
Industrial associations	Data from their members, e.g. the weights of batteries POM and of waste batteries sorted and treated	Depends on the association, which may decide to keep the data only accessible to their members or to publish some of them	Depends on the association	The data from the members are harmonised

2.5.2.1 Pan-European data sources

Eurostat
At European level, the Directorate-General Eurostat of the European Commission compiles and publishes data on the mass of batteries put on the market and collected. The data are provided by the national EPA.

2.5.2.2 Multi-national data sources

Industrial associations
Both the battery compliance schemes and the facility operators may be members of industrial associations. The following associations whose members may be linked to the production, collection and recycling of batteries exist:

Eucobat
European association of national collection schemes for batteries (www.eucobat.eu).

RECHARGE
European association for Advanced Rechargeable Batteries (www.rechargebatteries.org).

Eurobat
Association of European Automotive and Industrial Battery Manufacturers (www.eurobat.org).

EPBA
European Portable Battery Association (www.epbaeurope.net)

EBRA
European Battery Recycling Association (www.ebra-recycling.org)

ILA
International Lead Association (www.ila-lead.org)

ACEA, JAMA, KAMA
Automobile Manufacturers Associations (see chapter 2.6.2), including Electrically Chargeable Vehicles (www.acea.be, www.jama-english.jp, http://kama.or.kr/eng/K_eng_main.jsp)
Industrial associations usually collect, compile and partly publish data from their members.The list does not include either the industrial associations of EEE manufacturers and organisations collecting and treating WEEE (section 2.4), or the associations of the automobile industry (section 2.6).

2.5.2.3 National data sources

Environmental protection agency (EPA)
The EPA define at a national level which data they require from the compliance schemes. Some countries like France require detailed data that are compiled into an annual national report[6] and published. The EPAs in other countries may publish no further data other than that sent to Eurostat. The data used by the EPA are provided by the compliance schemes.

Compliance schemes
Compliance schemes collect the data from the operators collecting and treating the waste batteries (see list in Annex 1A). Some compliance schemes (are required to) publish the data in reports, like the annual "Erfolgskontrolle" (success control) reports of the German compliance schemes GRS, ÖcoReCell, EPR, and REBAT (see Table 39, Annex 3). These compliance schemes compile the data they collect from the operators of sorting and recycling facilities for waste batteries.

2.5.2.4 Other data sources

Operators of sorting and recycling facilities
The operators collect raw data, i.e. the mass of the input and output fractions to and from their facility, quantitative and qualitative results of analyses of the composition, and quality of these fractions etc. These data are usually confidential. They are aggregated and compiled to fulfill the reporting requirements of the compliance schemes and/or authorities.

2.5.3 Evaluation of data availability and accessibility

Eurostat
Table 11 presents the information available from Eurostat concerning BATT considering the aspects scope, spatial area, and time coverage. It is of interest to note that data about waste generation, treatment and recycling is depicted as W0841 which means batteries and accumulators wastes according to EWC-Stat classification. In contrast, mass collected is reported as W1606B which refers to the LoW classification. The spatial and time coverage are different as well. Switzerland is not covered at all. The evaluation of data availability from Eurostat is displayed in Table 24 in Annex 1C.

[6] The website called SYDEREP (www.syderep.ademe.fr) groups the Registers and Observatories for the WEEE, batteries and accumulators, fluorinated gases, tires and ELV sectors. Based on analysis of the B&A producers and recycling companies' annual reporting, ADEME issues an annual report allowing both the follow-up of the B&A market in France and communication regarding the achievement of the collection and recovery objectives set by EU regulation. A summary in English of the report is available on the webpage www.ademe.fr/en/batteries-and-accumulators-in-france-summary.

Table 11: Data on Eurostat concerning BATT

Content	Product group	Spatial coverage	Time coverage	Unit	Description
Generation of waste**	Batteries and accumulators (W0841)	EU28 + NOR	2004, 2006, 2008, 2010, 2012	kg per cap Tonne	Distinction by NACE activities
Collection	Portable batteries and accumulators (W1606B)	AUT, BEL, BGR, CZE, DEU, EST, FIN, FRA, HUN, IRL, LTU, LUX, LVA, MLT, POL, PRT, SVK, SVN, SWE	2013	Tonne Percentage	-
Treatment	Batteries and accumulators wastes (W0841)	EU28 + NOR	2010, 2012	kg per cap Tonne	Treatment distinction: TRT, DSP_L, DSP_D, DSP_O, INC, RCV_E, RCV_NE, RCV_B, RCV_O
Recycling*	Batteries and accumulators wastes (W0841)	EU28 + NOR	-	-	Recycling efficiency; material composition of in/output on elemental basis
	*NOTE: first year of obligation 2014. Reported data on basis of Directive 2006/66/EC and Regulation (EU) No 493/2012. No data published so far. **rather "batteries reported as waste" since it comprises batteries arising as waste from the waste declarations of economic operators (waste statistics). This means that the amount displayed are the waste classified by "waste producers" as batteries according to the LoW. This is different from the batteries potentially generated as waste across EU.				

Associations

Table 12 lists an extract of data sources providing data about collection, treatment and recycling of batteries. In the case of portable batteries, Eucobat, EPBA, and EBRA were identified to deliver valuable data in order to complete data gaps from official reporting, for instance in terms of data granularity. Individual compliance and collection schemes were already contacted (e.g. BEBAT) or will be contacted in the context of D4.2 CRM Assessment Strategies to gain more detailed information. Concerning lead automotive batteries, Eurobat, ACEA, JAMA, KAMA, ILA, and EUROBAT can deliver supplementary information.

Table 12: Data sources for BATT collection, treatment and recycling (see Excel file data inventory)

Data source	Product groups	Spatial coverage	Description	Data availability
Eucobat key figures of batteries POM and collected	Portable and some data on industrial batteries on POM and collected in the countries in which collection of industrial batteries by schemes is not forbidden	BEL, CZE, DEU, DNK, ESP, FIN, FRA, IRL, ITA, LUX, NLD, PRT, ROU	Data collected by the Eucobat members on portable and industrial batteries POM and collected 2011-2014, including data on POM and collected embedded in (W)EEE	Confidential data made available by Eucobat after signature of a NDA
Eurobat, ACEA, JAMA, KAMA, ILA	Lead automotive batteries		Collection and recycling of automotive lead-based batteries	Executive summary publicly available: http://www.eurobat.org/sites/default/files/ihs_eurobat_report_lead_lores_final.pdf
EUROBAT (lead)	Lead industrial batteries		Battery market volumes	Available online: http://www.eurobat.org/sites/default/files/industrial_batteries_data_and_outlook-update_2013.pdf
Eucobat study	Portable batteries	BEL, FRA, NLD, DEU, ROU, ESP	Age and types of collected waste batteries.	Data will be available in June 2016

EPBA	Portable batteries		Portable batteries POM and collected	Public: http://www.epbaeurope.net/documents/Perchards_Sagis-EPBA_collection_target_report_-_Final.pdf
EBRA	All batteries	SWZ, ESP, FRA, POL, BEL, DEU, SWE	Confidential statistics about the quantities of batteries and accumulators recycled by the EBRA members	Confidential data that can be made available by EBRA after signature of a NDA

2.5.4 Selected Country Case studies of data management on MS level

SRM potential in WEEE-batteries in Germany

TUB carried out treatment trials covering WEEE appliances and batteries using the ProSUM harmonised approach for data collection. In this section, preliminary results were evaluated focusing on the assessment of cobalt incorporated in laptop batteries in order to test the harmonised methodology and to be input to D4.2 CRM Assessment Strategy (Mählitz & Rotter, 2016).

In 2015, at two German recycling facilities, sorting analyses were carried out focusing on the German WEEE collection groups 3 and 5 (IT and small household appliances). In this context, two WEEE containers comprising about 3,5 t each and 1296 devices in total, were sorted according to the UNU key classification (device type specific mass share). Battery containing devices were disassembled, weighed, and battery mass as well as system were documented. At the second facility, more than 350 devices were examined to determine the mass share and chemical system of embedded batteries per UNU key. In the context of further research activities, more laptops (UNU Key 030301) and incorporated battery packs were dismantled and documented. Laptop battery packs have between three and nine battery cells, but additionally consist of the casing material, battery management system, and cables. Since data about chemical composition of batteries is mainly based on cell mass, battery packs were manually disassembled to determine the mass share of battery cells. For simplification (improvements will be made using the results from D2.2 and D3.1), it was assumed that laptop batteries are only LCO systems (BATT key 'BattLiCoO2'). The chemical composition of these systems was gathered through a literature analysis. The references were entered into the EndNote bibliography. The application to other battery-driven devices and chemical systems is easily achievable and will be further developed in D4.2.

Via the German collection scheme, 332.066 t WEEE were collected in 2015 in collection groups 3 and 5 (EAR, 2016). The sorting analyses of two WEEE containers resulted in an average mass share of laptops (UNU key 030301) of about 0.3 m% in this collection group. The extensive surveys of laptop battery masses revealed a mass share of 10 m% with a standard deviation of ± 3 m%. About 85 ± 2 m% of laptop battery packs consist of battery cells. The literature review yields a cobalt mass fraction of 17 ± 4 % in LCO battery systems (see Table 13).

Table 13: Results from treatment trials for WEEE-batteries in German collection group 3 and 5

Waste group			WEEE	WEEE + BATT	WEEE + BATT	WEEE + BATT	BATT
Data source			Stiftung ear	Sorting analyses	Dismantling studies		Literature review
	Year		01-12/2015	12/2015	07/2015	01/2015	2005-2012
	Collection group		3+5	3+5	-	3+5	-
WEEE flows in Germany		t	332.066	-	-	-	-
UNU Key			-	303	303	303	-
	in collection group 3+5	m%	-	0,3%	-	-	-
BATT key			-	Lithium	-	Lithium	BattLiCoO2
	- pack in UNU Key 303	m%	-	11% ± 4%	-	10%	-
	Cell chemistry		-	LCO	-	LCO	LCO
	Cells in battery pack	m%	-	-	85% ± 2%	-	-
SRM	Cobalt in LCO cells	m%	-	-	-	-	17% ± 4%

The results show that the potential of cobalt in ca. 98 t laptop LCO cells are about 17 t in 2015. Nevertheless, taking into consideration that producers substitute cobalt in lithium batteries with polymetallic material combinations, such as Ni-Mn-Co 'BattLiNMC' (ca. 10 m% Co), the cobalt content decreases to roughly 9 t. This illustrates the complexity of gathering and using data from different sources concerning complex products to provide reliable data for the EU-UMKDP. Supplementary information are in Annex 3, page 94, which will be included and further checked against other MS studies in the context of D4.2.

2.6 ELV – end-of-life vehicles

2.6.1 System flow diagram description

After the use phase of a product it enters the end-of-life phase via collection. Regarding end-of-life vehicles, there is no compliance scheme or clearing house for an organised ELV collection on a European level. However, there are national organisations overseeing ELV collection in some member states such as Sweden. ELV can be disposed of at authorised treatment facilities or workshops free of charge. The last holder receives a certificate of destruction (COD), facilitating a de-registration.

Vehicles are processed in general in a defined order. Firstly, in de-pollution all main hazardous liquids (such as fuel, washing or cooling agents) and the vehicle battery are removed, where the batteries are sent to treatment and recycling of batteries (cross-link to BATT system, see take back system for automotive batteries in Figure 4).

In the next step, spare parts for re-use are extracted and valuable parts and components for recycling and energy recovery are dismounted and go to smelters, or other recycling. For younger ELV the number of electronic components is considerably higher than for older end-of-life vehicles. These components may be dismantled and go to WEEE processing and recycling facilities, but it is not (yet) a common procedure (cross-link to WEEE system, see WEEE treatment in Figure 3).

The remaining vehicle bodies are shredded, often with the intermediate step of compaction and transport to another facility. Post-shredder technologies to treat and process the generated particles mainly encompass magnetic and eddy current separation to sort ferrous and non-ferrous metals, and sometimes also density separation to separate plastics from inerts (e.g. remaining glass).

The output fractions go to material recycling facilities such as smelters (for ferrous and non-ferrous metals), whereas fractions with a high calorific value (e.g. automotive shredder residues (ASR) which have a considerable mass fraction of plastics and even wood) may go to energy recovery, but sometimes landfilled since their properties can be regarded as challenging for incineration processes. The residual material with a low calorific value due to mostly inert materials is mainly landfilled, or used in road or dike construction.

Treatment and shredder facilities report annually to the EPA, delivering data on amounts of input, processed fractions, and output, according to Directive 2000/53/EC on end-of-life vehicles and Commission Decision 2005/293/EC setting rules on the monitoring of reuse/recycling/recovery targets set out in Directive 2000/53/EC. This data is then used by the EPA to calculate recycling and recovery rates.

The secondary raw materials (SRM) produced re-enter production and manufacturing. During the production of the SRM, non-functional recycling may take place, e.g. where the alloying or disturbing elements present are not removed and remain unused within the generated SRM. This is for instance true for wrought aluminium alloys being mixed in every recycling cycle with cast alloys and hence they accumulate alloying elements. This leads to a cascade use from wrought low-alloy aluminium to cast high-alloy aluminium, e.g. used in engine blocks.

Export and import of (waste) products and (waste) materials to/from EU member states and countries outside the EU can take place at every step within the system. Transboundary waste shipments provide information on the export flows of waste, assuming all ELV cross-border transport is officially reported as such. Export and import of secondary materials are recorded in official trade statistics.

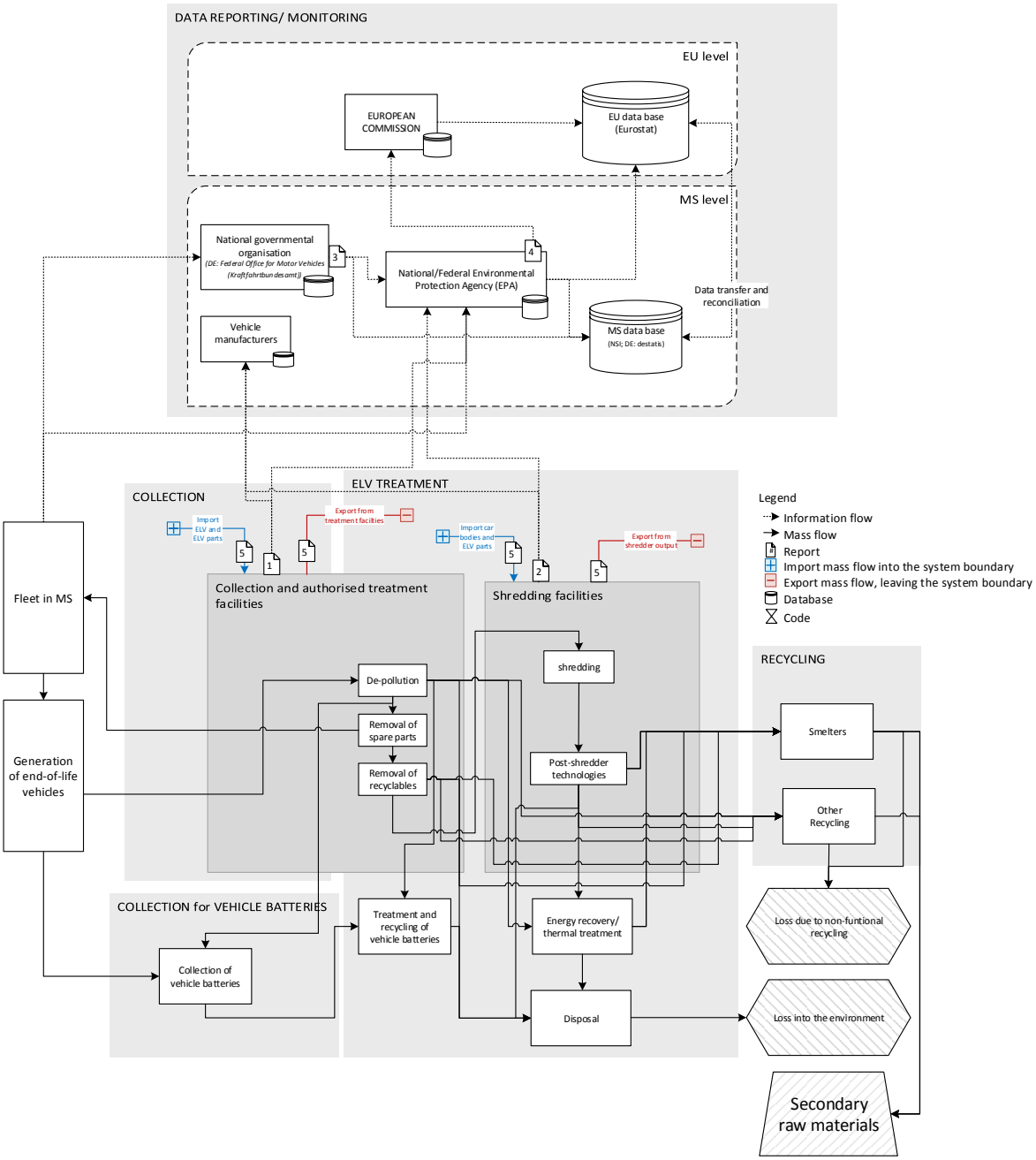

Figure 5: System description for ELV

Information flows

Data reporting required by legislation or based on (economic) interest including contracts is shown in the table below:

Table 14: Information flows for (EL)V system diagram

Report	Report from	Report to	Obligatory by	Information content	Submission interval
1	Collection and authorized treatment facility	National EPA; car manufacturers	Directive 2000/53/EC	Total mass and number of ELV entering the waste management system	1-year
2	Shredder facilities	National EPA; car manufacturers	Directive 2000/53/EC	Total mass and number of ELV entering shredding facilities	1-year
3	National governmental organisation	National EPA		Vehicle fleet, new registrations, deregistration	1-year
4	ELV recycling; National EPA	EU Commission	ELV directive 2000/53/EC	ELV recycling rates	1-year
5	National statistics organisation	National EPA		Transboundary transport of waste subject to authorization	1-year
6	Manufacturers and retailers	Foreign trade statistics		Cross-border trade statistics	n/a

2.6.2 Identification and description of data sources

2.6.2.1 Pan-European data sources

Eurostat
Eurostat has data on waste generation and treatment reported according to the ELV directive and the Waste Statistics Directive. Eurostat also has data on vehicles in use and new vehicle registrations.

2.6.2.2 Multi-national data sets

Industrial associations

IMDS (International Material Data System)
The automobile industry's material data system, today a global standard used by almost all of the global original equipment manufacturers (OEM). In IMDS, all materials used for automobile manufacturing are collected, maintained, analysed and archived. Using the IMDS, it is possible to meet the obligations placed on automobile manufacturers, and thus on their suppliers, by national and international standards, laws and regulations. IMDS does not hold data on waste and waste treatment, but on the material composition of vehicles eventually reaching end-of-life. Access to IMDS is very restricted. Suppliers only have access to their own data. Manufacturers only have access to the specific components they source and only for the purposes of meeting standards and legislation, not e.g. for purchase price negotiations with suppliers. This means that even within auto manufacturing companies, acces is restricted to specific departments. IMDS is not available for ProSUM.

International Dismantling Information System (IDIS)
The IDIS was developed by the automotive industry to meet the legal obligations of the EU End-of-Life Vehicle (ELV) directive. It is an information system for pre-treatment and dismantling information of ELV, provided by vehicle manufacturers. It currently covers 2090 different models and variants from 72 car brands. The access to and the use of the system is free of charge for any commercial enterprise that handles end-of-life vehicles. It contains safe handling information like airbag deployment instructions, information about potentially recyclable parts (such as plastic parts) and components that are explicitly mentioned in the EU ELV directive (e.g. mercury and lead in batteries and electronic devices for monitoring and phasing out hazardous content). In the

context of ProSUM, IDIS does not contain complete material composition data nor CRM composition data. It only contains information about such selected parts and materials that are mentioned in the ELV directive or deemed to be important to recycle for reaching the ELV target. IDIS may be a possible source for e.g plastic components, should ProSUM decide to include such materials. IDIS is not publicly available, but access for such purposes as ProSUM may be possible.

There are a number of organisations representing automobile industry interests and activities, of which five are mentioned here, but they provide little or no data relevant for the scope of ProSUM. The examples are:

European Automobile Manufacturers Association (ACEA)
ACEA represents the interests of the fifteen European car, truck, and bus manufacturers at EU level. ACEA reports data on new registrations of vehicles yearly on, accessible from their website, but no data on end-of-life treatment.

JAMA
The Japan Automobile Manufacturers Association is a non-profit industry association which comprises Japan's fourteen manufacturers of passenger cars, trucks, buses, and motorcycles. JAMA has a European branch, but does not report any ELV data.

KAMA
The Korea Automobile Manufacturers Association is a non-profit organisation, representing the interests of automakers in Korea. KAMA does not report any ELV data for Europe.

OICA
The International Organization of Motor Vehicle Manufacturers does not report any ELV data for Europe.

EUCAR
The European Council for Automotive Research and Development does not report any ELV data for Europe.

2.6.2.3 National data sources

National public authorities
Bodies such as Environmental Protection Agency (EPA), Ministry of Environment, Traffic Authority, and Governmental Departments for Business and Industry, demand and collect information from involved facilities and other authorities, process said information, and are responsible for producing and publishing statistics.

National Statistics Institutes (NSI)
NSIs are usually involved in the production of national data on commission by the responsible public authorities.

Traffic public authorities
They may hold the administration of vehicle registries, thus data on deregistration on vehicles for end-of-life treatment or export.

Table 15 lists general data sources applicable in all Member States.

Table 15: Organisations having data on stocks and flows of end-of-life vehicles, type of data collected, confidentiality, harmonisation and level of detail of the data

Data source	Collected data	Confidentiality of the data	Level of granularity	Harmonisation of the data
Eurostat	Aggregated data on vehicles in use and newly registered, the total mass of end-of-life vehicles collected, de-polluted and dismantled, shredded, and reuse/ recovery as well as reuse/recycling rates.	Data on yearly ELV flows publicly available on the Eurostat webpage.	Very low, e.g. no differentiation between passenger cars and goods vehicles, or according to vehicle components.	Aggregated and harmonised data from the member states, which may have used different methods to collect them.
Ministry of Environment/ National EPA/ NSI	Data on total vehicle waste collected, treated, recycled/recovered, producing required reports about recovery and recycling rates to the European Commission.	Depends on the country – some countries publish the data, others do not.	Low, see above. Governmental bodies partly have detailed information, but only aggregated data is publicly accessible.	Data classification and methods to collect the data depend on the country. Usually governmental bodies collect data from dismantling and shredding facilities, which in turn may report based on individual methodologies.
Industrial associations	Information for dismantling, manufacturer-specific material compositions, sales and registration data.	Mostly confidential, sales and registration data publicly accessible.	Partly very high (e.g. for manufacturer specific material compositions).	Data classification and collection methods not harmonised, data formats depend on individual platform/association.
Operators of sorting and recycling facilities	Raw data on the masses of input waste vehicles de-polluted and dismantled, and shredded, on the output (de-polluted/ dismantled fractions and/or products, hulks, shredded metal/non-metal fractions) and the composition of the fractions (data to calculate the recovery/recycling rate).	Confidential	Medium, data collection in facilities oftentimes based on assumptions, such as average vehicle mass for treated ELV, instead of weighted vehicles masses.	Data format depends on the reporting requirements of the authorities.
Car manufacturers	Data on e.g. sales, component configurations, powertrain, masses, and material composition.	Mostly confidential.	Very high	Data format depends on individual manufacturer.

2.6.3 Evaluation of data availability and accessibility

Legal requirements for reporting of ELV recycling rates and data available on Eurostat

To comply with Directive 2000/53/EC on end-of-life vehicles (ELV Directive) the Member States have to take measures to ensure that targets for recycling and recovery are met. For this the MS have to report their recycling and recovery rates to the European Commission on a yearly basis. Commission Decision 2005/293/EC lays down detailed rules on the monitoring of the reuse/recovery and reuse/recycling targets set out in Directive 2000/53/EC, which are a minimum of 95 m.-% and 85 m.-%, respectively (Directive 2000/53/EC). The rules set down in the Commission Decision are summarised in the following paragraphs.

The **total number** of ELV arising in a MS (W) is calculated as the sum of all ELV entering an authorised treatment facility, whereas the total mass of ELV arising in a MS (W1) shall be calculated as the sum of the individual vehicle masses entering authorised treatment facilities.

In accordance with the waste hierarchy in Directive 2008/98/EC on waste the total output of **de-pollution** and **dismantling** of end-of-life vehicles has to be assigned to either **reuse** (A), **recycling** (B1), **energy recovery** (C1), or **disposal** (E1) (the number 1 indicates the relation to de-pollution and dismantling), where the total recovery equals the summation of recycling and energy recovery (D1 = B1 + C1).

The more detailed designation of pre-defined downstream waste fractions to reuse, recycling, energy recovery, or disposal is on a voluntary basis. The downstream waste fractions mentioned in Directive 2000/53/EC and Commission Decision 2005/293/EC are:

- batteries
- liquids (excluding fuel)
- oil filters
- other materials arising from de-pollution (excluding fuel)
- catalysts
- metal components
- tyres
- large plastic parts
- glass
- other materials arising from dismantling

Data on shredder output also has to be accredited to one of the waste destinations (i.e. recycling (B2), energy recovery (C2), and disposal (E2), where the number 2 refers to output from shredder facilities). This has to be done for the total output of shredder facilities, but also for ferrous scrap (steel), non-ferrous materials (Al, Cu, Zn, Pb, etc.), shredder light fraction (SLF), and other.

End-of-life vehicles may also be exported to other countries for further treatment. These subsequent treatment steps are credited to the MS of origin to minimise administration and monitoring. Data reported encompasses the total mass of ELV exported per country (**), the total

- recycling (F1)
- recovery (F2)
- disposal (F3)

of (part of) ELV exported.

With this information a total designation of the arising ELV per year to reuse (A), total recycling (B1 + B2 + F1), and total recovery (D1 + D2 + F2) is possible. Subsequently, total reuse and recycling (X1 = A + B1 + B2 + F1), and total reuse and recovery (X2 = A + D1 + D2 + F2) can be calculated. Divided by the total mass of ELV arising in the MS (W1) these values give the required recycling rates X1/W1 and X2/W1 for ELV in a member states.

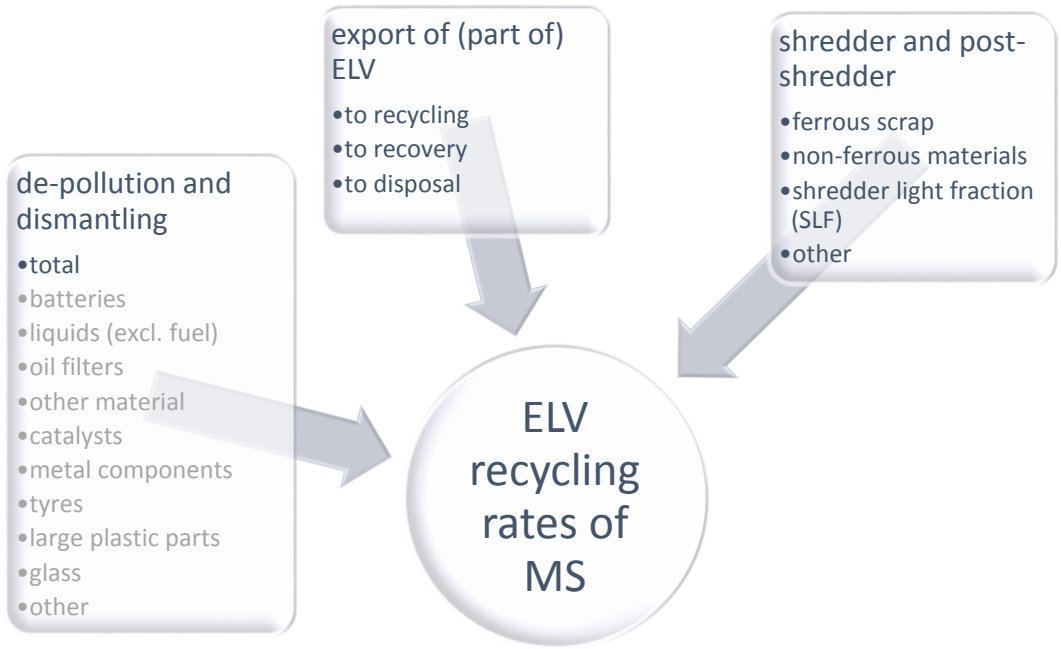

Figure 6: Minimum required data from Member States to be reported to Eurostat (voluntary data in grey)

Data availability based on legal requirements by Directive 2000/53/EC

In Table 26 (Annex 1C) the availability of the described data on ELV is summarised. For Croatia and Malta there is no reported data published on Eurostat, the same applies to Switzerland as a non-EU country (in comparison to Norway, the data of which is reported on Eurostat). For all EU28 countries except Greece, Ireland, Italy, Romania, and Slovenia at least the total waste generated is reported on Eurostat, keeping in mind that:

- Greece reported from 2006 to 2011
- Ireland, Romania, and Slovenia reported from 2006 to 2012
- Italy reported from 2005 to 2012

All regarding total ELV waste generated in tonnes.

Data on flows from de-pollution and dismantling less available than information for total ELV waste generated. In addition to the countries without information on total waste generated, Bulgaria, the Czech Republic, Denmark, Hungary, Lithuania, Luxembourg, the Netherlands, Poland, and Sweden only provide data on total waste from de-pollution and dismantling, but not more detailed data on the optional downstream waste flows (compare Figure 6).

Data availability for shredder output is similar to total waste generated with the exception of Sweden, as is the availability for information on exports, with reported data for Sweden, but not for the United Kingdom.

Availability and distinctions made on Eurostat are listed in Table 16. An overview of reported data for the four categories: total waste generated; treatment, de-pollution and dismantling; treatment-shredder; and export for the reporting years 2005 to 2013 is presented in Table 26 in Annex 1C.

This shows that the minimum requirements of Directive 2000/53/EC and Regulation 2005/293/EC are not fully met now in the European Union. Some countries currently not reporting to Eurostat full data sets for the annual reports, which can be due to serious financial crises (e.g. in Greece, Italy, and Ireland). Regarding the optional data on downstream waste streams in de-pollution and dismantling even more countries have to adapt to the level of detail other countries report (such as Spain, Estonia, Finland, or Germany).

If compared with the required information compiled in the questionnaire the data availability on Eurostat shows a picture with more gaps (Table 21, page 71). Hardly any data requested in the questionnaire is available in the compiled data sheets on Eurostat, with the exception of total waste generated (see above), total input and output of treatment de-pollution and dismantling (with the assumption that input equals output), total input and output of treatment shredding, and the composition of downstream waste flows. Data on treatment steps other than de-pollution and dismantling, and shredding is not reported, as is information on the recycling of the treated downstream waste flows. Additionally no data on number and capacity of treatment and recycling facilities or the technologies used in these facilities are available.

Table 16: Data on Eurostat concerning ELV

Waste step	Scope	Spatial area	Time coverage	Units of Measure	Description
ELV reported as waste	M1 (passenger cars) and N1 (goods vehicles)*	EU28 - HRV - MLT + NOR	2005-2013	Tonne	Distinction of collection in: Total
Collection	M1 (passenger cars) and N1 (goods vehicles)	EU28 - HRV - MLT + NOR	2005-2013	Tonne	Distinction of collection in: Total
Treatment: de-pollution and dismantling	See above	See above	2005-2013	Tonne	Distinction of: Total, optionally batteries, liquids (excl. fuel), oil filters, other material, catalysts, metal components, tires, large plastic parts, glass, other
Treatment: shredder and post-shredder treatment	See above	See above	2005-2013	Tonne	Distinction of: Total, ferrous scrap, non-ferrous materials, shredder light fraction (SLF), other
Recovery and recycling	See above	See above	2005-2013	Tonne	Distinction of: Total, ferrous metals, non-ferrous metals
	* Note: Assumption that all vehicle waste is collected, because no information on complementary flows and non-compliant processing is available.				

Data availability on a Member State level

Oposite to the case of WEEE and BATT there is not as much data on end-of-life vehicles available. Reporting procedures, and in some member states no compliance schemes, lead to scattered and incomplete data. For many countries most of the data required by the Directive 2000/53/EC and Regulation 2005/293/EC is collected at a Member State level, either by NSI, Ministry of Environment, or EPA and usually provided to them by dismantling and shredding facilities. The latter report input and output of their plants and the downstream waste flows in part (see Figure 6).

To provide a more detailed insight into nationally available data, six example countries have been selected with the objective to answer all questionnaire questions (see Table 28, page 78):

- Germany
- France
- United Kingdom
- Sweden
- Switzerland
- Norway

Countries were selected due to the involvement of national parties within the ELV group which leads to a better result, because of familiarity with national reporting procedures and regarding a comparison between different countries. The results of the questionnaires can be found in Annex 1B and will be explained in this chapter using the example of Germany.

The questionnaire result for Germany can be seen in Table 17, the questions connected to the different categories can be found in Table 21 (page 71).

The total collected amount of ELV is reported in Germany within the report of reuse/recovery and reuse/recycling rates to the EU, compiled by the German Environmental Protection Agency. This number as well as total mass is also the basis for calculating the recycling rates. Concerning the specification of end-of-life vehicles it is assumed that the scope of all reported data are passenger cars (M1 by definition of 2005/64/EC), which is the reason for the yellow marking in the traffic light table. Unfortunately, there is no data on mass fractions of specified ELV or a chemical or component composition for ELV, leading to the two red markings for 1 c) and 1 d).

Table 17: Questionnaire results for ELV and Germany

1) COLLECTION		3) TREATMENT: shredder and post-shredder treatment		5) RECYCLING (i.e. material recycling)	
Officially reported collection		Mass and specification of waste		Mass and specification of waste	
1 a)	x	3 a)	x	5 a)	x
1 b)	x	3 b)	x	5 b)	x
1 c)	x	3 c)	x	5 c)	x
1 d)	x	3 d)	x	5 d)	x
		3 e)	x	5 e)	x
Complementary and non-compliant processing *(e.g. illegal export, illegal placing, theft, ...)*		Facility information		Facility information	
1 e)	x	3 f)	x	5 f)	x
1 f)	x	3 g)	x	5 g)	x
1 g)	x	3 h)	x	5 h)	x
		3 i)	x	5 i)	x
2) TREATMENT: de-pollution and dismantling		4) TREATMENT: other treatment			
Mass and specification of waste		Mass and specification of waste			
2 a)	x	4 a)	x		
2 b)	x	4 b)	x		
2 c)	x	4 c)	x		
2 d)	x	4 d)	x		
2 e)	x	4 e)	x		
Facility information		Facility information			
2 f)	x	4 f)	x		
2 g)	x	4 g)	x		
2 h)	x	4 h)	x		
2 i)	x	4 i)	x		

Until now there has been no information on complementary flows and non-compliant processing, but there is an ongoing project financed by the German EPA to model scenarios and collect information on the fate of ELV missing in the national statistics.

Regarding de-pollution and dismantling there is reported data on the total amount sent for treatment and the total output (assuming they are equal and no long-term storage takes place within the process, which is true only partially, as there are still untreated ELV stored in dismantling facilities from the environmental scrapping bonus in 2009). There is information on the destination of downstream waste flows (2 a), c), and e)), but only partial data on the composition of ELV (2 d)), i.e. complying with the optional information described in Regulation 2005/293/EC and Figure 6. Additionally, there is a database for dismantling facilities (and for shredder facilities, compare 3 f) and g)) listing name and address of the facilities, causing the green markings for 2 f) and g). The technologies used and the total capacity is not reported here (red marks for 2 h) and i)).

Following the usual treatment chain for ELV, there is data on the total input and output of ELV downstream waste into shredding facilities and out of them (same assumption as above), but comparable to dismantling facilities there is no information on the technologies used or the total capacity of the facilities.

In general, there is no information on treatment other than de-pollution and dismantling, and shredding.
Regarding recycling, there is partial information on the total amount of downstream waste streams going to recycling and the amount and specification of recycled material (yellow markings for 5 a), c), and d)), because the reported recycling rates are based on the assumption that:

- all ferrous metals from post-shredder treatment are recycled;
- all non-ferrous metals from post-shredder treatment are recycled;
- other materials with a high calorific value go to energy recovery; and
- inert materials go to landfill.

There is no directly measured data on these issues. However, there is no information on the composition of the waste flows (e.g. regarding CRM content) or the destination. It is only assumed that ferrous metals go to steel smelters and non-ferrous metals to a suitable smelter. No information is reported on the number, capacity, or location of recycling facilities or the technologies used.
For a more detailed study of the German ELV flows reporting consider the German country case study in chapter 2.6.4, and Table 40 as well as Figure 10, page 95.
By comparison on a pan-European level, Germany is one of the Member States with better data coverage (Table 27, page 77), but even here there is still a lot of potential for improving reporting strategies.

2.6.4 Selected Country Case studies of data management at the MS level

Sweden
A material flow analysis (MFA) of the Swedish ELV recycling system, carried out at Chalmers University, is presented in a scientific paper currently under review in a scientific journal. The MFA is based on official ELV waste flows statistics required by the ELV directive, substantially complemented with data on key system processes. Data was sourced from official statistics, reports, and waste management literature and, in total, 18 qualified experts. The resulting MFA covers officially reported ELV flows handled in treatment: from dismantling, through processing of dismantled components and materials, shredding operations, post-shredding operations to energy recovery and slag treatment, landfilling and metal refining. It also contains an estimate of CRM input to the ELV recycling system. Data mainly represents the year 2012. The Swedish case study will present a valuable source to be used in the ProSUM data model and is expected to be published in 2016.

Germany
For Germany a study was undertaken for the year of 2012. Here the German report on ELV recycling rates to the European Commission was analysed regarding data sources, assumptions, and reliability. The developed MFA for vehicles (see Figure 10) depicts waste flows from the point of becoming waste (= end-of-life vehicle) with entry into the waste management system via collection to produced downstream waste flows of the last treatment step, i.e. shredding.

The reporting of reuse/recovery and reuse/recycling rates for Germany is conducted on the basis of Commission Regulation 2005/293/EC and the Guidance “How to report on ELV recycling rates” and encompasses the minimum required mass flows as well as the additional information on downstream waste flows of the treatment step de-pollution and dismantling (e.g. batteries, liquids, etc.). All assumptions are compliant with Regulation 2005/293/EC and thus are comparable to information flows in other countries abiding the Regulation.

2.7 MIN - Mining waste

2.7.1 System flow diagram description

Mineral exploration, mining, mineral processing and metal production are some of the early steps in the long value chain that also includes production of metal containing goods for the society like cars, computers, batteries etc. Each of these steps generates a product with a higher value compared to the used material but at the same time it also generates waste. In many contexts all types of waste generated in the mining and metal industry is categorised as mining waste. Such a simplistic description is, however, not sufficient to meet the requirements in the ProSUM project and a more detailed classification to accurately describe the location, origin and composition of the waste is required. Figure 7 shows a simplified flow scheme for different categories of products and waste that is generated by different processes in the mineral industry.

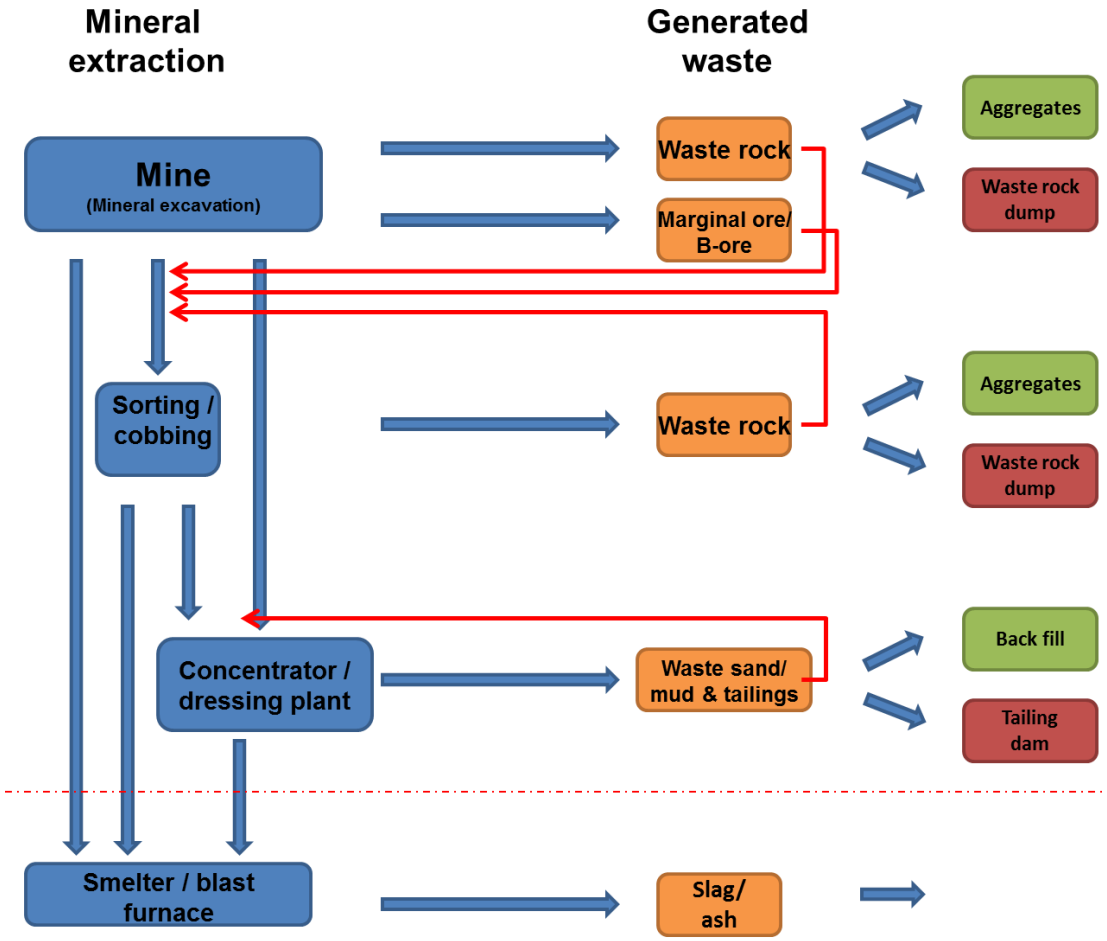

Figure 7: System description of mining waste

Mine and mining activity

Mining of metallic ores is an extractive industry which is part of the primary industry sector of a nation's economy. Mining of ore is the process of extracting useful minerals from the Earth's crust. The mining activity produces ore which in most cases consist of aggregates of economic minerals together with the non-economic minerals (gangue) that also make up the ore. The coarse-grained ore might sometimes be treated with some sort of sorting, for example magnetic sorting, to remove as much as possible of barren rock. This usually takes place at the site of mining.

In order to access the economically useful metallic minerals in the crust, the top soil, overburden rock, rocks from tunnelling and excavations have to be removed. This results in waste rocks which, due to its low economic value, in most cases are deposited close to the mine. Some of the rock is used as backfill in mines, for dam construction or for other infrastructure purpose, at the mine site or in the vicinity of the mine. The remaining waste rock is deposited in a waste rock deposit. Weakly

mineralised rock (marginal ore or B-ore) has sometimes been stockpiled in anticipation of better metal prices and overcapacity in the concentrator or similar. In cases the stockpiles were never processed they are also classified as mining waste since they are located close to the mine.

A special case is when low-grade ore is crushed to coarse grain size and then leached by different solutions, so called heap-leaching. Due to the low value of the ore it cannot be transported any longer distances but is deposited close to the mine. The mining method is not so common within the EU, only two known examples in Finland and Cyprus, but the method is used at several mines worldwide and is mentioned in feasibility studies of mining projects in EU. Possibly heap-leaching can become an important source for raw material in the future and must therefore be considered in the ProSUM project.

(Mineral) processing plant and (mineral) processing activity

In the past metallic ore was used directly in smelters and blast furnaces to produce metals. Today when the mining industry process ore at lower metal grades the ore commonly undergoes various processes to remove the minerals that are economically uninteresting, minerals that disturb the following metal producing process, to separate different metal minerals and to increase the metal content in the final product. The mineral processing activity can include magnetic separation, gravimetrical separation, floatation etc., processes that result in a mineral concentrated as main product and sand (tailings) as waste. Various leaching processes, for example cyanide-leaching for gold, also leave sand as waste.

There are also other processes that use chemicals to purify the ore and increase the metal content, for example refinement of bauxite to alumina (aluminium oxide) which generates waste in form of insoluble matter (red mud).

The remaining sand from mineral processing activity and mud from chemical treatment of the ore is deposited in dams in the vicinity of the processing plant. Some of the waste sand can be used as backfill.

Metal production waste

The products from mineral processing, and sometimes directly from the mine production, goes to a metal producing plant in order to produce raw metals. This metals are further processes at metal refineries, steelworks etc. Pig iron is produced at blast furnaces from the reduction of iron oxides with cooking coal, base metals like copper, zinc, lead and nickel is produced at smelters, commonly by oxidizing the metal sulphides to metals. Both processes generate waste in the form of slag and ash.

It was decided at an early stage in the project that metal production waste from smelters and blast furnaces should be excluded from the project, mainly because very few of the participating geological survey were in the possession of such data. Recently, the idea to include at least the location and type of minerals concentrates processed at the metal producing plant could be included in the ProSUM work. One of the reasons was that this would provide a link in the value chain to waste from other sources included in ProSUM since a large part of that waste is processed at metal producing plants. Inputs from primary and secondary sources would need to be identified and included in the meta data to allow for differentiation.

2.7.2 Identification and description of data sources

Attempts to gather pan-European, multi-national and national data on primary mineral resources and their exploitation have, during the last decade, been performed in several projects, most of them funded by EU. Although the projects was primarily focused on primary resources these data, in particular data on mining activity, is important because each mining activity generate mining waste and most of the ore mined during the last 50-100 years have undergone some form of enrichment that produces mineral processing waste.

An extension of the ProMine project (ProMine-AC) created a data model for mining waste and waste from metal production and gathered data on that subject.

Data on generation of waste in society, gathered by the national environmental protection agencies, is compiled by Eurostat. Unfortunately, this data is not sufficiently detailed or comprehensive to meet the requirements of the ProSUM projects. Eurostat data can, however, serve as a general reference to the data produced in the ProSUM project.

2.7.2.1 Pan-European data sources

Minerals4EU
The network will provide data, information and knowledge on mineral resources around Europe, based on an accepted business model, making a fundamental contribution to the European Innovation Partnership on Raw Materials (EIP RM) (Minerals4EU, 2016)

ProMine
The ProMine project was dealing with Nano-particle products from new mineral resources in Europe. It was the first pan-European GIS-based database containing the known and predicted metalliferous and non-metalliferous resources, which together define the strategic reserves (including secondary resources) of the EU (ProMine, 2016). The project also provided an **anthropogenic concentration (AC)** database that is most valuable next to the mineral deposit database, mining district database.

EuroGeoSource (EGS)
EuroGeoSource is a data portal, which allows access by Internet to the aggregated geographical information on geo-energy (oil, gas, coal etc.) and mineral resources (metallic and non-metallic minerals, industrial minerals and construction materials: gravel, sand, ornamental stone etc.), coming from a wide range of sources in a significant coverage area of Europe (ten countries) (EuroGeoSource, 2016).

Eurostat
See chapter 2.3.1

2.7.2.2 Multi-national data sources

Fennoscandian Ore Deposit Database (FODD)
The Fennoscandian Metallogenic Map and its explanation book indicate and describe areas of metal deposits and probable future metal ore discoveries in the Fennoscandian Shield (FODD, 2016).

International Copper/Nickel/Lead-Zinc Study Groups
These study groups primarily track the fate of individual elements at the primary and secondary processing facilities and their output. As such they can be used to complement and cross check the ProSUM quantification focussing much more on the (past) consumption, use and disposal before scrap products are traded in the mining and refining industries.

2.7.2.3 National data sources

National geological surveys
See chapter 2.3.3

National environmental protection agencies
See chapter 2.3.3

Ministry of Mining, Natural resources, Industry or equivalent

2.7.2.4 Other data sources

Universities and research institutions

Helmholtz Institute, Germany
Uppsala University, Sweden

The main source of detailed data on mining waste, the kind of data that is essential for a good outcome of the ProSUM project, is going to be the national geological surveys and organisations that they cooperate with. The participating geological surveys and similar organisations are listed below Table 45 (Annex 4).

2.7.3 Evaluation of data availability and accessibility

The responsibility to document mining and mineral processing activities varies from country to country and can sometimes be divided between different organisations. In some countries parts of the information is classified. In order to determine what information the different geological surveys collate, a questionnaire was sent to the participating geological surveys. The response rate was 70% and the result is summarised in Figure 8. An overview about data availability for EU28+2 and likely data providers is in Table 29 (Annex 1C, page 79).

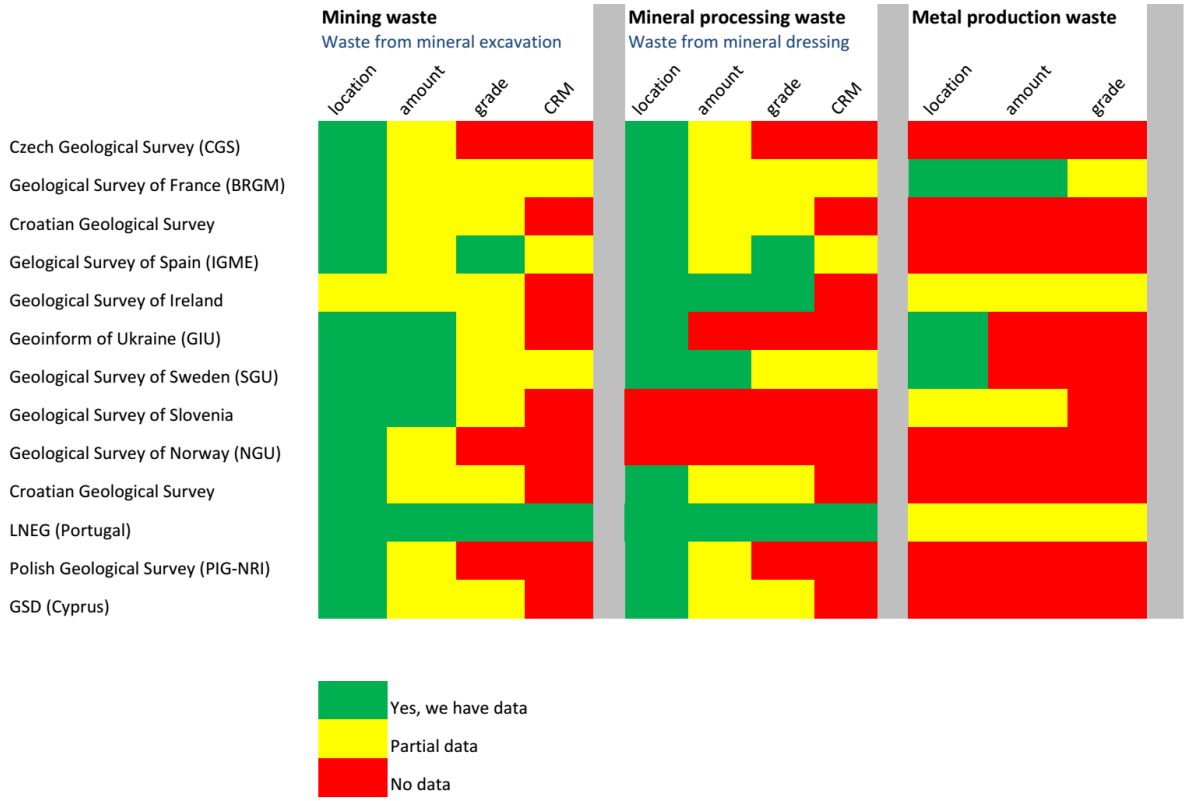

Figure 8: Overview of data availability for mining waste

Most of the geological surveys had information on the location of mines and of mineral processing plants. The amount of generated waste from mining and mineral processing was known by some but all surveys had partial information in the sense that they could get the information or they could make estimates. Some surveys had very little information on the metal grade of the waste but some had partial data. For critical raw materials most surveys lack that kind of information with a few exceptions. The questionnaire also contained a question on waste from metal production (smelters and blast furnaces). It turned out that very few of the surveys was in possession of that kind of information though some surveys had at least partial information on location, amount and grade of the generated waste from the metal production.

2.7.4 Selected Country Case studies of data management on MS level

SGU are planning to do a test using their statistics on mining and mineral processing activities in order to investigate and develop the new data model for mining waste produced by WP5 (an extension of the Minerals4EU data model). The work can also act as a template for other countries and identify possible weaknesses in the data. It will also provide an opportunity to create calculation principles for how to estimate the amount of waste from the amount of mined and processed ore, differences between open pit and underground mines, differences between types of processed ore etc. This work is planned for autumn 2016 parallel to direct sampling of mineral processing waste to determine the grades of CRM.

3 Conclusions and Recommendations

The data and information available to describe end-of-life stocks and flows focused on critical raw materials are scarce. Where they are available they are scattered amongst various institutions at European, national, and regional levels, and lack harmonised formats and/or consistent granularity. The varying data formats lead to information being lost due to e.g. aggregation of data or transformation of data formats (estimation of split factors).

Eurostat publishes data in an aggregated manner and information content gets lost from harvesting to publication. Incoherent and incomplete information (timescale, classification, and spatial coverage) aggravate the usage for ProSUM purposes. In order to describe and characterise the waste flows within the EU, data at the MS level reveal information of a more valuable quality. However, the availability and accessibility of information from official e.g. reports, authorities, academic papers, and projects vary significantly between the considered waste groups.

3.1 WEEE

In the case of **WEEE**, data reporting about collection and treatment is regulated in Directive 2012/19/EU. The WEEE categories to be reported are defined in Annex I-IV of this Directive. Since producers and retailers have to consider their extended producer responsibility when putting their products on market, compliance organisations (compliance schemes) were found to fulfil legal obligations on their behalf. Member states, i.e. national authorities or EPAs, gather information from compliance organisations to report to the EC. However, the reported information only covers around 35% of the total waste generation potential. Additional research studies and projects have been carried out within the EU and worldwide, to calculate and assess the potential of WEEE, its components, and critical raw materials.

The mass of WEEE generated, collected and recycled is reported on a European level according to the WEEE directive classification. However, the level of detail required for ProSUM (UNU Key classification) is not commonly available. Data to characterise (downstream) waste flows is not available at the EU or MS level, which is usually reported in (less) collection categories. Studies such as the CWIT report deal with WEEE composition, complementary flows, and characterisation. Moreover, compliance schemes are a valuable source of information as they collect existing information and sometimes carry out further studies and benchmarking.

A number of different sources have been identified at the EU level from both the private and public sectors. This gives good geographic and time coverage for data because the different sources complement each other. However, there is a high diversity in the codification and aggregation of the data and because the format of data is not standard for all countries, data compatability and analysis is difficult.

The Eurostat data is provided too infrequently and with insufficient granularity to characterise waste flows.

Data on the outputs from WEEE treatment and recycling facilities and the capacity of such facilities are commercially sensitive and, therefore, not available and very difficult to collect.

Specific country studies provide additional more detailed data on WEEE generation and flows allowing for extrapolation to other countries.

WEEE losses in the waste bin are particularly relevant in the context of ProSUM, but the data available are mostly estimated, quite heterogeneous and varies greatly dependent upon a number of factors including the economy of the country.

The data source inventory revealed that some data gaps encountered can be filled with additional data sources (104 listed in EndNote library) identified within this deliverable (compare Table 22 and Table 23 in Annex 1C).

3.2 BATT

With regard to **BATT**, data reporting on collection and treatment as well as recycling (efficiency) is required by Directive 2006/66/EC. For the reporting of recycling efficiency, batteries and accumulators are classified as lead acid, nickel cadmium and other. However, this only applies for portable batteries. Data reporting on automotive and industrial batteries is not mandated and information has to be gathered from industrial associations or research projects.

In Eurostat only 19 of the EU28+2 Members states report collected masses. Information about complementary flows, treatment specification or designation, as well as recycling data are not available. However, they have to be reported in future years.

The low granularity of the Eurostat reported data (distinction of the battery types PbA, NiCd, other) can sometimes be improved at the national level with help of data from industrial associations and compliance schemes (see German example).

Data for batteries in complementary waste flows can only be obtained from dedicated individual studies on (multi-)national level.

Data about SRMs in battery (downstream) waste is more detailed compared with other waste groups since reporting at the elemental level is required by Directive 2006/66/EC. The first year of reporting is 2014 but there are only a few recycling plants for some battery types, the publication of data may be limited for commercial reasons. Some countries, like Germany, already report data about recycled battery masses (see Table 25, page 75).

Making these data available for the ProSUM project will be crucial in order to prospect SRMs in waste flows. Nevertheless, in total 61 references concerning the description and characterisation of battery waste flows were identified so far and fed into the shared EndNote library.

3.3 ELV

ELV data reporting is regulated by Directive 2000/53/EC and encompasses total vehicle waste generated, treated, and recovered/recycled. Complying with the ELV Directive, this data covers passenger cars (M1) and goods vehicles (N1) in total; no further distinction is made.

Information reported on treatment (de-pollution and dismantling) is at two levels, a minimum requirement, i.e. total ELV waste treated, and an optional classification in several output flows from de-pollution and dismantling. Due to the effort required to produce more detailed data, member states report with different qualities and levels of detail. Also, from the EU28+2 countries covered by ProSUM, three are not covered on Eurostat (Croatia, Malta, and Switzerland), and several others do not report regularly.

Legislation on ELV does not include information on components or even chemical composition of vehicles. This means that this data is not collected, either at a European or on a member state level. There are only a few studies collecting and/or researching data with this level of detail. Information on CRM content is only qualitatively available, if available at all. Vehicles are very complex products (consisting of not only many different materials, but also many components and products). Vehicle configurations vary in one car type for one manufacturer alone and are consumer dependent. Data is scattered along the production chain and for waste management. This provides many challenges in characterising ELV waste flows for CRMs. Here a specified classification of vehicles and end-of-life vehicles comparing to e.g. the UNU keys for WEEE could solve this classification problem but the dominant problem of a general lack of data remains. Here more research has to be initiated and done, based on current and finished projects, which started to collect data on the component and chemical composition of ELV. As it is a wide and complex field there are plenty of research opportunities with different focal points, e.g. current and future ELV and their composition, technology changes such as electrical vehicles, their composition and impact on future fleets and ELV generation, change and trend of technological demand regarding

changing compositions and exisiting reuse/recovery and reuse/recycling rates, and many more. Also more detailed reporting procedures and requirements for ELV disassembly facilities and WEEE processing facilities treating ELV components would have a positive effect on available data.
Another issue regarding ELV information is the large share of complementary flows and non-compliant processing. For instance in Germany alone, a few million vehicles are unaccounted for per year, which can be e.g. temporarily de-registered, (dumped) illegally, or subject of illegal transboundary shipments. Deliverable 3.2 in month 18 will give more information on this topic.

3.4 MIN

There is no EU legislation forcing the recycling of mining waste and there are no statistics at European level that deal specifically with the economic aspects of mining waste. Information on mining waste must be collected at a national level, from geological surveys, environmental protection agencies, universities and other organisations. There are, however, solid information about mines and mining activities in the data gathered by the Minerals4EU project. This information and the organisations that provided data to the project make up the backbone of the mining waste part of the ProSUM project.

A rough estimate of generated mining waste (waste rock and mineral processing waste) can be generated from Minerals4EU data since every mine has produced waste rocks when removing country-rocks to access ore and most of the ore produced during the last century has been processed to extract the economically interesting minerals while generating mineral processing waste. By considering mining method, ore type, amount of ore, mineral processing methods and other factors it is possible to develop parameters making it possible to estimate amount and composition of mining waste.

To be useful in the ProSUM project and for future data users these rough estimates of mining waste have to be corrected and supplemented with more detailed information. In some countries, this work has already been done, often through environmental studies in accordance with EU's environmental legislation, in other countries there are reliable mining and mineral processing statistics to be used. In the few cases where information about a country's mining waste is extremely poor, field work including sampling, analytical work and size estimates is needed.

The results will then be gathered in a common database using common data model and code lists to ensuring that the mining waste data is comparable between countries and that mining waste is comparable to primary resources as well as to other secondary resources.

One problem already identified in the project is the general lack of data on most of the critical raw materials. This problem can only be solved by sampling of waste. Pilot projects to sample mining waste with respect to critical raw materials are planned in Ireland and in Sweden.

3.5 Next steps

Data reporting on waste flows for the three waste groups WEEE, BATT, and ELV is regulated in the respective Directives (see chapter 1.3). Additionally many other institutions, associations, and organisations deal with one or more aspects of these waste flows. This means that within the required reporting scope there is a data basis for WEEE, BATT, and ELV on a European level, not meeting the requirements and ambition set in ProSUM. In addition to the manifold sources this leads to serious problems regarding data, mainly data granularity, conflicting data, and data gaps. For MIN however, it is a different case. Here, available data is administered by a multi national network of European and national geological surveys. Within this framework data management is much more harmonised based on the elaborate INSPIRE classification.

The next steps to be tackled regarding information on waste flows address the identified problems: granularity, conflicting data, and data gaps.

Differences in granularity for WEEE, BATT, and ELV present a problem for data availability and consistency. In this context the following issues have to be focused on.

- Regional/geographical granularity
  Data attributed to different geographical or regional system boundaries are difficult to compare and process. Even more so when data is only available for instance for a part of a member state which is not representative for the average country (e.g. data for the capital in a centralised country with an otherwise high rural share).
- Temporal granularity
  Varying temporal resolutions make comparability challenging, especially with data that is subject to e.g. seasonal variations (such as peak waste generation after holidays or changing waste flow compositions due to promoted collection events). Controlled and regulated collection and reporting procedures can help decreasing this problem.

Conflicting data due to different data sources, depicting values and ranges that do not match, pose a special problem, regarding robustness of data for e.g. validation in models and statistics.

- A harmonised waste and downstream waste flow classification is one important prerequisite to face the problem of conflicting data. Without a harmonised classification system for collected and reported data an extraction of detailed and robust data is demanding, laborious, and often simply impossible. The harmonised classification presented in Deliverable 5.3 Review and harmonisation of data is a first step to adjust this.
- There is a need to cross-check and validate data between different available information sources, e.g. comparable countries, information due to collection or treatment methods. Assumptions will have to be developed and documented based on expert knowledge in order to collate the available information to overcome the identified challenges. One valuable instrument is to apply the ProSUM approach, using the stock and flow models being a major output of WP3 in order to cross-check the waste flow data with the (modelled) waste generation amounts and predicted characteristics. Application options for such a procedure would be for instance the specification of chemical systems in batteries collected.

Another major challenge is data gaps due to confidential data, lack of incentive for providing more transparency and detailed knowledge, or simply lack of knowledge of an issue.

- With the purpose of filling the data gaps identified, the developed questionnaires will be circulated to corresponding data sources determined. These incorporate national and regional authorities, national statistical institutions, associations of waste management companies, coordination centres and clearing houses, and many more (see chapter 5, Annex 1A).
- Also, it is necessary to examine conducted treatment trials (such as sorting analyses or chemical analyses CRM relevant waste flows) e.g. in a research or industrial environment and initialise significant and fruitful new treatment trials to characterise downstream waste flows, based on the recommendations of Deliverable 4.3 Waste and Tailings Characterisation, M30. The results from such activities can also be input to extrapolations and adaptations and hence lead to more consistent and applicable data.
- Additionally, further and often undisclosed sources have to be addressed, such as Ecosystèmes data (a WF member PRO), presenting a huge potential to fill data gaps.

For MIN, it is time to do a follow-up of the questionnaire that was circulated more than a year ago (summarised in chapter 2.7.3), this time accompanied by a description of the data models and a complete set of code lists. This will make it possible for each of the organisations to determine more precisely the amount and quality of the data they can provide. Some geological surveys have plans to sample waste deposits in the near future. This would be coordinated so that we use similar methods for sampling and analysis (further depicted in the D4.3, M30).

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5 Annexes

Annex 1A Data sources

This deliverable contains a separate excel file comprising:

Table 18: Annex 1A Data sources

Scope	Corresponding excel sheet	Description
General		
	ProSUM_IN	ProSUM Information network
Member state level		
	MS_National Authorities	National authorities
	MS_EPA	Environmental Protection Agency
	MS_NSI	National statistical institutes
	MS_WasManAss	Associations of waste management companies
WEEE		
	MS_WEEE_ImplLaw	Implementing law for WEEE
	MS_WEEE_CoordCenter	Coordination centres and clearing houses
	MS_WEEE_ProdReg	Producer register
	MS_WEEE_Compl.organ.	Compliance organisation
	MS_WEEE_OtherDataSources	Other data sources related to WEEE
BATT		
	MS_BATT_Compl.organ.	Compliance organisation
MIN		
	MS_MIN_GeoSurveys	Geological surveys of the Member States

Annex 1B Questionnaires

Table 19: WEEE Questionnaire - information required for WEEE EoL characterisation and description

1) COLLECTION	
Officially reported collection	
0 a)	WEEE generated
1 a)	Total amount of WEEE collected
1 b)	WEEE collected per category (e.g. portable batteries,...; chemistry,...)
1 c)	Mass fraction of WEEE per category (e.g. 60 % portable batteries; or 12 % Li-Ion, 20 % AlMn,...)
1 d)	Material/Chemical composition of WEEE (elemental mass fraction, material declaration, ...)
Complementary and non-compliant processing	
1 e)	Total amount of WEEE collected in complementary flow
1 f)	WEEE collected in complementary flow per category (e.g. portable batteries,...; chemistry,...)
1 g)	Mass fraction of WEEE in complementary flow per category (i.e. mass fraction of 1 f)
2) TREATMENT (sorting, pre-processing,...)	
Mass and specification of waste	
2 a)	Total amount of WEEE into treatment - Input (e.g. mass per year)
2 b)	Mass fraction of WEEE into treatment per category - Input
2 c)	Total amount of WEEE into treatment - out of EU
2 d)	Mass fraction of WEEE into treatment per category - out of EU
2 e)	Amount of WEEE downstream waste from treatment - Output (e.g. mass per year)
2 f)	Composition of WEEE downstream waste from treatment - Output (i.e. downstream waste flow composition, e.g. CRM content,...)
2 g)	Destination of WEEE downstream waste from treatment - Output (next treatment or recycling process)
Facility information	
2 h)	Number of facilities?
2 i)	Location of individual facilities? (e.g. city name, GPS, region, ...)
2 j)	Technology used? (e.g. shredder, eddy-current separator,..)
2 k)	Capacity? (theoretical throughput per year)
3) RECYCLING (i.e. material recycling)	
Mass and specification of waste	
3 a)	Total amount of WEEE downstream waste into recycling - Input (e.g. mass per year)
3 b)	Mass fraction of WEEE (downstream) waste into recycling per category- Input (e.g. material, PCB, Li-ion batteries, ...)
3 c)	Amount recycled - Output (e.g. tonnes of plastics/metal etc.)
3 d)	Specification of recycled material - Output On material basis (e.g steel making, Aluminum remelting, plastics regranulation)
3 e)	Destination of recycled material from recycling - Output
Facility information	
3 f)	Number of plants?
3 g)	Location of individual plants? (e.g. city name, GPS, region, ...)
3 h)	Technology used? (e.g.pyrometallurgical/smelter, hydro-, ...)
3 i)	Capacity? (theoretical throughput per year)

Table 20: BATT questionnaire - information required for BATT EoL characterisation and description

1) COLLECTION	
Officially reported collection	
1 a)	Total amount of mixed BATT waste collected
1 b)	Specification of mixed BATT waste collected (e.g. portable batteries,...; chemistry,...)
1 c)	Mass fraction of specified BATT in mixed BATT flow (e.g. 60 % portable batteries; or 12 % Li-Ion, 20 % AlMn,...)
1 d)	Chemical composition of BATT (elemental mass fraction, material declaration, ...)
Complementary and non-compliant processing	
1 e)	Total amount of mixed BATT waste collected in complementary flow
1 f)	Specification of mixed BATT collected in complementary flow (e.g. portable batteries,...; chemistry,...)
1 g)	Mass fraction of specified BATT in complementary flow (i.e. mass fraction of 1 f)
2) TREATMENT (sorting, pre-processing,...)	
Mass and specification of waste	
2 a)	Total amount of BATT into treatment (sorting) - Input (e.g. mass per year)
2 b)	Mass fraction of specified BATT into treatment - Input
2 c)	Amount of BATT (downstream waste) from treatment - Output (e.g. mass per year)
2 d)	Composition of BATT (downstream waste) from treatment - Output (i.e. downstream waste flow composition, e.g. CRM content,...)
2 e)	Destination of BATT (downstream waste) from treatment - Output (next treatment or recycling process)
Facility information	
2 f)	Number of facilities?
2 g)	Location of individual facilities? (e.g. city name, GPS, region, ...)
2 h)	Technology used? (e.g. shredder, eddy-current separator,..)
2 i)	Capacity? (theoretical throughput per year)
3) RECYCLING (i.e. material recycling)	
Mass and specification of waste	
3 a)	Total amount of BATT (downstream waste) into recycling - Input (e.g. mass per year)
3 b)	Composition of BATT (downstream waste) into recycling - Input (e.g. material, PCB, Li-ion batteries, ...)
3 c)	Amount recycled - Output (e.g. tonnes of plastics/metal etc.)
3 d)	Specification of recycled material - Output On material basis (e.g steel making, Aluminum remelting, plastics regranulation)
3 e)	Destination of recycled material from recycling - Output
Facility information	
3 f)	Number of plants
3 g)	Location of individual plants (e.g. city name, GPS, region, ...)
3 h)	Technology used (e.g.pyrometallurgical/smelter, hydro-, ...)
3 i)	Capacity (theoretical throughput per year)

Table 21: ELV questionnaire - information required for ELV EoL characterisation and description

1) COLLECTION	
Officially reported collection	
1 a)	Total amount of mixed ELV waste collected
1 b)	Specification of ELV collected (e.g. passenger cars, vans, …)
1 c)	Mass fraction of specified ELV in mixed ELV flow (i.e. mass fraction of 1 b), e.g. 40% passenger cars with petrol, 30% with diesel, …)
1 d)	Chemical or componential composition of specified ELV (elemental mass fraction, material declaration, …)
Complementary and non-compliant processing *(e.g. illegal export, illegal placing, theft, ...)*	
1 e)	Total amount of ELV in informal collection
1 f)	Destination of ELV from informal collection
1 g)	Chemical or componental composition of specified ELV (elemental mass fraction, material declaration, …)
2) TREATMENT: **de-pollution and dismantling**	
Mass and specification of waste	
2 a)	Total amount of ELV into treatment - Input (e.g. mass per year)
2 b)	Mass fraction of specified ELV into treatment - Input
2 c)	Amount of ELV (downstream waste) from treatment - Output
2 d)	Composition of ELV waste from treatment - Output (i.e. downstream waste flow composition, e.g. CRM content,…)
2 e)	Destination of ELV waste from treatment - Output *(next treatment or recycling process)*
Facility information	
2 f)	Number of facilities?
2 g)	Location of individual facilities? (e.g. city name, GPS, region, …)
2 h)	Technology used? (e.g. manual dismantling, mechanical..)
2 i)	Capacity? (theoretical throughput per year)
3) TREATMENT: **shredder and post-shredder treatment**	
Mass and specification of waste	
3 a)	-3e) see above
*Treatment **facilities** - description*	
3 f)	-3i) see above
4) TREATMENT: **other treatment**	
Mass and specification of waste	
4 a)	-4e) see above
Facility information	
4 f)	-4i) see above
5) RECYCLING (i.e. material recycling)	
Mass and specification of waste	
5 a)	Total amount of ELV (downstream waste) into recycling - Input (e.g. mass per year)
5 b)	Composition of ELV waste/components into recycling - Input
5 c)	Amount recycled -Output (e.g. tonnes of plastics/metal etc.)
5 d)	Specification of recycled material - Output On material basis (e.g steel making, Aluminum remelting, plastics regranulation)
5 e)	Destination of recycled material from recycling - Output
Facility information	
5 f)	Number of plants?
5 g)	Location of individual plants? (e.g. city name, GPS, region, …)
5 h)	Technology used? (e.g.pyrometallurgical/smelter, hydro-, ...)
5 i)	Capacity? (theoretical throughput per year)

Annex 1C Overview data availability

WEEE Overview data availability

Table 22: Data inventory for WEEE on Eurostat (green – data available; yellow - data (partially) available, but not always publicly available; red - no data available; grey - for certain fractions, there was no data available in all years)

		Gen.	1) COLLECTION							2) TREATMENT (sorting, pre-processing,…)											3) RECYCLING (i.e. material recycling)								
			Officially reported collection					*Complementary flows*			*Mass and specification of waste*							*Plant information*				*Mass and specification of waste*					*Plant information*			
		0 a)	1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	2 j)	2 k)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)
on Member state level																													
AUT	Austria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BEL	Belgium	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BGR	Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CYP	Cyprus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DNK	Denmark	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ESP	Spain	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FIN	Finland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRA	France	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HRV	Croatia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IRL	Ireland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LTU	Lithuania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LUX	Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LVA	Latvia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MLT	Malta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NLD	Netherlands	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POL	Poland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVK	Slovakia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVN	Slovenia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 23: General data inventory: overview and evaluation of data availability for WEEE EoL information for EU28+2 (green – data available; yellow - data (partially) available, but not always publicly available; red - no data available)

		Gen.	1) COLLECTION							2) TREATMENT (sorting, pre-processing,…)											3) RECYCLING (i.e. material recycling)								
			Officially reported collection				*Complementary flows*			*Mass and specification of waste*							*Plant information*					*Mass and specification of waste*					*Plant information*			
		0 a)	1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	2 j)	2 k)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)
on Member state level																													
AUT	Austria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BEL	Belgium	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BGR	Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CYP	Cyprus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DNK	Denmark	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ESP	Spain	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FIN	Finland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRA	France	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HRV	Croatia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IRL	Ireland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LTU	Lithuania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LUX	Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LVA	Latvia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MLT	Malta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NLD	Netherlands	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POL	Poland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVK	Slovakia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVN	Slovenia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

BATT Overview data availability

Table 24: Data inventory for BATT on Eurostat (green – data available; yellow - data (partially) available, but not always publicly available; red - no data available; grey - data are (partially) available. Required since 2015 in context of reports about recycling efficiency)

		Gen.	1) COLLECTION							2) TREATMENT (sorting, pre-processing,…)									3) RECYCLING (i.e. material recycling)								
			Officially reported collection				*Complementary*			*Mass and specification of waste*					*Facility information*					*Mass and specification of waste*					*Facility information*			
		0 a)	1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)
AUT	Austria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BEL	Belgium	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BGR	Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CYP	Cyprus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DNK	Denmark	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ESP	Spain	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FIN	Finland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRA	France	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HRV	Croatia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IRL	Ireland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LTU	Lithuania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LUX	Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LVA	Latvia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MLT	Malta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NLD	Netherlands	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POL	Poland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVK	Slovakia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVN	Slovenia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 25: General data inventory: overview and evaluation of data availability for BATT EoL information for EU28+2, focus on portable batteries, but not exclusively. Status not completed (green – data available; yellow - data (partially) available, but not always publicly available; red - no data available; grey - data are (partially) available. Required since 2015 in context of reports about recycling efficiency; question marks – most likely)

		Gen.	1) COLLECTION							2) TREATMENT (sorting, pre-processing,…)									3) RECYCLING (i.e. material recycling)								
			Officially reported collection				*Complementary*			*Mass and specification of waste*					*Facility information*				*Mass and specification of waste*					*Facility information*			
		0 a)	1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)
AUT	Austria	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BEL	Belgium	X	X[1)2)]	X[2)]	X[2)]	X	X	X	X	X[2)]	X[2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BGR	Bulgaria	X	X[1)3)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CYP	Cyprus	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	X	X[1)2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	X	X[1)2)]	X[2)]	X[2)]	X	X	X	X	X[2)]	X[2)]	X	X	X	X	X	X	X	X[2)]	X[2)]	X[2)]	X[2)]	X[2)]	X	X	X	X
DNK	Denmark	X	X[1)2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ESP	Spain	X	X[1)2)]	X	X	?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FIN	Finland	X	X[1)2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRA	France	X	X[1)3)]	X[3)]	X[3)]	X	X	X	X	X[3)]	X[3)]	X	X	X	X[3)]	X[3)]	X[3)]	X	X[3)]	X[3)]	X[3)]	X[3)]	X[3)]	X[3)]	X[3)]	X[3)]	X
GBR	United Kingdom	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HRV	Croatia	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IRL	Ireland	X	X[1)2)]	X	X	?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy	X	X[1)2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LTU	Lithuania	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LUX	Luxembourg	X	X[1)2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LVA	Latvia	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MLT	Malta	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NLD	Netherlands	X	X[1)2)]	X[2)]	X[2)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POL	Poland	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVK	Slovakia	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVN	Slovenia	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	X	X[1)]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	X	X	?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

1) EPBA, 2) National compliance schemes, 3) National EPA

ELV Overview data availability

Table 26: Data on ELV complying with directive 2000/53/EC; compiled and published by Eurostat

	total waste generated [Mg]	total	liquids (excl. fuel) (LoW: 1301 until 1306+1406+160113)	tyres	oil filters	other materials arising from de-pollution (excl. fuel)	metal components (LoW: 160117+160118)	large plastic parts	glass	other materials arising from dismantling (LoW: 160122+160199)	batteries and accumulators	catalysts	total	ferrous scrap (steel)	non-ferrous materials (Al, Cu, Zn, Pb, etc.)	shredder light fraction (SLF) (LoW: 191003 + 191004)	other materials arising from shredding (LoW: 191005 + 191006)	total waste generated to export	export to disposal	export to recovery	export to recycling
	collection	treatment of materials from dismantling and de-pollution											treatment of materials from shredding					treatment of exported ELV			
compiled data on Eurostat, by Member State																					
AUT	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BEL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BGR	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CYP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CZE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DEU	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DNK	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ESP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
EST	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
FIN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
FRA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GBR	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GRC	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
HRV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HUN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
IRL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ITA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LTU	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LUX	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LVA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MLT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NLD	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
POL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
PRT	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ROU	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SVK	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SVN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SWE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CHE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NOR	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 27: Data inventory for ELV on Eurostat (green – data available; yellow - data (partially) available, but not always publicly available; red - no data available; grey - data are (partially) available).

		1) COLLECTION							2) TREATMENT (de-pollution and dismantling)									3) TREATMENT (shredder and post-shredder treatment)									4) TREATMENT (other treatment)									5) RECYCLING (i.e. material recycling)								
		Officially reported				Complementary			Mass and specification of waste					Facility information				Mass and specification of waste					Facility information				Mass and specification of waste					Facility information				Mass and specification of waste					Facility information			
		1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)	4 a)	4 b)	4 c)	4 d)	4 e)	4 f)	4 g)	4 h)	4 i)	5 a)	5 b)	5 c)	5 d)	5 e)	5 f)	5 g)	5 h)	5 i)
on Member state level																																											
AUT	Austria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BEL	Belgium	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BGR	Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CYP	Cyprus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DNK	Denmark	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ESP	Spain	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FIN	Finland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRA	France	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HRV	Croatia	-	X	X	X	X	X	X	-	X	-	-	X	X	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IRL	Ireland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LTU	Lithuania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LUX	Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LVA	Latvia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MLT	Malta	-	X	X	X	X	X	X	-	X	-	-	X	X	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NLD	Netherlands	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POL	Poland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVK	Slovakia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SVN	Slovenia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	-	X	X	X	X	X	X	-	X	-	-	X	X	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 28: Information on ELV flows for examplary countries

		1) COLLECTION							2) TREATMENT (de-pollution and dismantling)									3) TREATMENT (shredder and post-shredder treatment)									4) TREATMENT (other treatment)									5) RECYCLING (i.e. material recycling)								
		1 a)	1 b)	1 c)	1 d)	1 e)	1 f)	1 g)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	2 i)	3 a)	3 b)	3 c)	3 d)	3 e)	3 f)	3 g)	3 h)	3 i)	4 a)	4 b)	4 c)	4 d)	4 e)	4 f)	4 g)	4 h)	4 i)	5 a)	5 b)	5 c)	5 d)	5 e)	5 f)	5 g)	5 h)	5 i)
		Officially reported				Complementary			Mass and specification of waste					Facility information				Mass and specification of waste					Facility information				Mass and specification of waste					Facility information				Mass and specification of waste					Facility information			
on Member state level																																											
AUT	Austria																																											
BEL	Belgium																																											
BGR	Bulgaria																																											
CYP	Cyprus																																											
CZE	Czech Republic																																											
DEU	Germany	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DNK	Denmark																																											
ESP	Spain																																											
EST	Estonia																																											
FIN	Finland																																											
FRA	France	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRC	Greece																																											
HRV	Croatia																																											
HUN	Hungary																																											
IRL	Ireland																																											
ITA	Italy																																											
LTU	Lithuania																																											
LUX	Luxembourg																																											
LVA	Latvia																																											
MLT	Malta																																											
NLD	Netherlands																																											
POL	Poland																																											
PRT	Portugal																																											
ROU	Romania																																											
SVK	Slovakia																																											
SVN	Slovenia																																											
SWE	Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NOR	Norway	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

MIN Overview data availability

Table 29: Data inventory for MIN from Geological surveys (green – data available; yellow - data (partially) available; red - no data available; white – no response or not asked; blue – likely data providers; pink-likely future data providers).

			1) Mining waste				2) Mineral processing waste				3) Metal production waste		
			Waste from mineral excavation				*Waste from mineral dressing*						
on Member state level		Reference	Location	Amount	Grade	CRM	Location	Amount	Grade	CRM	Location	Amount	Grade
AUT	Austria												
BEL	Belgium												
BGR	Bulgaria												
CYP	Cyprus	GSD	X	X	X	X	X	X	X	X	X	X	X
CZE	Czech Republic	Czech Geological Survey (CGS)	X	X	X	X	X	X	X	X	X	X	X
DEU	Germany	Helmholtz Institute Freiberg	?	?	?	?	?	?	?	?	?	?	?
DNK	Denmark	Geological Survey of Denmark and Greenland	?	?	?	?	?	?	?	?	?	?	?
ESP	Spain	Geological Survey of Spain (IGME)	X	X	X	X	X	X	X	X	X	X	X
EST	Estonia												
FIN	Finland		?	?	?	?	?	?	?	?	?	?	?
FRA	France	Geological Survey of France (BRGM)	X	X	X	X	X	X	X	X	X	X	X
GBR	United Kingdom												
GRC	Greece												
HRV	Croatia	Croatian Geological Survey	X	X	X	X	X	X	X	X	X	X	X
HUN	Hungary												
IRL	Ireland	Geological survey of Ireland	X	X	X	X	X	X	X	X	X	X	X
ITA	Italy												
LTU	Lithuania												
LUX	Luxembourg												
LVA	Latvia												
MLT	Malta												
NLD	Netherlands												
POL	Poland	Polish Geological Survey (PIG-NRI)	X	X	X	X	X	X	X	X	X	X	X
PRT	Portugal	LNEG	X	X	X	X	X	X	X	X	X	X	X
ROU	Romania												
SVK	Slovakia		?	?	?	?	?	?	?	?	?	?	?
SVN	Slovenia	Geological Survey of Slovenia	X	X	X	X	X	X	X	X	X	X	X
SWE	Sweden	Geological Survey of Sweden (SGU)	X	X	X	X	X	X	X	X	X	X	X
CHE	Switzerland												
NOR	Norway	Geological Survey of Norway (NGU)	X	X	X	X	X	X	X	X	X	X	X

X	data available
X	partial data
X	no data
?	likely data providers
?	likely future data provider

Annex 2 Overview bibliographic information WEEE, BATT and ELV

All data is structured into one bibliographic overview in EndNote where all meta data is kept and stored in harmonised formats for future replication. The data sources are further described and evaluated in an Excel file which is also aligned with the simultaneous deliverables D2.2 and D3.1. Combined, the total inventory is forming the project Milestone 4 'Existing Data Inventory' and will be transferred later into the EU-UMKDP

Table 30: EndNote extract of WEEE references

Author(s)	Title	Year	Spatial coverage
Alavi, N.	Waste electrical and electronic equipment (WEEE) estimation: A case study of Ahvaz City, Iran	2014	
Araújo, M.G.	A model for estimation of potential generation of waste electrical and electronic equipment in Brazil	2012	Brazil
Bakas, I.	Present and potential future recycling of critical metals in WEEE	2014	
Balde, C.P.	Transboundary movements of used and waste electronic and electrical equipment: Estimates from the European Union using trade statistics	2016	
C.P. Baldé	E-waste statistics: Guidelines on classifications, reporting and indicators	2015	EU;NL;CN
Bigum, M.	WEEE and portable batteries in residual household waste: Quantification and characterisation of misplaced waste	2013	DNK
Bollinger, L. A.	Growing cradle-to-cradle metal flow systems, An application of agent-based modeling and system dynamics to the study of global flows of metals in mobile phones	2010	
Böni, H.	Disposal of Flat Panel Display Monitors in Switzerland	2011	
Böni, H.	Rückgewinnung von kritischen Metallen aus Elektronikschrott am Beispiel von Indium und Neodym	2015	CHE
Brechbühler-Peskova, M.	Rückgewinnung von Indium aus Bildschirmen: Ist das sinnvoll?	2016	CHE
Bridgwater, E.	Defra EV0801 National compositional estimates for local authority collected waste and recycling in England, 2010/11	2013	UK
Buchert, M.	Landfill Mining Option oder Fiktion?	2013	DEU
Chancerel, P.	Data availability and the need for research to localize, quantify and recycle critical metals in information technology, telecommunication and consumer equipment	2013	
Chung, S.	Projection of waste quantities: the case of e-waste of the People's Republic of China	2011	China
Shan-shan Chung	Generation of and control measures for, e-waste in Hong Kong	2011	Hong Kong
European Commission	WEEE Member State Contacts	2015	
Cucchiella, F.	Recycling of WEEEs: An economic assessment of present and future e-waste streams	2015	
Defra	National compositional estimates for local authority collected waste and recycling in England	2013	GBR
Dehoust, G.	Klimaschutzpotenziale der Abfallwirtschaft Am Beispiel von Siedlungsabfällen und Altholz	2010	
Duan, H.	Systematic characterization of generation and management of e-waste in China	2015	
Dvoršak, S.	Municipal Solid Waste Composition in Romania and Bulgaria	2011	BGR, ROU
EEA	Transboundary shipments of waste in the EU - Developments 1995-2005 and possible drivers	2008	
EFFACE	EFFACE Project	2016	EU
EIA	The UK's harmful trade in electronic waste	2011	GBR
Eijsbouts, R.J.J.	Research into complementary waste streams for e-waste in the Netherlands	2008	
EUROSAI	Coordinated audit on the enforcement of the European Waste Shipment Regulation	2013	BGR, GRC, HUN, IRL, POL, NLD, NOR,SVN
Eurostat	Waste Electrical and Electronic Equipment (WEEE)	2015	
Friege, H.	Optimising waste from electric and electronic equipment collection systems: a comparison of approaches in European countries	2015	DE, SE, BE, CH, DK
Habib, K.	Material flow analysis of NdFeB magnets for Denmark: a comprehensive waste flow sampling and analysis approach	2014	DNK
Habib, K.	Tracking the Flow of Resources in Electronic Waste - The Case of End-of-Life Computer Hard Disk Drives	2015	DNK
Habuer	Time-series product and substance flow analyses of end-of-life electrical and electronic equipment in China	2013	CHN

Hischier, R.	Does WEEE recycling make sense from an environmental perspective? The environmental impacts of the Swiss take-back and recycling systems for waste electrical and electronic equipment (WEEE)	2005	CHE
Huisman, J	Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE)	2008	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, IRL, ITA, LTU, LUX, LVA, MLT, NLD, NOR, POL, PRT, ROU, SVK, SVN, SWE
Jaco Huisman	Eco-efficiency evaluation of WEEE take-back systems	2010	
Huisman, J.	The Dutch WEEE flows	2012	NLD
Botezatu, I., Herreras, L., Liddane, M., Hintsa, J., Luda di Cortemiglia, V., Leroy, P., Vermeersch, E., Mohanty, S., van den Brink, S., Ghenciu, B., Dimitrova, D., Nash, E., Shryane, T., Wieting, M., Kehoe, J., Baldé, C.P., Magalini, F., Zanasi, A., Ruini, F., and Bonzio, A.	Countering WEEE Illegal Trade (CWIT) Summary report	2015	
Stockholm Environment Institute	Eestis tekkinud segaolmejäätmete, eraldi kogutud paberi- ja pakendijäätmete ning elektroonikaromu koostise uuring	2013	
Kahhat, R.	Materials flow analysis of e-waste: Domestic flows and exports of used computers from the United States	2012	
Kalmykova, Y.	Out with the old, out with the new – The effect of transitions in TVs and monitors technology on consumption and WEEE generation in Sweden 1996–2014	2015	SWE
Kasper, A.C.	Printed wiring boards for mobile phones: Characterization and recycling of copper	2011	Brazil
Kees Wielenga, Jaco Huisman	(W)EEE Mass balance and market structure in Belgium	2013	BEL
Labie, R.	Recuperation of critical metals in Flanders: Scan of possible short term opportunities to increase recycling	2015	BEL
Lau, W.K.	A material flow analysis on current electrical and electronic waste disposal from Hong Kong households	2013	
Li, B.	Estimation of retired mobile phones generation in China: A comparative study on methodology	2015	
Li, J.	Measuring the generation and management status of waste office equipment in China: a case study of waste printers	2016	China
Liu, X.	Generation amount prediction and material flow analysis of electronic waste: a case study in Beijing, China	2006	
Jaco Huisman, Feng Wang, Rocco Mosconi, Alessandro Gobbi, Mattia Manzoni, Nando Pagnoncelli, Gabriella Scarcella, Andrea Alemanno, Irene Monti	Households WEEE arising in Italy	2012	ITA
Magalini, F.	Quantifying waste of Electric and Electronic Equipment in Romania	2015	ROU
Magalini, F.	eWaste in Latin America, Statistical analysis and policy recommendations	2015	Latin America
	Study On Collection Rates Of Waste Electrical And Electronic Equipment (WEEE), possible measures to be initiated by the Commission as required by Article 7(4), 7(5), 7(6) and 7(7) of Directive 2012/19/EU On Waste Electrical And Electronic Equipment (WEEE)	2016	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, HRV, IRL, ITA, LTU, LUX, LVA, MLT, NLD, NOR, POL, PRT, ROU, SVK, SVN, SWE
Mmereki, D.	Estimation of waste electronic and electrical equipment arising in Botswana-A case study of Gaborone City	2012	
Monier, V.	Study on the quantification of Waste of Electical and Electronic Equipment (WEEE) in France	2013	FRA
Montejo, C.	Analysis and comparison of municipal solid waste and reject fraction as fuels for incineration plants	2011	Spain

Mueller, S. R.	A geological reconnaissance of electrical and electronic waste as a source for rare earth metals	2015	
Navazo, J. M. V.	Material flow analysis and energy requirements of mobile phone material recovery processes	2013	
Oguchi, M.	Product flow analysis of various consumer durables in Japan	2008	
Oguchi, M.	A preliminary categorization of end-of-life electrical and electronic equipment as secondary metal resources	2011	JPN
Oguchi, M.	Toxic metals in WEEE: Characterization and substance flow analysis in waste treatment processes	2012	
HFT Network OY	Assessment of waste streams of electrical and electronic equipment (EEE) in Estonia	2003	EST
Paginu, V.	Governance of Metals Flows from Electrical and Electronic Equipment Waste in the Netherlands	2011	NLD
Pannuzzo, B.	Material Flow Analysis on High Value WEEE Generation and Collection in Finland	2014	FIN
Parfitt, J.P.	Municipal Waste composition - what is still in the residual bin and what can we get out	2010	UK
European Parliament	Directive 2011/65/EU of the European Parliament and the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment	2011	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, IRL, ISL, ITA, LTU, LUX, NLD, POL, ROU, SVK, SVN, SWE, UKR
European Parliament	Directive 2012/19/EU of the European parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)	2012	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, IRL, ISL, ITA, LTU, LUX, NLD, POL, ROU, SVK, SVN, SWE, UKR
Polák, M.	Estimation of end of life mobile phones generation: The case study of the Czech Republic	2012	Czech Republic
Rademaker, J. H.	Recycling as a Strategy against Rare Earth Element Criticality: A Systemic Evaluation of the Potential Yield of NdFeB Magnet Recycling	2013	EUR
Rahmani, M.	Estimation of waste from computers and mobile phones in Iran	2014	
SYDEREP - French Battery producer Register	Batteries and Accumulators in France (Piles et accumulateurs)	2016	FRA
SYDEREP (SYstème DEclaratif des filières REP) - French Battery producer Register	2014 annual report and summary	2015	FRA
Robinson, B.H.	E-waste: An assessment of global production and environmental impacts	2009	
Rothmann, M.	Characterization and Life Cycle Assessment of management of small combustible waste	2014	DNK
Sander, K.	Transboundary shipment of waste electrical and electronic equipment / electronic scrap – Optimization of material flows and control	2010	
Savvilotidou, V.	Determination of toxic metals in discarded Liquid Crystal Displays (LCDs)	2014	
Sommer, P.	Battery related cobalt and REE flows in WEEE treatment	2015	DEU
Steiger, U.	Erhebung der Kehrichtzusammensetzung 2012	2012	
Steubing, B.	Assessing computer waste generation in Chile using material flow analysis 30, 473–482	2010	Chile
Streicher-Porte, M.	Key drivers of the e-waste recycling system: Assessing and modelling e-waste processing in the informal sector in Delhi	2005	Delhi, India
Sun, Z.	Recycling of metals from urban mines - a strategic evaluation	2016	
Taghipour, H.	Determining heavy metals in spent compact fluorescent lamps (CFLs) and their waste management challenges: Some strategies for improving current conditions	2014	Iran
Tan, Q.	A study of waste fluorescent lamp generation in mainland China	2014	
TemaNord	Methods to measure the amount of WEEE generated - Report to the Nordic council's subgroup on EEE waste	2009	
Tran, H.P.	Estimation of the Unregistered Inflow of Electrical and Electronic Equipment to a Domestic Market: A Case Study on Televisions in Vietnam	2016	Vietnam
Tsamis, A.	Recovery of Rare Earths from electronic wastes: An opportunity for high-tech SMEs	2015	
Ueberschaar, M.	Enabling the recycling of rare earth elements through product design and trend analyses of hard disk drives	2015	

Bayerisches Landesamt für Umwelt	Restmüllzusammensetzung in Phasing-Out-Gebieten (EU Ziel-2-Programm Bayern) Abschöpfbares Wertstoffpotenzial als Funktion abfallwirtschaftlicher Rahmenbedingungen	2007	
Bayerisches Landesamt für Umwelt	Hausmüll in Bayern Bilanzen 2014	2014	
Umweltbundesamt	Transboundary shipment of waste electrical and electronic equipment / electronic scrap - Optimization of material flows and control	2010	DEU
Avfall Sverige utveckling	Hushållsavfall i siffror - Kommun- och länsstatistik 2012	2012	
Van Eygen, E	Resource savings by urban mining: The case of desktop and laptop computers in Belgium	2016	BEL
Voncken, J.H.L.	The Rare Earth Elements - An Intoduction	2016	GLO
Walk, W.	Approaches to estimated future quantities of waste electrical and electronic equipment (WEEE)	2004	
Walk, W.	Forecasting quantities of disused household CRT appliances – A regional case study approach and its application to Baden-Württemberg	2009	
Wang, F.	Enhancing e-waste estimates: Improving data quality by multivariate Input–Output Analysis	2013	
Wang, F.	E-waste: collect more, treat better Tracking take-back system performance for eco-efficient electronics recycling	2014	
Wang, R.	Recycling of non-metallic fractions from waste electrical and electronic equipment (WEEE): A review	2014	
Xue Wang	Prioritizing material recovery for end-of-life printed circuit boards	2012	
Widmer, R.	Global perspectives on e-waste	2005	Global
WRAP	Market flows of WEEE materials	2011	UK
Yamane, L.H.	Recycling of WEEE: Characterization of spent printed circuit boards from mobile phones and computers	2011	
Jianxin Yang	WEEE flow and mitigating measures in China	2008	China
Yoshida, Aya	Material flow analysis of used personal computers in Japan	2009	Japan
Tomohiro Tasaki, Atsushi Terazono	Material flow analysis of used personal computers in Japan	2009	Japan
Zeng, X.	Uncovering the Recycling Potential of “New” WEEE in China	2016	China
Ruying Gong, Wei-Qiang Chen, Jinhui Li	Uncovering the Recycling Potential of “New” WEEE in China	2016	China
Zhang, L.	Estimating future generation of obsolete household appliances in China	2012	

Additional data sources for WEEE are listed in Table 31 below.

Table 31: WEEE data sources

Reference	Scope	Spatial coverage	Description	Data availability
Germany: Transboundary Shipment of Electronic Waste - Optimization of Material Flows and Control, 2010	WEEE	Germany	The report describes approaches, measures and regulation structures for the export of used electrical/electronic equipment and waste electrical/electronic equipment to non-EU countries. It aims at optimising the protection of the environment and resource flows.	http://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/3933.pdf
The UK's Harmful Trade in Electronic Waste, 2011	WEEE	UK	Report deals with the issue of illegal trade in electronic waste in UK.	http://www.greencustoms.org/docs/EIA_E-waste_report_0511_WEB.pdf
The Dutch WEEE Flows, 2012	WEEE	The Netherlands	The Dutch POM and WEEE generated data and the potential flows that has been both illegal and legally exported	http://ec.europa.eu/environment/waste/weee/pdf/Report_Dutch_WEEE_Flows%202012%2003%2015.pdf
The EFFACE Project	WEEE	Europe	The overall aim of EFFACE was to assess and propose effective and feasible policy options and recommendations for the EU to combat environmental crime. EFFACE draws on a combination of quantitative and qualitative approaches and data and an in-depth investigation of different types of environmental crime.	http://efface.eu/

Coordinated audit on the enforcement of the European Waste Shipment Regulation.	WEEE	Europe	Cooperative audit on the enforcement of the European Waste Shipment Regulation is based on eight individual national audit reports, carried out by the supreme audit institutions of Bulgaria, Greece, Hungary, Ireland, Poland, the Netherlands, Norway and Slovenia.	http://www.eurosaiwgea.org/Environmental%20audits/Waste/Documents/European%20Waste%20Shipment%20Regulation%20Joint%20report%2010-10-2013%20%28final_%29.pdf
Transboundary shipments of waste in the EU developments 1995-2005 and possible drivers, 2008	WEEE	Europe	Report by EEA. Transboundary shipments of waste in the EU developments 1995-2005 and possible drivers.	http://scp.eionet.europa.eu/publications/Transboundary%20shipments%20of%20waste%20in%20the%20EU/wp/tech_1_2008
Waste Without Borders - Transboundary Shipment of Waste EEA Report, 2009	WEEE	Europe	This report presents data on waste shipments within Europe and out of Europe for both so called notified waste (mostly hazardous and problematic waste) as well as for non-hazardous waste. It presents drivers for shipments but also gaps that still exist in our knowledge as regards some waste streams (such as e-waste) or what influence shipments have on the environment.	http://www.eea.europa.eu/publications/waste-without-borders-in-the-eu-transboundary-shipments-of-waste
Movements of waste across the EU's internal and external borders, 2012	WEEE	Europe	Regulations for transboundary waste shipment.	http://www.eea.europa.eu/publications/movements-of-waste-EU-2012
(W)EEE Mass balance and market structure in Belgium, 2013	WEEE	Belgium	The report is based on a decade's-worth of information gathered by Recupel (a Belgian WEEE take-back and recycling organization) to explore how much of EEE exists in Belgium, where it comes from and where it goes.	http://i.unu.edu/media/unu.edu/news/39523/Recupel-Report-FINAL.pdf
Study on the quantification of waste of electrical and electronic equipment (WEEE) in France, 2013	WEEE	France	Summary: the evaluation of household and similar WEEE arising in 2012 is between 17 and 24kg/inhabitant, with a reference scenario of 20 kg/inhabitant. This is the result of a theoretical evaluation of WEEE arising following the UNU methodology. It describes the model, hypothesis and the data sources which were used for this evaluation. It also gives details of the results the generated by the model, such as the EEE quantities placed on the market and the evaluated volume of WEEE arising.	http://www.ademe.fr/sites/default/files/assets/documents/91257_report-weee-arising-france.pdf
IMPEL – TFS Enforcement Actions III, 2013	WEEE	Europe	The project aims to promote and improve inspections and enforcement of waste shipments through and out of the European Union. Its objectives included carrying out inspections on waste shipments, knowledge exchange and capacity building in order to harmonise the level of enforcement and expertise within the participating 30 countries. For this purpose joint activities were carried out over six inspection periods throughout 2012 (Year 1) and 2013 (Year 2). This report covers the results for the inspection periods in both Years 1 and 2.	http://www.weee-forum.org/sites/default/files/documents/fr-2013-22-enforcement-actions-iii.pdf
Market Flows of Electronic Products & WEEE Materials, 2011	WEEE	UK	A model to estimate EEE products placed on the market and coming to the end of useful life. Summary data findings for 2009-2020.	http://www.wrap.org.uk/sites/files/wrap/MDD036%20Summary%20report%20FINAL.pdf
Small WEEE flows in Czech Republic thesis, 2015	Small WEEE	Czech Republic	This thesis is a comprehensive study describing and quantifying material flows of waste electric and electronic equipment (WEEE) in the Czech Republic; specifically the material flow of small waste electric and electronic equipment (s-WEEE) as well as representative substances	http://www.weee-forum.org/sites/default/files/documents/2015_small_weee_flows_in_czech_republic_thesis_by_milos_polak.pdf

I pirati dei RAEE	WEEE	Italy	The aim of the report is to analyze all the data on the management of WEEE collected, putting in report the effects of the so-called informal management of the entire supply chain, from collection to treatment, and monitoring the effects.(In Italian language)	http://www.legambiente.it/sites/default/files/docs/raee_dossier_i_pirati_dei_raee_02.pdf
Commission Staff Working Paper - Impact Assessment Accompanying document to a legislative proposal and additional non-legislative measures strengthening the inspections and enforcement of Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, 2013	WEEE	Europe	This Impact Assessment report examines options to strengthen the inspections and enforcement of the WSR in order to effectively prevent illegal waste shipments.	http://ec.europa.eu/environment/waste/shipments/pdf/sec_2013_268.pdf
Quantifying waste of electric and electronic equipment in Romania, 2015	WEEE	Romania	This study for the first time in Romania provides evidence that will support the develpoment of more accurate future collection targets and methods of quantifying household WEEE generated. The study also highlights the consumers' WEEE disposal habits, attitudes and activities outside of officially reported collection and recycling.	http://www.ecotic.ro/wp-content/uploads/2015/11/WEEE-Generated-study-2015.pdf
E-waste map, 2015	WEEE	Global	The e-waste world-map provides comparable, country-level data on the amount of electrical and electronic equipment put on the market and the resulting amount of e-waste generated in most countries around the world.	http://www.step-initiative.org/step-e-waste-world-map.html
The Global E-waste monitor, 2014	WEEE	Global	This monitor aims to present the first comprehensive assessment of e-waste volumes, their corresponding impacts and management status on a global scale.	http://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf
INTERPOL Bureau Veritas Waste report, 2009	WEEE	Global	This report shows the volume of WEEE produced & exported from several countries.	http://www.interpol.int/Media/Files/Crime-areas/Environmental-crime/Electronic-Waste-and-Organized-Crime-Assessing-the-Links-2009/
Équipements électriques et electroniques. COLLECTION REPÈRES RAPPORT ANNUEL.	WEEE	France	Annual report of the WEEE management in France (2014)	http://www.ademe.fr/sites/default/files/assets/documents/rapport_annuel_deee_donnees_2014_201603.pdf
Italian's attitude to the recovery and recycling of household appliances, 2013.	WEEE	Italy	A study of Italians' behaviour with regard to separate collection of waste and awareness of the importance of the correct treatment of WEEE.	http://www.ecodom.it/en-us/Studies-Research/The-IPSOS-Study
End-of-life appliances and electronic devices in Italian Households.	WEEE	Italy	Italians seem reluctant to consign WEEE for separate collection: so a very large number of decommissioned electrical and electronic appliances are just sitting in cupboards, lofts or cellars .... why? Doxa performed a survey to identify the most common reasons.	http://www.ecodom.it/en-us/Studies-Research/DOXA-Survey
Household WEEE generared in Italy Country study, 2012	WEEE	Italy	Advantage/disadvantage of the new Directive. Amount of household WEEE generated, put on market. WEEE collection in Italy	http://www.weee-forum.org/system/files/2012_ecodom_weee_arising_in_italy_en.pdf
Centro di coordinamento raee. Rapporto annuale 2014. Ritiro e trattamento dei rifiuti. Da apparecchiature elettriche ed elettroniche in italia., 2014	WEEE	Italy	The annual report of the WEEE Clearinghouse documents the WEEE situation in Italy in 2014	CENTRO DI COORDINAMENTO RAEE RAPPORTO ANNUALE 2014 RITIRO E TRATTAMENTO DEI RIFIUTI DA APPARECCHIATURE ELETTRICHE ED ELETTRONICHE IN ITALIA
I pirati dei RAEE	WEEE	Italy	The aim of the report is to analyze all the data on the management of WEEE collected, putting in report the effects of the so-called	http://www.legambiente.it/sites/default/files/docs/raee_dossier_i_pirati_dei_raee_02.pdf

			informal management of the entire supply chain, from collection to treatment, and monitoring the effects.(In Italian language)	
Cost Calculating Model for Electronics Waste Management	WEEE	Denmark	The focus of this project was to create a cost calculating model for the collection of WEEE at municipal container stations. We developed and tested our model by using it to calculate an estimate for the total cost of collecting WEEE in Denmark."	https://www.wpi.edu/Pubs/E-project/Available/E-project-050612-085500/unrestricted/RenoSam_Final_Report.pdf
Danish WEEE statistics, 2013	WEEE/ batteries/ELV	Denmark	Danish WEEE Statistics	https://www.dpa-system.dk/en/WEEE/ProducerResponsibility/Statistics
Norwegian WEEE statistics 2015	WEEE	Norway	Norwegian WEEE statistics with yearly data	http://www.eeregisteret.no/ShowHTML.aspx?file=Statistikk.htm
Method to measure the amount of WEEE generated : Report to Nordic council's subgroup on EEE waste	WEEE	Norway	In order to evaluate the effectively of collecting schemes, it is necessary to know the quantity of WEEE generated. The purpose for this project has been to establish a method to measure amount of WEEE generated. It has also been developed a practical Excel model to demonstrate the method.	http://norden.diva-portal.org/smash/record.jsf?pid=diva2%3A701677&dswid=4837
INTERPOL Bureau Veritas Waste report 2009	WEEE	UK	Electronic Waste and Organized Crime Assessing the links. Phase II report for the INTERPOL Pollution Crime Working Group May 2009. Volume of WEEE produced & exported from several countries. Profits. Flows of US WEEE (origin & destination countries exporters importers) (WP4). Quote legislation (International US federal & US States) (WP3).Illegal disposal of WEEE in UK; Organized crime/crime group involvement (method structure) crimes associated	http://www.interpol.int/Media/Files/Crime-areas/Environmental-crime/Electronic-Waste-and-Organized-Crime-Assessing-the-Links-2009/
Cost impact of WEEE evidence trading	WEEE	UK	The current UK WEEE market works within a system of opaqueness whereby those that pay the price of compliance generally have very little idea of the actual costs, the infrastructure involved and the margins that are extracted by that infrastructure.This paper has analysed that market based on information supplied by a range of participants, most of who contributed on the basis of commercial confidentiality. The paper has looked initially at the impact of 'ransom' price profiteering in 2007 and then at the cost to producers of the current evidence system."	
Realising the Reuse value of Household WEEE, 2011	WEEE	UK	A summary of a study investigating WEEE being disposed of via Household Waste Recycling Centres and local authority bulky waste collections, the reasons for disposal, its state of repair, and its potential value.	http://www.wrap.org.uk/sites/files/wrap/WRAP%20WEEE%20HWRC%20summary%20report.pdf
Waste Crime: Tackling Britain's Dirty Secret	WEEE	UK	The report analyses the waste crime in UK and it is structured as follows: Evidence regarding the nature, scale and impact of waste crime is presented; The factors that are contributing to a rise in crime are discussed; The business case for action is analysed; and Recommendations for tackling the problem are set out	http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf
Electrical product material composition	WEEE	UK	Overview of updated data within the Market Flows Model of Electronic Products.	http://www.wrap.org.uk/sites/files/wrap/Electrical%20product%20material%20composition%20overview.pdf
Reducing vulnerabilities to crime of the European waste management industry: the research base and the prospects for policy	WEEE	Europe	European Journal of Crime, Criminal Law and Criminal Justice: This paper reviews the literature and then introduces and applies a method to look in greater depth at vulnerabilities that the waste	https://biblio.ugent.be/publication/393314

			management business offers for crime. It suggests that some current and quite contingent developments open up prospects for higher standards and for a reduction in irregularities and illegalities in waste management.	
End of waste criteria, final report, 2009	WEEE	Europe	EC / Institute for Prospective Technological Studies: 2009 report. The objective of this report is to provide a general methodology for defining criteria for when a waste ceases to be a waste. The general methodology can then be applied on specific waste streams resulting in end of waste stream specific criteria. General information of WEEE: presentation with some figures; treatment & recycling (minimum required treatment processes.	http://susproc.jrc.ec.europa.eu/documents/Endofwastecriteriafinal.pdf
Threat Assessment 2013 Environmental Crime in the EU	WEEE	Europe	This in-depth Europol threat assessment follows the assessment presented in the SOCTA and aims to provide a detailed account of the threat of environmental crime in the EU. This threat assessment primarily relies on information provided by Member States and Europol's partners.	https://www.europol.europa.eu/content/threat-assessment-2013-environmental-crime-eu
Exploring tomorrow's organised crime, 2015	WEEE	Europe	This report outlines key driving factors for the evolution of serious and organised crime in the EU. The document describes these key drivers, their impact on serious and organised crime and the potential impact on individual crime areas and organised crime groups (OCGs).	https://www.europol.europa.eu/content/massive-changes-criminal-landscape
Regulations on the export of used electrical and electronic equipment and guidance to test of functionality,	WEEE	Denmark	This guidance document contains information on the rules on shipment of used electric and electronic equipment.	http://mst.dk/service/publikationer/publikationsarkiv/2015/feb/regulations-on-the-export-of-used-electronic/
Analyzing End of Life LCD TV WEEE Flows in Europe, 2013	WEEE	Europe	The study utilizes a Sales-Stock-Lifespan model to estimate future flows of LCD TVs across twenty European countries from 2005 to 2016. Quantification of patterns in the waste stream can help designers and decision makers to anticipate on design consequences in collection and treatment before posing new design changes.	http://www.hitech-projects.com/euprojects/greenelec/deliverables/Analyzing%20End%20of%20Life%20LCD%20TV%20WEEE%20Flows%20in%20Europe%20-%20Final.pdf
Building local capacity to address the flow of e-wastes and electrical and electronic products destined for reuse in selected African countries and augment the sustainable management of resources through the recovery of materials in ewastes, 2010	WEEE	Europe	The aim of the research is to identify the principle pathways of used electronic and electric equipment (EEE) from Europe to West Africa as well as potential leakage points for end-of-life products that are mandatory required under the WEEE directive to undergo sound waste treatment within Europe. The study focuses on sources, destinations and volumes of used EEE exports as well as on the characteristics of the export business. The role of the two ports and regions in focus is also analyzed.	http://www.basel.int/Portals/4/Basel%20Convention/docs/eWaste/E-waste_Africa_Project_Europe.pdf

Table 32: EndNote extract of BATT references

Author(s)	Title	Year	Spatial coverrage
SYDEREP (SYstème DEclaratif des filières REP) - French Battery producer Register	2014 annual report and summary	2015	FRA
Eucobat	Age and types of batteries collected in 6 countries	2016	BEL, DEU, ESP, FRA, NLD, ROU
GRS Batterien,	Annual review 2012	2013	DEU
GRS Batterien,	Annual review 2013	2014	DEU
Eurobat	The availability of automotive lead-based batteries for recycling in the EU		EU
IHS	The availability of automotive lead-based batteries for recycling in the EU - A joint industry analysis of EU collection and recycling rates 2010-2012, prepared by information company IHS	2014	FRAU, DEU, ITA, NLD, ESP, SWE, GBR
SYDEREP - French Battery producer Register	Batteries and Accumulators in France (Piles et accumulateurs)	2016	FRA
EPBA	Battery Compliance Organisations Directory	2015	
Valpak Consulting	Battery Recycling Market Research Study RENEW	2010	GBR
Timothy W. Ellis	Battery Recycling: defining the market and identifying the technology required to keep high value materials in the economy and out of the waste dump	2011	
Sommer, P.	Battery related cobalt and REE flows in WEEE treatment	2015	DEU
Fisher, Karen	Battery Waste Management Life Cycle Assessment	2006	
Alexandre Chagnesa	A brief review on hydrometallurgical technologies for recycling spent lithium-ion batteries	2013	
Informations-Portal-Abfallbewertung,	Charakteristische Zusammensetzung	2016	DEU
Ivano Vassura	Chemical characterisation of spent rechargeable batteries	2009	
	The collection of waste portable batteries in Europe in view of the achievability of the collection targets set by Batteries Directive 2006/66/EC	2015	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ISL, ITA, LTU, LUX, LVA, NLD, POL, PRT, ROU, SRB, SVK, SVN, SWE, UKR, NOR, HRV
Commission of the European Communities,	Commission Decision of 29 September 2008 establishing, pursuant to Directive 2006/66/EC of the European Parliament and of the Council, a common methodology for the calculation of annual sales of portable batteries and accumulators to end-users	2008	
European Commission,	Commission Regulation (EU) No 493/2012 of 11 June 2012 laying down, pursuant to Directive 2006/66/EC of the European Parliament and of the Council, detailed rules regarding the calculation of recycling efficiencies of the recycling processes of waste batteries and accumulators	2012	
Mudgal, Shailendra	Comparative Life-Cycle Assessment of nickel-cadmium (NiCd) batteries used in Cordless Power Tools (CPTs) vs. their alternatives nickel-metal hydride (NiMH) and lithium-ion (Li-ion) batteries	2011	
EPBA	Compliance Blueprint - A guidance document for setting up a Battery Compliance Organisation	2007	
Chancerel, P.	Data availability and the need for research to localize, quantify and recycle critical metals in information technology, telecommunication and consumer equipment	2013	
European Parliament,	Directive 2006/66/EC of the European Parliament and the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC	2006	
European Parliament and the Council of the European Union,	Directive 2013/56/EU of the European Parliament and of the Council of 20 November 2013 amending Directive 2006/66/EC of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators as	2013	

	regards the placing on the market of portable batteries and accumulators containing cadmium intended for use in cordless power tools, and of button cells with low mercury content, and repealing Commission Decision 2009/603/EC		
J. L. FRICKE	The Disposal of Portable Batteries	2003	
Hischier, R.	Does WEEE recycling make sense from an environmental perspective? The environmental impacts of the Swiss take-back and recycling systems for waste electrical and electronic equipment (WEEE)	2005	CHE
ÖcoReCell	Dokumentation 2014 Erfolgsbericht nach den Vorgaben des Batteriegesetzes	2015	DEU
EBRA	EBRA statistics	2016	SWZ, ESP, FRA, POL, BEL, DEU, SWE
EFFACE	EFFACE Project	2016	EU
M.B.J.G. Freitas	Electrochemical recycling of cobalt from cathodes of spent lithium-ion batteries	2007	
Jody, B.J.	End-of-life vehicle recycling: state of the art of resource recovery from shredder residue	2007	USA
Ay, Peter	Entwicklung eines innovativen Verfahrens zur automatisierten Demontage und Aufbereitung von Lithium-Ionen-Batterien aus Fahrzeugen	2012	
European Recycling Platform,	Erfolgskontrolle 2014 für Batterien in Deutschalnd (annual report for batteries in Germany)	2014	DEU
Eucobat	Eucobat survey on number of sorting and recycling plants, location, technology used and capacity	2016	BEL, CZE, DEU, DNK, ESP, FIN, FRA, IRL, ITA, LUX, NLD, PRT, ROU
WRAP	Flow Modelling of Batteries from Mobile Computing Devices	2015	
Eurostat	Generation of Batteries and accumulator wastes (WStatR)	2015	EU28
BEBAT	How the battery life cycle influences the collection rate of battery collection scheme	2014	BEL
Carl Johan Rydh	Impact on global metal flows arising from the use of portable rechargeable batteries	2002	
Eucobat	Key figures	2016	BEL, CZE, DEU, DNK, ESP, FIN, FRA, IRL, ITA, LUX, NLD, PRT, ROU
Miljøstyrelsen	Kortlægning af dagrenovation i Danmark, Med fokus på etageboliger og madspild	2014	DNK
Berger, Roland	The Lithium-Ion Battery Value Chain	2012	
Meisenzahl, Sonja	Marktstudie des Batterieaufkommens und der Batterierückgabe , speziell der Lithium-Batterien	2010	
Defra	National compositional estimates for local authority collected waste and recycling in England	2013	GBR
Althaus, Hans-Jörg	Ökobilanz von Li-Ion Batterien für Elektrofahrzeuge		
Avicenne	The Portable Rechargeable Battery (PRB) market in Europe (2008-2015)	2010	DEU, FRAU, ITA, ESP, BEL, AUT, NLD, CHE, GBR, PRT
Bakas, I.	Present and potential future recycling of critical metals in WEEE	2014	
Giuseppe Granata	Product recovery from Li-ion battery wastes coming from an industrial pre-treatment plant: Lab scale tests and process simulations	2012	
Voncken, J.H.L.	The Rare Earth Elements - An Intoduction	2016	GLO
Tsamis, A.	Recovery of Rare Earths from electronic wastes: An opportunity for high-tech SMEs	2015	
Ferella F.	RECOVERY OF ZINC AND MANGANESE FROM SPENT BATTERIES BY DIFFERENT LEACHING SYSTEMS	2006	
Labie, R.	Recuperation of critical metals in Flanders: Scan of possible short term opportunities to increase recycling	2015	BEL
Bernardes, a. M.	Recycling of batteries: A review of current processes and technologies	2004	
Jo Dewulfa	Recycling rechargeable lithium ion batteries: Critical analysis of natural resource savings	2010	
Jinqiu Xua	A review of processes and technologies for the recycling of lithium-ion secondary batteries	2008	
Eurostat	Sales and collection of portable batteries and accumulators	2016	AUT, BEL, BGR, CZE, DEU, EST, FIN, FRA, HUN,

			IRL, LIE, LTU, LUX, LVA, MLT, POL, PRT, SVK, SVN, SWE
Daniel Assumpcao Bertuola	Spent NiMH batteries: Characterization and metal recovery through mechanical processing	2006	
Xianlai ZENG	Spent rechargeable lithium batteries in e-waste: composition and its implications	2014	
Sullivan, J. L.	Status of life cycle inventories for batteries	2012	
Germano Dorella, Marcelo Borges Mansur	A study of the separation of cobalt from spent Li-ion battery residues	2007	
Magalini, F.	Study On Collection Rates Of Waste Electrical And Electronic Equipment (WEEE), possible measures to be initiated by the Commission as required by Article 7(4), 7(5), 7(6) and 7(7) of Directive 2012/19/EU On Waste Electrical And Electronic Equipment (WEEE)	2016	AUT, BEL, BGR, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, HRV, IRL, ITA, LTU, LUX, LVA, MLT, NLD, NOR, POL, PRT, ROU, SVK, SVN, SWE
Katrin Würfel	Technische Bewertung verfügbarer Verfahrenstechnologien und Lösungsansätze zur Verwertung von Lithiumbatterien und Akkumulatoren	2013	EU28+2
Myrsini Giannouli	Waste from road transport: development of a model to predict waste from end-of-life and operation phases of road vehicles in Europe	2007	EU15
Bigum, M.	WEEE and portable batteries in residual household waste: Quantification and characterisation of misplaced waste	2013	DNK

Table 33: EndNote extract of ELV references

Author(s)	Title	Year	Spatial coverage
Frits M. Andersen	Projection of end-of-life vehicles: Development of a projection model and estimates of ELVs for 2005-2030	2008	EU27
Eurostat	Eurostat Database, Road Transport Statistics	2016	EU27
J. Heiskanen	A look at the European Union's End of Life Vehicle Directive - Challenges of treatment and disposal in Finland	2013	FIN
Jody, B.J.	End-of-life vehicle recycling: state of the art of resource recovery from shredder residue	2007	USA
Joung, Hyun-Tae	Status of recycling end-of-life vehicles and efforts to reduce automobile shredder residues in Korea	2007	KOR
Kummer, B	The new ELV Directive – A major challenge for the 28 EU member countries and the industry	2014	EU
Mallampati, Srinivasa Reddy	Quantitative analysis of precious metals in automotive shredder residue/combustion residue via EDX fluorescence spectrometry	2015	KOR
James Tickner	Measurement of Gold and Other Metals in Electronic and Automotive Waste Using Gamma Activation Analysis	2016	
Vermeulen, I.	Automotive shredder residue (ASR): Reviewing its production from end-of-life vehicles (ELVs) and its recycling, energy or chemicals' valorisation	2011	GLO
Ciacci, Luca	A comparison among different automotive shredder residue treatment processes	2010	
Du, X.	Scarce Metals in Conventional Passenger Vehicles and End-of-life Vehicle Shredder Output	2014	CHE
Du, X.	Quantifying the distribution of critical metals in conventional passenger vehicles using input-driven and output-driven approaches: a comparative study	2015	
EEA	Transboundary shipments of waste in the EU - Developments 1995-2005 and possible drivers	2008	
European Parliament,	Directive 2000/53/EC of the European Parliament and the Council of 18 September 2000 on end-of life vehicles	2000	BEL, DEU, DNK, ESP, FIN, FRA
Myrsini Giannouli	Waste from road transport: development of a model to predict waste from end-of-life and operation phases of road vehicles in Europe	2007	EU15
Habib, K.	Material flow analysis of NdFeB magnets for Denmark: a comprehensive waste flow sampling and analysis approach	2014	DNK
J. Heiskanen	A look at the European Union's End of Life Vehicle Directive - Challenges of treatment and disposal in Finland	2013	FIN

Hiratsuka, Jiro	Current status and future perspectives in end-of-life vehicle recycling in Japan	2013	
IHS	The availability of automotive lead-based batteries for recycling in the EU - A joint industry analysis of EU collection and recycling rates 2010-2012, prepared by information company IHS	2014	FRAU, DEU, ITA, NLD, ESP, SWE, GBR
Jody, B.J.	End-of-life vehicle recycling: state of the art of resource recovery from shredder residue	2007	USA
Joung, Hyun-Tae	Status of recycling end-of-life vehicles and efforts to reduce automobile shredder residues in Korea	2007	KOR
Labie, R.	Recuperation of critical metals in Flanders: Scan of possible short term opportunities to increase recycling	2015	BEL
Mallampati, Srinivasa Reddy	Quantitative analysis of precious metals in automotive shredder residue/combustion residue via EDX fluorescence spectrometry	2015	KOR
Merz, C.	Import und Export von Gebrauchtfahrzeugen in Europa	2012	DEU
Mueller, S. R.	A geological reconnaissance of electrical and electronic waste as a source for rare earth metals	2015	
Rademaker, J. H.	Recycling as a Strategy against Rare Earth Element Criticality: A Systemic Evaluation of the Potential Yield of NdFeB Magnet Recycling	2013	EUR
Sakai, Shin-ichi	End-of-life vehicle recycling and automobile shredder residue management in Japan	2007	
Sander, K.	Separation of components and materials from end-of-life vehicles aiming at the recovery of critical metals	2014	DEU
Singh, Jiwan	Recovery of precious metals from low-grade automobile shredder residue: A novel approach for the recovery of nanozero-valent copper particles	2016	KOR
Vermeulen, I.	Automotive shredder residue (ASR): Reviewing its production from end-of-life vehicles (ELVs) and its recycling, energy or chemicals' valorisation	2011	GLO
Voncken, J.H.L.	The Rare Earth Elements - An Intoduction	2016	GLO
Widmer, R.	Scarce Metals in Conventional Passenger Vehicles and End-of-Life Vehicle Shredder Output	2015	CHE
Yano, Junya	Dynamic flow analysis of current and future end-of-life vehicles generation and lead content in automobile shredder residue	2013	

Annex 3 Country case studies – supplementary information

WEEE Country case study – CWIT report

WEEE in waste bin data

Table 34: Raw data from the literature review for WEEE in waste bin

Country	Year	Amount	Reported unit	Source
BE	2010	1.54	kg/inhabitant	(Wielenga, 2013)
BG	2009	0.0	% in residual waste	(Dvoršak S. et al., 2011)
CH	2012	10 000	ton	(Steiger, 2014)
CZ	2010	24 400	ton	(Polak, N/A)
DE	2012	0.6 1.4	% in residual household waste in Bayern kg/inh in Hamburg	(Bayerisches Landesamt für Um welt, 2012) (N/A, Hausmüllmenge und Hausmüllzesammensetzung in der Freien Hansestadt Hamburg im Jahr 2012, 2013)
DK	2010	29	g per household per week	(Bayerisches Landesamt für Um welt, 2012)
ES	2010	0.12 0.34	% in residual household waste % in Refuse derived fuel	(Montejo, 2011)
EE	2011	1.8	% in residual household waste	(N/A, 2013)
FR	2007	1.0	kg / inhabitant	(Monier, 2013)
UK	2010	194	kt	(Bridgwater, 2010) (WRAP, 2011)
IT	2010	per product	% in households disposing WEEE in waste bin	(Magalini, 2012)
NL	2010	2.3	kg/inhabitant	(Huisman, 2012)
PT	2007	16 000	ton	(Bayerisches Landesamt für Um welt, 2012)
RO	2009	0.1	% in residual waste	(Dvoršak S. et al., 2011)
SE	2010	0.46%	% in residual waste	(Avfall Sverige, 2013)

If the reported unit is in ton, it is converted to kg/inh using the number of inhabitants. If the data is available as a percentage of residual household waste, it is multiplied with the total amount of residual household waste from households and services. The latter data is obtained from the Waste Statistics Regulation by extracting waste category W101 (household and similar wastes) for households and the service sector (except wholesale of waste and scrap) from Eurostat's database "Eurobase". The amount of refuse-derived fuel is obtained from the same database and revealed using the total from waste category W103 (sorting residues). The Italian data is surveyed among households. This data is multiplied with total WEEE generated data from both businesses and households.

The result of the analysis for waste bin data is displayed in Table 35. The information below will be complemented with new studies identified.

Table 35: Raw data from literature review for WEEE in waste bin and estimates for other countries

Income level	Country	Population (1000)	Year	Literature (kg/inh)	Literature (ton)	Estimate (in tons based on % of WEEE gen.)	Estimate (in tons, based on kg/inh.)
High	AT	8,466	2012			12,929	11,095
	BE	10,840	2010	1.53	16,632		
	CH	8,002	2012	1.25	10,000		
	DE	81,917	2012	1.40	114,684		
	DK	5,535	2010	0.63	3,488		
	FI	5,426	2012			7,656	7,111
	FR	61,795	2007	1.00	61,795		

	UK	62,262	2010	3.12	195,000		
	IE	4,585	2012			6,173	6,009
	LU	529	2012			582	582
	NL	16,615	2010	2.30	38,180		
	NO	5,038	2012			7,840	6,602
	SE	9,416	2010	1.23	11,550		
Middle	CY	872	2012			1,208	1,221
	CZ	10,507	2010	2.32	24,422		
	ES	46,073	2010	0.79	47,922		
	EL	11,299	2012			15,184	15,826
	IT	60,821	2012	1.01	42,922		
	MT	417	2012			523	584
	PT	10,599	2007	1.51	16,000		
	SK	5,439	2012			5,277	7,618
	SI	2,055	2012			2,662	2,878
Low	BG	7,505	2010	0.00	0		
	EE	1,340	2011	3.76	5,041		
	HR	4,402	2012			4,934	6,099
	HU	9,962	2012			12,792	13,803
	LT	3,008	2012			3,526	4,168
	PL	38,896	2012			39,378	53,892
	RO	21,484	2009	0.39	8,475		

Table 36: Weight percentage of product categories of the WEEE in residual waste

WEEE category (WEEE Directive)	Average of NL, UK, DK
Temperature exchange equipment	0.2%
Screens	12%
Lamps	4%
Large Equipment	1.3%
Small Equipment	59%
Small IT	24%

WEEE in metal scrap

Table 37: Weight percentage of product categories of the WEEE in ferrous metal scrap

WEEE category (WEEE Directive)	Average of NL, UK, FR and BE
Temperature exchange equipment	8%
Screens	3%
Lamps	0%
Large Equipment	62%
Small Equipment	20%
Small IT	6%

From the available studies (Huisman, 2012), (Magalini, 2012), (Monier, 2013), (Polak, N/A) (Wielenga, 2013), and (WRAP , 2014), it is found that on average 8% of the WEEE is temperature exchange equipment, 3% screens, 0% lamps, 62% large equipment, 20% small equipment and 6% small IT equipment as displayed in Table 37. For the individual countries with data available, The Netherlands, Belgium, France, Czech Republic and United Kingdom, the specific findings are used. For all other countries, the above average is used to determine WEEE in these particular flows. However, the result should be used with a lot of caution, and are merely indications on amounts, as those compositions of WEEE in metal scrap can differ significantly between countries.

The transboundary movement of WEEE, mixed in metal scrap, is estimated by using the same composition (2 weight% of WEEE in ferrous metal scrap) and the relevant trade statistics. The exports from ferrous metal scrap from the EU28 are 17 Mt in 2010. When applying the same 2%, this roughly indicates that 400 kt of WEEE is exported in mixed metal scrap. The average price of the exported ferrous metal scrap is 0.31 euro/kilogram. Thus the 400 kt resembles a value of approximately 124 million euro. The largest export markets from the EU28 region are United Kingdom ± 100 kt, Netherlands: ± 57 kt, Belgium: ± 47 kt, Germany: ± 27 kt, Romania: ±44 kt.

Table 38: Collected WEEE in Germany in 2014 (EAR, 2016)

Collection group	B2C		Public waste management authority
	Output (coordinated via Stiftung ear) (t)	Output (take-back systems from producers) (t)	Output (t)
1	6.454	16.945	94.054
2	85.484	7.907	25.292
3	45.115	1.847	184.625
4	2.595	3.767	110
5	11.343	2.435	86.701
Total	150.991	32.901	390.782

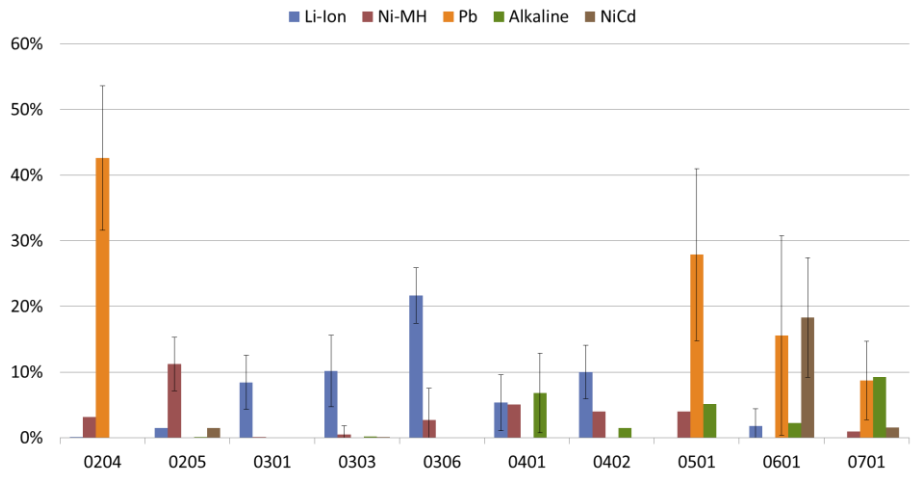

Figure 9: Ratio of battery weight and product weight per UNU-Key from WEEE treatment trials in Germany (TUB, 2014-2016)

Table 39: Batteries collected and reported by German compliance scheme for 2014 (data from annual reports)

Compliance scheme:			GRS	ÖcoReCell	CCR Rebat	ERP
	Type groups	System	Collected (t)	Collected (t)	Collected (t)	Collected (t)
Primary batteries	Round cells	ZnC/Zn-air	1892	99	757	170
		AlMn	10226		1303	
		Li	105	7	-	3
	Button cells	AgO	150	0	-	-
		AlMn		1	-	-
		Zn-air		0	-	-
		Li		1	-	1
Secondary cells	Round cells	Li-Ion	556	49	489	65
		NiMH	526	4	24	-
		NiCd	856	0	366	192
	Button cells	NiCd	-	0	-	-
		Li-ion		0	-	-
		NiMH		0	-	65
	Small lead batteries		706	0	470	105

Sources

[1] destatis Bericht über die Abfallentsorgung in Deutschland im Jahr 2012 (https://www.destatis.de/DE/Publikationen/Thematisch/UmweltstatistischeErhebungen/Abfallwirtschaft/Abfallentsorgung2190100127004.pdf?__blob=publicationFile)
[2] Jahresbericht über die Altfahrzeug-Verwertungsquoten in Deutschland im Jahr 2012 (http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Abfallwirtschaft/jahresbericht_altfahrzeug_2012_bf.pdf)
[3] Jahresbericht über die Altfahrzeug-Verwertungsquoten in Deutschland im Jahr 2009 (http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Abfallwirtschaft/jahresbericht_altfahrzeug_2009_bf.pdf)
[4] ICCT (International Council on Clean Transportation), European Vehicle Market Statistics – Pocketbook 2012 (http://www.theicct.org/sites/default/files/publications/Pocketbook_2012_opt.pdf)

Abbreviations

KBA Kraftfahrtbundesamt (Federal Office for Motor Vehicles)
AS Außenhandelsstatistik (foreign trade statistics)
DF disassembly facilities

Table 40: ELV country case study supplementary data

No.	Flow/stock/other	Value	Unit	Source/original source	Assumptions	Comments
1	vehicles registered in Germany (car fleet)	51.735.177	-	[2], Tab. 4 / KBA	Appointed date: 01.01.2012	
	vehicles registered in Germany (car fleet)	62.082.214	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
	Average mass passenger car in 2012	1.2	Mg	NK / [2], p. 9 and [4], p. 48	Value has no empirical source and is based on the average ELV mass in 2012 (0.998 Mg) and the average pc mass in Germany in 2011 (1.484 Mg)	No average passenger car mass available.
	passenger car fleet	42.927.647	-	[2], Tab. 4 / KBA	Appointed date: 01.01.2012	
	passenger car fleet	51.513.176	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
2	deregistration (final and temporary)	8.020.227	-	[2], Tab. 4 / KBA		
2	deregistration (final and temporary)	9.624.272	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
	deregistration (final)	3.200.000	-	[2], Tab. 4 / KBA	40 % of total deregistrations, based on last percentage in 2006, before deregistration system changed	
	deregistration (final)	3.840.000	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
3	reregistrations	4.820.227	-		60 % of total deregistrations minus export used cars to EU and non-EU	
3	reregistrations	5.784.272	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
8	ELV missing (calc.)	2.711.180	-		based on the assumption that 40 % of total degistrations are final and no ELV are exported (only used cars)	Calculated: deregistration (fin.+temp.) – deregistration (fin.)
8	ELV missing (calc.)	3.253.416	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	

	average ELV mass 2012	0,998	Mg	[2], p. 9		Nationwide, yearly inquiry, requesting all certified disassembly facilities to submit data on ELV accepted and treated
	average ELV mass 2009	0,898	Mg	[3], p. 9		Nationwide, yearly inquiry, requesting all certified disassembly facilities to submit data on ELV accepted and treated
4	export used cars EU MS (EU26)	959.251	-	[2], Tab. 5		
4	export used cars EU MS (EU26)	1.151.101	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
	export used cars non-EU MS total	391.044	-	[2], Tab. 6		
	export used cars non-EU MS total	469253	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
5	export used cars CH and NO	43.888	-	[2], Tab. 6		
5	export used cars CH and NO	52.666	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
6	export used cars non-EU exc. CH and NO	347.156	-	[2], Tab. 6		
6	export used cars non-EU exc. CH and NO	416.587	Mg		Calculated, using a theoretical average mass of passenger cars in Germany in 2012	
7	export ELV	0	-	[2], KOM-table 3 + footnote a) to KOM-table 3/ KBA and AS		According to "transboundary shipment of waste subject to approval" [UBA, http://www.umweltbundesamt.de/sites/default/files/medien/377/dokumente/egabfstatvexport2012.pdf]
	export depolluted and dismantled car bodies	28.753	-	Calc. with [2], KOM-table 3	calculated with an average car body mass of 802 kg ([2], p. 26, footnote 21	
	export depolluted and dismantled car bodies	23.050	Mg	[2], KOM-table 3		
15	export car bodies to recycling	18.440	Mg	[2], KOM-table 3	Recovery: 85% Recycling: 80 % According to requ. of 2000/53/EC	
16	export car bodies to recovery	1.153	Mg	[2], KOM-table 3	Recovery: 85% Recycling: 80 % According to requ. of 2000/53/EC	
17	export car bodies to disposal	3.458	Mg	[2], KOM-table 3	Recovery: 85% Recycling: 80 % According to requ. of 2000/53/EC	
	export components	4.300	Mg	[2], KOM-table 3		
	export components to recycling	3.851	Mg	[2], KOM-table 3		
	export components to disposal	3	Mg	[2], KOM-table 3		
	export components to recovery	449	Mg	[2], KOM-table 3		
	export light ASR	87	Mg	[2], KOM-table 3		
	export light ASR to recycling	34	Mg	[2], KOM-table 3		
	export light ASR to disposal	14	Mg	[2], KOM-table 3		
	export light ASR to recovery	53	Mg	[2], KOM-table 3		
10	leftover from 2009 (car-scrapping bonus)	55.000	-	[2], fig. 2		

10	leftover from 2009 (car-scrapping bonus)	49.390	Mg	Calc. with [2], fig. 2	Average ELV mass of 898 kg in 2009, [3] see above	Available data is the number of 55,000 ELV left from 2009. This number was multiplied with the average ELV mass from 2009 to get a value in Mg. Not clear, if 55,000 is just a rounded/approximate number.
9	input ELV in disassembly facilities 2012	489.800	Mg	[1], p. 15		Nationwide, yearly inquiry, requesting all certified disassembly facilities to submit data on ELV accepted and treated
	total output disassembly facilities (destatis)	525.100	Mg	[1], p. 109		Nationwide, yearly inquiry, requesting all certified disassembly facilities to submit data on ELV accepted and treated
11	output dismantling to reuse	26.504	Mg	[2], KOM-table 1		
12	output dismantling to recycling	57.284	Mg	[2], KOM-table 1		
13	output dismantling to energy recovery	7.338	Mg	[2], KOM-table 1		
14	output dismantling to disposal	1.454	Mg	[2], KOM-table 1		
18	total output disassembly facilities to shredder (calc)	432.520	Mg	Calc. with [2], KOM-table 3	Calc. with output fractions of DF	
19	loss car bodies before shredder (calc)	82.790	Mg	Calc. with [2], KOM-table 3 and [1], p. 112	difference between total output DF (calc) and shredder input from GER	
	Input shredder total	14.466.200	Mg	[1], p. 112		
	shredder facilities shredding car bodies	62	-	[1], p. 112		
	Input shredder (shredding car bodies)	4.300.000	Mg	[2], fig. 6		Value originally from unpublished destatis data [pers. comm. with UBA, Regina Kohlmeyer]
	Input car bodies to shredder	548.410	Mg	[1], p. 112		
20	input car bodies to shredder from GER	515.310	Mg	[1], p. 112		
21	Input car bodies to shredder IMPORT	33.100	Mg	[1], p. 112		
	Output Shredder light ASR from ELV	137.103	Mg	Calc. with [1], p. 112 and [2]	Light ASR makes up for 25 m.-% of car body input to shredder ([2], p. 10)	
	Output Shredder light ASR	409.000	Mg	[2], fig. 7		Value originally from unpublished destatis data [pers. comm. with UBA, Regina Kohlmeyer]
23	light ASR recycling	69.922	Mg	[2], fig. 7	percentage from shredder facility reports	
24	light ASR energy recovery	61.696	Mg	[2], fig. 7	percentage from shredder facility reports	
25	light ASR disposal	5.484	Mg	[2], fig. 7	percentage from shredder facility reports	
22	Output shredder ferrous metals	229.993	Mg	[2], p. 18	relation ferrous : non-ferrous is 63 % : 10.3 % ([2], p. 18)	
25	Output shredder non-ferrous metals	37.507	Mg	[2], p. 18	relation ferrous : non-ferrous is 63 % : 10.3 % ([2], p. 18)	

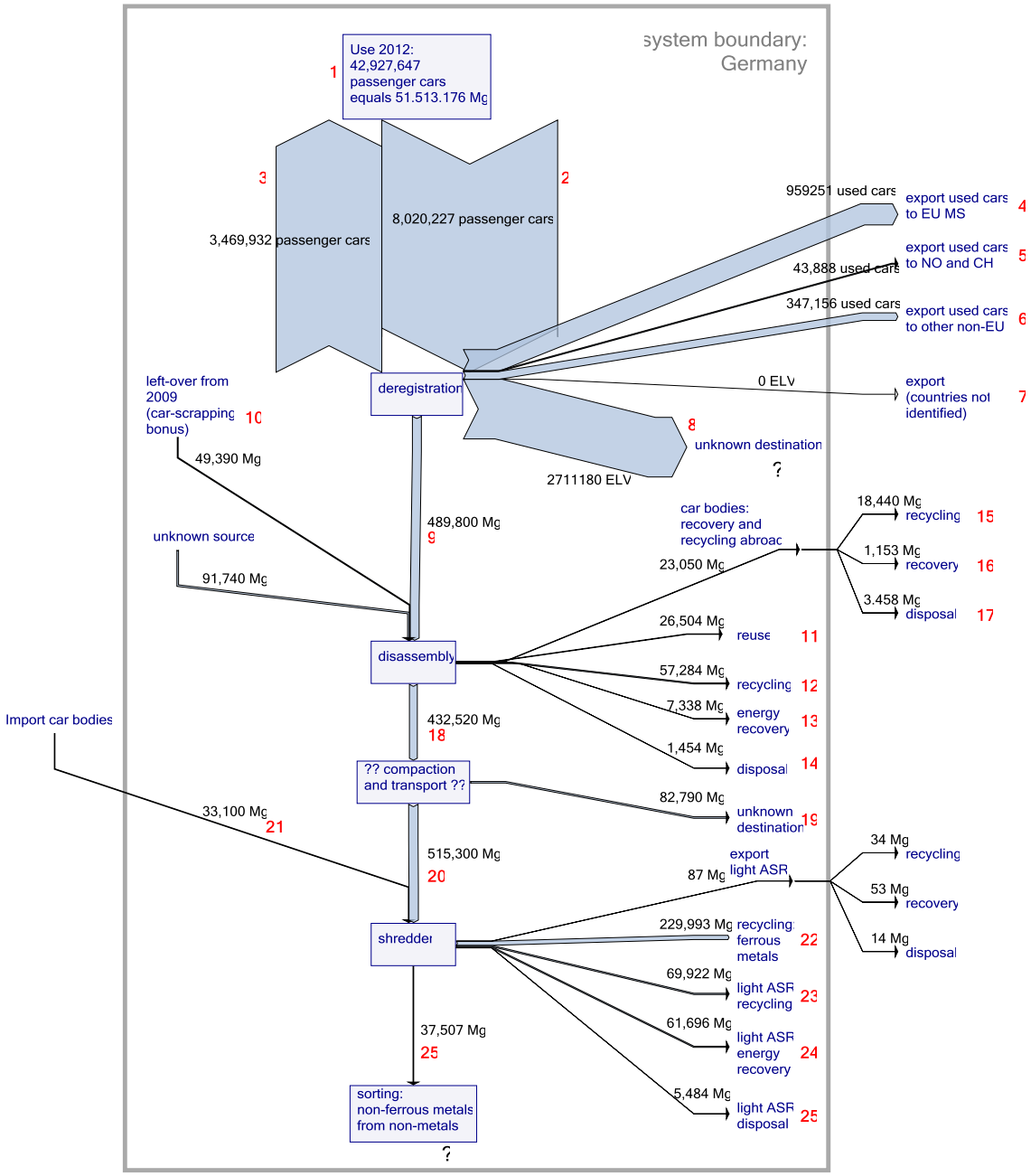

Figure 10: ELV country case study for Germany 2012

Annex 4 Supplementary information

Table 41: Waste operations 'wst_oper' codes on Eurostat and its use for different waste groups

Code	Label	WEEE	BATT
TRT	Total waste treatment		X
COL	Waste collected	X	X
COL_HH	Waste collected from households	X	
COL_OTH	Waste collected from other sources	X	
DSP_L	Landfill / disposal (D1-7, D12)		X
DSP_D	Deposit onto or into land		X
DSP_O	Land treatment and release into water bodies		X
INC	Incineration / disposal (D10)		X
RCV	Recovery	X	
RCV_E	Incineration / energy recovery (R1)		X
RCV_NE	Recovery other than energy recovery		X
RCV_B	Recovery other than energy recovery – backfilling		X
RCV_O	Recovery other than energy recovery – except backfilling		X
RCV_REU	Total recycling and reuse	X	
REU	Reuse	X	
TRT_NAT	Treatment in Member State	X	
TRT_OEU	Treatment in another Member State of the EU	X	
TRT_NEU	Treatment outside the EU	X	

Table 42: List of Key Figures categories for POM

10 WEEE cat (Directive)	KF category	Description of KF category
	1a	Large household appliances (ex C&F's)
	1b	Cooling & freezing appliances (incl. air con.)
1	1	Total LHHA + C&F
2	2	Total Small Household Appliances
	3a	IT&T equipment (excluding monitors)
	3b	All monitors - IT&T
3	3	Total IT&T equipment + monitors
	4a	Consumer equipment (excluding TV's)
	4b	All TV's – CE
4	4	Total CE + Screens + PV
	5a	Luminaires
	5b	Lamps
5	5	Total Lamps & Luminaires
6	6	Electrical and electronic tools
7	7	Toys, leisure and sports equipment
8	8	Medical devices
9	9	Monitoring and control instruments
10	10	Automatic dispensers
	PV	Photovoltaic panels
	Other	"Other" WEEE

Table 43: Correlation of WEEE Directive categories and KF categories

10 WEEE cat (Directive)	KF category	Description of KF category
1	A	Large household appliances (ex C&F's)
1	B	Cooling & freezing appliances (incl. air con.)
3	C	IT&T equipment (excluding monitors)
2, 3, 4, 5, 6, 7, 8, 9, 10	D	OWAB (mix of small equipment and other categories not included in other groups)
3, 4	E	Screens
5	F	Lamps
4	G	PV panels

Table 44: Reported WEEE categories on Eurostat

Code	Label
EE_LHA	Large household appliances
EE_SHA	Small household appliances
EE_ITT	IT and telecommunications equipment
EE_CON	Consumer equipment
EE_LIT	Lighting equipment
EE_GDL	Gas discharge lamps
EE_EET	Electrical and electronic tools
EE_TLS	Toys, leisure and sports equipment
EE_MED	Medical devices
EE_MON	Monitoring and control instruments
EE_ATD	Automatic dispensers

Figure 11 Reported mass of batteries recycled from the German compliance scheme GRS (Gemeinsames Rücknahmesystem Batterien, 2016)

Mass of batteries recycled / § 15 (1) No. 3, No. 5 and No. 6 Batteries Act
Qualitative and quantitative results of recycling and disposal

Battery system	AlMn/ZnC Zn-air	Battery mix	Li/Li-Ion	Button cells	NiMH	NiCd	Small lead batteries	Sum
	t	t	t	t	t	t	t	t
Products according to information from recycling facilities	**7,642**	**3,472**	**541**	**63**	**354**	**717**	**529**	**13,318**
Zinc and zinc compounds	1,825	579	–	3	–	–	–	2,407
Ferro-manganese	1,054	328	–	23	–	–	–	1,405
Steel alloys (containing iron/nickel)	1,359	805	84	5	299	408	–	2,960
Mercury and mercury compounds	–	< 1	–	< 1	–	–	–	1
Lead and lead compounds	–	123	–	–	–	–	406	529
Cadmium and cadmium compounds	–	46	–	–	–	105	–	151
Other metals (aluminium, cobalt, copper, etc.)	7	32	49	2	1	–	–	91
Carbon	299	43	44	< 1	–	13	–	400
Plastics for recycling	57	19	2	< 1	–	1	29	109
Slag for recycling	1,356	758	37	–	–	–	–	2,151
Other residue for recycling	1,014	70	192	5	3	–	73	1,357
Spent water/exhaust air	657	413	24	10	13	55	–	1,172
Plastics for disposal	–	50	–	–	38	–	21	109
Slag/other residue for disposal	14	206	109	12	–	135	–	476
Mass of waste batteries sent abroad for recycling	603	–	205	–	–	271	0	1,079

As in previous years, the figure 'for recycling' is based on the information for material and other recycling.
The calculation of battery recycling efficiencies is based solely on information for 'material recycling'.

Table 45 Participating geological surveys and similar organisations

MIN data sources	
Geological surveys, participant in ProSUM	
	Bureau de Recherches Géologiques et Minières
	Czech Geological Survey
	EuroGeoSurveys
	Geological Survey of Denmark and Greenland
	Geological Survey of Slovenia
	Geological Survey of Sweden
Geological Surveys, participating under EGS umbrella	
	Bundesanstalt für Geowissenshaften und Rohstoffe, Germany
	Croatian Geological Survey, Croatia
	Geological Survey Department, Cyprus
	Geological Survey of Ireland, Ireland
	Geological Survey of Norway, Norway
	Geological Survey of the Netherlands, Netherlands
	Institute of Geology and Mineral Exploration, Greece
	Instituto Geologica y Minero de Espana, Spain
	Laboratoria Nacional de Energia e Geologia, Portugal
	Polish Geological Institute, Poland
	Geoinform of Ukraine, Ukraine
Universities and other organisations	
	Helmholtz Institute Freiberg, Germany
	Uppsala University, Sweden
Geological Surveys, on the mailing list	
	Geological and Geophysical Institute of Hungary, Hungary
	Geological Survey of Finland, Finland
	State Geological Institute of Dionys Stur, Slovakia