COUNCIL OF THE EUROPEAN UNION

Brussels, 13 March 2014 (OR. en)

7701/14
ADD 5

Interinstitutional File:
2014/0059 (COD)

WTO 101
COMER 87
RELEX 228
UD 83
CODEC 782

COVER NOTE

From:	Secretary-General of the European Commission, signed by Mr Jordi AYET PUIGARNAU, Director
date of receipt:	6 March 2014
To:	Mr Uwe CORSEPIUS, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2014) 53 final - PART 3/7
Subject:	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT PART 3 (First part of Annex III to the Impact Assessment) *Accompanying the document* Proposal for a Regulation of the European Parliament and of the Council setting up a Union system for supply chain due diligence self-certification of responsible importers of tin, tantalum and tungsten, their ores, and gold originating in conflict-affected and high-risk areas

Delegations will find attached document SWD(2014) 53 final - PART 3/7.

Encl.: SWD(2014) 53 final - PART 3/7

EUROPEAN
COMMISSION

Brussels, 5.3.2014
SWD(2014) 53 final

PART 3/7

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

PART 3 (First part of Annex III to the Impact Assessment)

Accompanying the document

Proposal for a Regulation of the European Parliament and of the Council

setting up a Union system for supply chain due diligence self-certification of responsible importers of tin, tantalum and tungsten, their ores, and gold originating in conflict-affected and high-risk areas

{COM(2014) 111}
{SWD(2014) 52}

ANNEX III

EUROPEAN COMMISSION

Directorate-General for Trade

Assessment of due diligence compliance cost, benefit and related effects on selected operators in relation to the responsible sourcing of selected minerals

FINAL REPORT

Reutlingen / Vienna

September 25, 2013

iPoint-systems gmbh

Ludwig-Erhard-Str. 52-56
72760 Reutlingen
Germany

Tel. +49 (0) 7121 144 89-60
Fax. +49 (0) 7121 144 89-89
info@ipoint-systems.com
www.ipoint-systems.com

Managing Director
Jörg Walden
Trade register
HRB 353830

Trade register Reutlingen
VAT-ID.No. DE 813135964
DUNS Nummer
314467197

Authors:

Katie Böhme

Paulina Bugajski-Hochriegl

Maria Dos Santos

INDEX

TABLES

FIGURES

List of Abbreviations

3T	Tin, Tantalum and Tungsten
3TG	Tin, Tantalum, Tungsten (3T) and Gold (G)
AIAG	Automotive Industry Action Group
ASM	Artisanal and Small-scale Mining
CFS	Conflict Free Smelter program
DFA	Dodd-Frank Act
DRC	Democratic Republic of the Congo
EIA	Economic Impact Assessment
EICC	Electronic Industry Citizenship Coalition
GeSI	Global e-Sustainability Initiative
HS	Harmonized Commodity Description and Coding System (HS) of tariff nomenclature
IPC	Association Connecting Electronics Industries
iPCMP	iPoint Conflict Minerals Platform
ISIC	International Standard Industrial Classification
ITRI	International Tin Research Institute
LSM	Large-scale mining
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances
SEC	U.S. Securities and Exchange Commission
SMEs	Small and medium-sized enterprises
UNGoE	UN Group of Experts on the Democratic Republic of Congo
WCO	World Customs Organization
WGC	World Gold Council

Abstract

The responsible sourcing of minerals from conflict-affected and high-risk areas has become a matter of interest for a wide range of stakeholders. This study aims at identifying and quantifying compliance costs and potential benefits for operators subject to a possible responsible sourcing initiative of the European Union. The focus lies on due diligence, as defined in the OECD *Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas*, performed along the supply chains for four minerals: tantalum, tin, tungsten, and gold. The first part of the study provides a description and visualization of the most important affected industry sectors, supply chain actors, applications, products, and economic data such as production, supply and demand per mineral. Part two presents the results of a targeted online survey, conducted with users of the iPoint Conflict Minerals Platform (iPCMP), to obtain information about due diligence compliance costs in relation to the responsible sourcing of the above-mentioned "conflict minerals".

Résumé

La gestion responsable des chaînes d'approvisionnement en minerais en provenance de zones de conflit ou à haut risque est devenue un enjeu pour de nombreuses parties prenantes. Cette étude a pour but d'identifier et d'évaluer les coûts de mise en conformité et les avantages potentiels pour les opérateurs soumis à une éventuelle initiative de l'Union européenne en matière d'approvisionnement. Elle se concentre sur le devoir de due diligence tel que défini dans le *Guide OCDE sur le devoir de diligence pour des chaînes d'approvisionnement responsables en minerais provenant de zones de conflit ou à haut risque* et sur sa mise en œuvre le long de la chaîne d'approvisionnement de quatre minerais : le tantale, l'étain, le tungstène et l'or. La première partie de l'étude décrit et présente les principaux secteurs de l'industrie concernés, les acteurs de la chaîne d'approvisionnement, les applications, les produits et les données économiques, notamment relatives à la production, à l'approvisionnement et à la demande pour chacun des minerais. La seconde partie présente les résultats d'une enquête auprès des utilisateurs de *iPoint Conflict Minerals Platform (iPCMP)* en vue d'obtenir des informations concernant les coûts de mise en conformité du processus de diligence en matière d'approvisionnement responsable des « minerais qui alimentent les conflits » susmentionnés.

1 Introduction

The responsible sourcing of minerals from conflict-affected and high-risk areas has only recently become a matter of interest for a wide range of stakeholders, including governmental authorities, global companies, non-governmental organisations, and consumers. The link between the illegal exploitation of natural resources in conflict zones and the financing of bloody conflict has been known for some time. However, the numerous conflicts in the African Great Lakes Region, which started in the mid-1990s and were and are still financed to a certain extent by certain minerals known as “Conflict Minerals”, has only in recent years become a matter of public interest.

The term “Conflict Minerals” refers to four mineral ores, or their derivatives, originating in conflict-affected and high-risk areas, the exploitation and trade of which are helping to finance extremely violent conflicts.[1] They include: columbite-tantalite (the ore from which the metal tantalum is extracted), cassiterite (the chief ore needed to produce tin), wolframite (an important source of the element tungsten), and gold (hereafter referred to as 3TG).

Table 1: Conflict Minerals

Ore	Metal /Chemical Symbol
Columbite-Tantalite	Tantalum / Ta
Cassiterite	Tin / Sn
Wolframite	Tungsten / W
Gold	Gold / Au

All four Conflict Minerals have a high economic importance and play a critical role in the manufacturing of essential components in a wide range of industry sectors. If the 3TG are sourced in conflict-affected and high-risk areas, they are frequently mined under severe working conditions by artisanal and small-scale miners (ASMs). The work of the poverty-driven artisanal and small-scale miners is, on the one hand, characterised by manual and informal operations on a very small national economy scale, on the other hand it contributes to a high amount of mineral production. ASM is prone to environmental pollution, child

[1] DFA 2010, SEC. 1502 (a).

labour, and worker health and safety. Mining sites in conflict areas are an important source for financing armed groups. Controlling these sites through informal taxation of minerals extraction and trade means gaining access to international demand over the production of the Conflict Minerals. This makes the mining sites strategically important, and exposes ASM workers and their families to recurrent violence and severe violations of human rights.

In order to avoid that violent conflicts perpetuate and that minerals mined in conflict-affected and high-risk areas remain a cost-efficient source for downstream manufacturing global companies, the UN Group of Experts on the Democratic Republic of Congo (UNGoE) developed the concept of due diligence (UNGoE, 2010). This has been taken up by the Organization for Economic Cooperation and Development (OECD) and published on 25 May 2011 under "OECD Due Diligence Guidance for responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas" (hereafter referred to as "OECD Due Diligence Guidance"). In this publication, "due diligence" is understood as an on-going, proactive and reactive process in which companies take reasonable steps and make efforts in good faith to identify and respond to the risk of contributing to conflicts. The OECD Due Diligence Guidance, which is voluntary in nature and has a global scope,[2] provides a five-step due diligence framework that can be integrated into corporate management systems:

1. Establish strong company management systems.
2. Identify and assess risks in the supply chain.
3. Design and implement a strategy to respond to identified risks.
4. Carry out independent third-party audit of supply chain due diligence at identified points of the supply chain.
5. Report on supply chain due diligence.[3]

Several industry-driven and mineral-based initiatives, together with the U.S. Conflict Minerals legislation, have taken the OECD Due Diligence Guidance as a relevant base-line case. On August 22nd, 2012, the United States of America implemented the first Conflict Minerals law, Section 1502 of the U.S. Dodd-Frank Wall Street Reform Act (hereafter referred to as "DF 1502"). DF 1502 requires that affected

[2] According to the Conflict Barometer of the Heidelberg Institute, approximately 20% of 396 global conflicts counted in 2012 were linked to natural resources (HIIK, 2012). Therefore, the OECD Due Diligence Guidance does not focus on a solitary region, but rather leaves the geographical scope open to further interpretation.

[3] Cf. OECD 2013b, p. 17-19.

companies listed on the U.S. stock exchange declare their use of the four Conflict Minerals tin, tungsten, tantalum and gold, and any other mineral or its derivatives determined by the Secretary of State to be financing conflict in the Democratic Republic of the Congo (DRC) or an adjoining country.[4] The first Conflict Minerals disclosure reports have to be filed on May 31st, 2014. In order to prepare these, U.S. companies are passing the reporting requirements through their global supply chains, so that it is estimated that 278.000 companies worldwide are going to be affected by DF 1502.[5]

Tracking the flow and the trade of minerals through global markets presents many difficulties for global companies. All Conflict Minerals are listed commodities and are thus traded globally. As the majority of trades are executed through direct contracts between sellers and buyers, neither seller nor buyer may be interested in divulging details of commercial transactions. Furthermore, metals can come from mining sources, via recycled production or from inventories. All sources can be mixed together at various stages of production, obscuring the mineral´s origin and making its traceability complex if not impossible. As a result of globalization, supply chains consist of complex multi-tiers, with many outsourced processes and - both upstream and downstream in the supply chain - many actors are not known to the end-producing Original Equipment Manufacturers (OEMs).

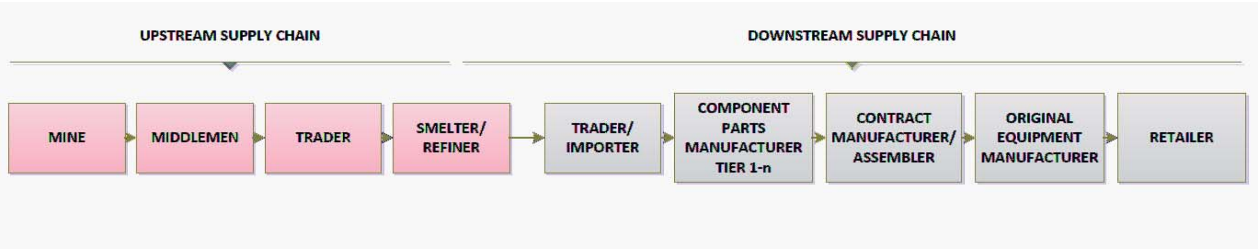

Figure 1: Simplified upstream and downstream supply chain

[4] With DF 1502 defining the term “adjoining country” with respect to the DRC as “a country that shares an internationally recognized border with the Democratic Republic of the Congo” (DF 2010, SEC. 1502 (e) (1), this includes Congo, Angola, Burundi, Central African Republic, Rwanda, Sudan, Tanzania, Uganda, Zambia.

[5] SEC 2012, p. 309.

After the reoccurrence of the issue on the European Commission's agenda over the past few years, the European Commission's Directorate-General for Trade launched a "Public consultation on a possible EU initiative on responsible sourcing of minerals originating from conflict-affected and high-risk areas" on March 27th, 2013, in order to get stakeholders' views on a potential EU initiative. The results of this Public Consultation, which ran until June 26th, 2013, are currently being used to help the European Commission in deciding whether and how to complement and/or continue on-going due diligence initiatives and support for good governance in mineral mining, particularly in developing countries affected by conflict. Another important measure to grasp fully the impact of a possible Conflict Minerals legislation in the EU is the careful consideration of the most important cost drivers which can be utilized to inform and influence the formulations of rules.

For this purpose, the European Commission's Directorate-General for Trade charged iPoint-systems gmbh with the task of analysing the complex impacts of a potential European Conflict Minerals legislation as part of the impact assessment process. In particular, the following study assesses the due diligence compliance cost, benefit and related effects on selected operators in relation to the responsible sourcing of selected minerals. The focus lies on due diligence, as defined in the OECD Due Diligence Guidance, performed along the supply chains for the 3TG.

1.1 Objectives

The following study aims at providing an identification and quantification of compliance costs for operators subject to an EU responsible sourcing initiative. The focus will lie on due diligence, as defined in the OECD *Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas*, performed along the supply chains for four minerals: tin, tungsten, tantalum, and gold. Therefore, the objectives of the study are both to provide a description of the global supply chains for the minerals in scope, while building upon the descriptive part, to carry out an economic impact assessment identifying and quantifying compliance costs for due diligence exercising operators.

Responsible global supply chain management implicates transparent and traceable supply chains. Starting with a supply chain analysis, for each of the four minerals the following characteristics shall be outlined:

- most important industries and industry subsectors depending on the 3TG

- type of economic operators involved in the supply chains
- main applications and type of products which contain conflict minerals

In order to provide a quantification of the supply chains, an overview of the production, supply and demand shall be provided, distinguishing between activities taking place in the EU, and those taking place predominantly outside the EU market.

Building upon the results of the supply chain analysis, an economic assessment of the expected impacts for requiring supply chain due diligence shall be carried out. The economic impact assessment will take into account already existing U.S. studies on the basis of experiences with Section 1502 of Dodd-Frank, specifications of the OECD due diligence principles, and a survey conducted with companies affected by the U.S. Conflict Minerals legislation. The main objective of the survey, conducted via online questionnaire, is to obtain statistically useful information concerning due diligence compliance costs of selected operators in relation to the responsible sourcing of selected minerals from conflict-affected and high-risk areas. Furthermore, the survey aims at obtaining data for a cost comparison concerning initial and ongoing costs between small and medium enterprises (SMEs) and large companies.

1.2 Methodology

Tracking complex global supply chains encompasses a mixture of qualitative methods coupled with quantitative approaches. Nevertheless, a limitation to such a supply chain study is that, besides information from already-existing studies, missing additional data are either not available or inconsistent. Confidential disclosure agreements between supply chain actors are not the exception, but rather the rule.

The first, descriptive part of the study draws on an extensive literature research of already existing data. It was created on the basis of Conflict Minerals-related studies, news, surveys, as well as other relevant publications by international and supranational institutions and organisations, notably the European Commission, the OECD, and the UN. Industry associations and industry/mineral/supply chain-based initiatives like for example the AIAG (Automotive Industry Action Group), EICC-GeSI (Electronic Industry Citizenship Coalition – Global e-Sustainability Initiative), the International Tungsten Industry Association (ITIA) and many others provided us with specific study-relevant information. Research institutes and scientific authorities (USGS – U.S. Geological Survey, BGS - British Geological Survey, ITRI – International Tin Research Institute, and others) helped us to get targeted insights into supply chain trends and numbers.

In order to present solutions and receive further input for further EIA calculations, a targeted online survey with users of the iPoint Conflict Minerals Platform (iPCMP) was launched. The key objective of the iPCMP user survey was to obtain statistically useful information concerning due diligence costs of selected operators in relation to the responsible sourcing of selected minerals from conflict-affected and high-risk areas. The data were collected via an online questionnaire, which was accessible from July 4th to September 7th, 2013. The questionnaire consisted of 17 single choice, multiple choice, close-ended and open-ended questions. Furthermore, a comment box should allow additional remarks at the end of some of the 17 questions as well as at the end of the survey. The questionnaire was created on the basis of existing Conflict Minerals-related studies, surveys, as well as other relevant publications by inter- and supranational institutions and organizations, notably the European Commission, the OECD, and the UN. The questions focus on different aspects which may serve as variables for further EIA calculations.

1.3 Structure

The study consists of two main parts: description of the global supply chains for tantalum, tin, tungsten and gold (Chapter 2), and the presentation of the results of the iPCMP user survey (Chapter 3).

Chapter 2 starts with a general overview of industry sectors using one or several affected minerals (2.1 Overview of affected industry sectors), followed by a specific supply chain description for each of the 3Ts and gold (2.2). The supply chain description part is divided into four chapters, each dedicated to one of the affected minerals (2.2.1 Tantalum, 2.2.2 Tin, 2.2.3 Tungsten, and 2.2.4 Gold). In order to trace the trade flows of each mineral, the main functions of the most important economic operators are described shortly in each of the metal´s first sub-chapter ("Economic Operators"). Additionally, examples for companies in the mineral´s upstream supply chain are given. The second sub-chapter ("Involved industry sectors and products") covers the main applications and uses for each mineral, and contains product examples listed by the HS Code. In order to fulfil one of the goals of the study, i.e. to make complex supply chains visible, a supply chain matrix showing the main involved industry sectors, their intermediate and final products, is presented. The third sub-chapter ("Production, supply and demand") addresses global economic trends such as production, supply and demand. Here, the main producing and consuming countries, as well as risks of supply shortage are presented. Furthermore, a distinction between activities taking place in the EU, and those taking place predominantly outside the EU market, is made.

Chapter 3 provides general information about the iPoint Conflict Minerals Platform (iPCMP) as well as information about the survey's objective, the sample, and the questionnaire construction. Chapter 3.3 ("Summary of results") offers a comprehensive analysis of the survey results, including descriptive, numeric and graphic evaluations.

2 Description of the global supply chains for the 3TG

2.1 Overview of affected industry sectors

A wide range of industry sectors use tantalum, tin, tungsten, and gold (the so-called "3TG") in their products. Generally spoken it can be said that small amounts of all conflict minerals can be found in almost every industry sector.

The *electronics industry* is one of the most, if not the most, exposed industry sector using metals deriving from minerals from conflict affected and high-risk areas. Tantalum, tin, tungsten, and gold can be found in solders, capacitors, wiring, semiconductors, contacts, lithium ion batteries and as nanoparticles in nearly all electronic and electrical appliances. Therefore cameras, tablet computers, notebooks, personal computers, mobile phones, mp3 players, electronic watches, electronic toys and a wide range of other consumer durables and technology industry appliances are dependent on conflict minerals to function. In terms of supply chain transparency and preparedness for responsible supply chain due diligence reporting the electronics industry can be seen as a forerunner, with multi-stakeholder initiatives like EICC-GeSi's Conflict Free Smelter (CFS) program, or IPC's Conflict Minerals Due Diligence Guide.

The *automotive industry* is another important user of 3TG and furthermore one of the most economically relevant industry sectors in terms of revenue. The 3TG can not only be found in onboard automotive electronics like vehicle navigation and entertainment systems, but also in a variety of other automotive applications. Metal alloys, glass coatings, automobile headlights, engine batteries and engine components, sealants, seat cushions, brake pads, airbag systems, traction controls, self- dimming mirrors and a wide range of other automobile parts contain one or several 3TG. As with the electronics industry, the automotive industry is working on transparency in the supply chain. Industry-based automotive initiatives (the AIAG, Automotive Industry Action Group) are investigating ways to ensure that automobiles and automotive products do not contain minerals from conflict-affected areas.

As with the automotive and electronics sectors, *aerospace and defence* applications heavily depend on all 3TG. Jet engines, alloys in components subjected to high temperatures like jet coatings, satellites, electronic components and tools like guidance and navigation systems, missiles, munitions, wiring and fasteners all contain conflict minerals. Aerospace supply chains are complex, long (a single commercial airplane contains over 5 million parts) and, due to the both commercial and military character of almost all aerospace manufacturers, strongly lagging in terms of transparency and sector preparedness regarding due diligence origin of minerals reporting.

Other industry sectors which are dependent on one or several conflict minerals are *industrial machinery and tooling equipment, medical devices, construction, consumer goods, lighting, jewellery, chemical industry, packaging*, and many others. Unlike electronics and automotive, due diligence best practice is rare among these sectors. The only exemptions are coming from the *jewellery industry*: The Responsible Gold Program of LBMA (London Bullion Market Association) takes the OECD "Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas" into account, while the Conflict-Free Gold Standard of the World Gold Council is aiming to offer a fully auditable approach to ensure supply chain integrity. Another conflict-free standard is coming from the Responsible Jewellery Council (RJC), which is auditing its members against its Chain-of-Custody Standard for the precious metals supply chain – a standard on responsible business practices for diamonds, gold and platinum group metals.

Table 2 gives an overview of industry uses of gold, tantalum, tin and tungsten by industry sector, while Figure 2 shows a simplified supply chain of the most relevant industry sectors using all 3TG in their products.

Table 2: Industry Uses of Gold (Au), Tantalum (Ta), Tin (Sn) and Tungsten (W)

Industry Sectors	Exemplary Subsectors/ Product Categories	Au	Ta	Sn	W
Electronics	Information Technology Communication Technology Consumer Electronics Electronic Household Appliances	X	X	X	X

Industry Sectors	Exemplary Subsectors/ Product Categories	Au	Ta	Sn	W
Automotive	Automobiles Automobile Engine and Parts Automobile Lighting Equipment Automobile Electrical and Electronic Parts Other Automobile Parts and Accessories Power Train/Brake Systems Manufacturing	X	X	X	X
Aerospace & Defence	Aircraft Aircraft Engines Aircraft Parts Space vehicles and Equipment Communications Equipment Search, Detection, Navigation Systems and Equipment	X	X	X	X
Industrial Machinery and Tooling Equipment	Machinery and Equipment Manufacturing (various appliances) Iron and Steel Forging Powder Metallurgy Part Manufacturing Hand and Edge Tool Manufacturing Electroplating/Plating		X	X	X

Industry Sectors	Exemplary Subsectors/ Product Categories	Au	Ta	Sn	W
Medical Engineering/Applications	Medical, Surgical and Dental Equipment Diagnostic Kits and Equipment Prosthetic Devices Medical Appliances	X	X		X
Construction	Industrial Construction Commercial and Institutional Building Construction Power and Communication Line Construction Cement Industry	X		X	X
Consumer Goods	Food and Beverages Personal and Household Goods Sports Equipment Apparel and Footwear	X		X	X
Lighting	Lighting Equipment Manufacturing LED manufacturing		X		X
Jewellery	Jewellery Watches	X			X
Chemical Industry	Chemicals Coating Materials Mill Products		X		X

Industry Sectors	Exemplary Subsectors / Product Categories	Au	Ta	Sn	W
Packaging	Container Manufacturing Tin Can Manufacturing			X	
Financial Industry	Bullion, Bars and Coins	X			

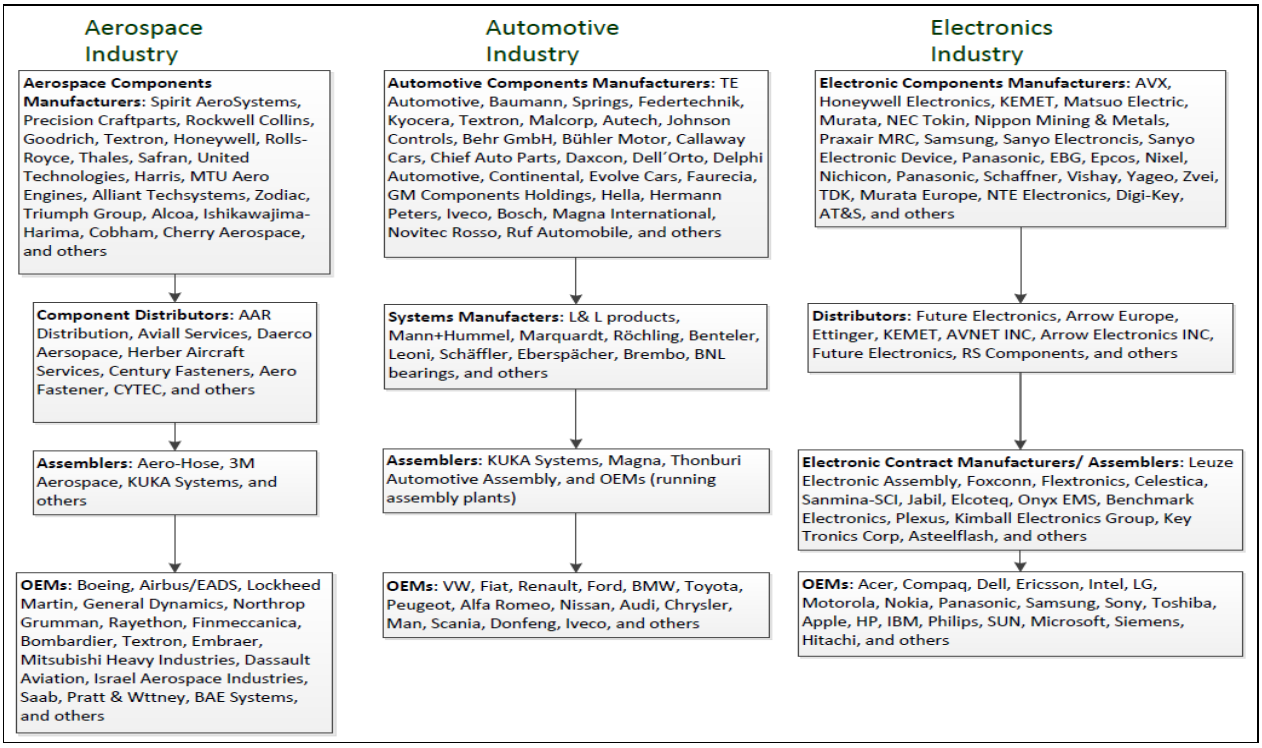

Figure 2: Example of supply chain-relevant industry sectors all using 3TG in their products

2.2 Specific supply chain description for each of the 3T and gold

2.2.1 Tantalum

Tantalum mainly occurs in very heterogeneous ores and in the form of tantalite Fe $(TaO_3)_2$, among around 70 other variants of tantalum minerals. Different ores of tantalum, colloquially known as "coltan" (short for columbite–tantalite), contain niobium and tantalum. Table 3 shows the properties of tantalum itself (black) and those due to the thin, adhesive oxide layer that forms spontaneously on the surface of tantalum metal (blue).

Table 3: Tantalum properties and related fields of applications (Espinoza, 2012)

Properties of tantalum	Related fields of applications
Thermodynamic stability with respect to copper	Microelectronics
High and temperature insensitive volumetric capacitance*	Capacitors
Bioinert	Biomedical and surgical applications
Resistant to corrosion	Chemical industry, textile industry
Ductile	Chemical industry, aerospace industry
Resistant to high temperature	Aerospace industry, turbines for electricity generation
High strength	Aerospace industry, turbines for electricity generation

* due to oxide layer

2.2.1.1 Economic Operators

The types of tantalum mining includes (Cabot Supermetals, 2010): open pit (hard and soft rock und often high "stripping ratios"), underground and alluvial. The conventional/hard rock and artisanal mining make up the largest part of the supply. In 2011, these sources accounted for 67% of the 3.75Mlb Ta_2O5 (1,393t contained Ta) supplied to the market. This has been the case since the start of the 2000s, with mining making up 55-75% of overall supply (Minor Metals Trade Association - mmta 2013). African countries are the third largest hard rock world supplier of tantalum pentoxide. The conflict region represents 23% of the primary supply (mmta, 2013).

Conventional mines, such as the ones in Australia, Brazil and Ethiopia, make up about half of the primary supply, while the other half comes from artisanal production, principally in Central Africa, Brazil and Nigeria. The latter form of mining is highly flexible and can quickly react to changing market conditions (Roskill, 2012).

The major reserves of tantalum are in Brazil and Australia. Although Africa also hosts considerable tantalum resources, these are probably nowhere close to the 80% of the global total often reported during the 2000s (Roskill, 2012). Annex 1 shows the world production of tantalum by development status, income, country groups, etc. among others.

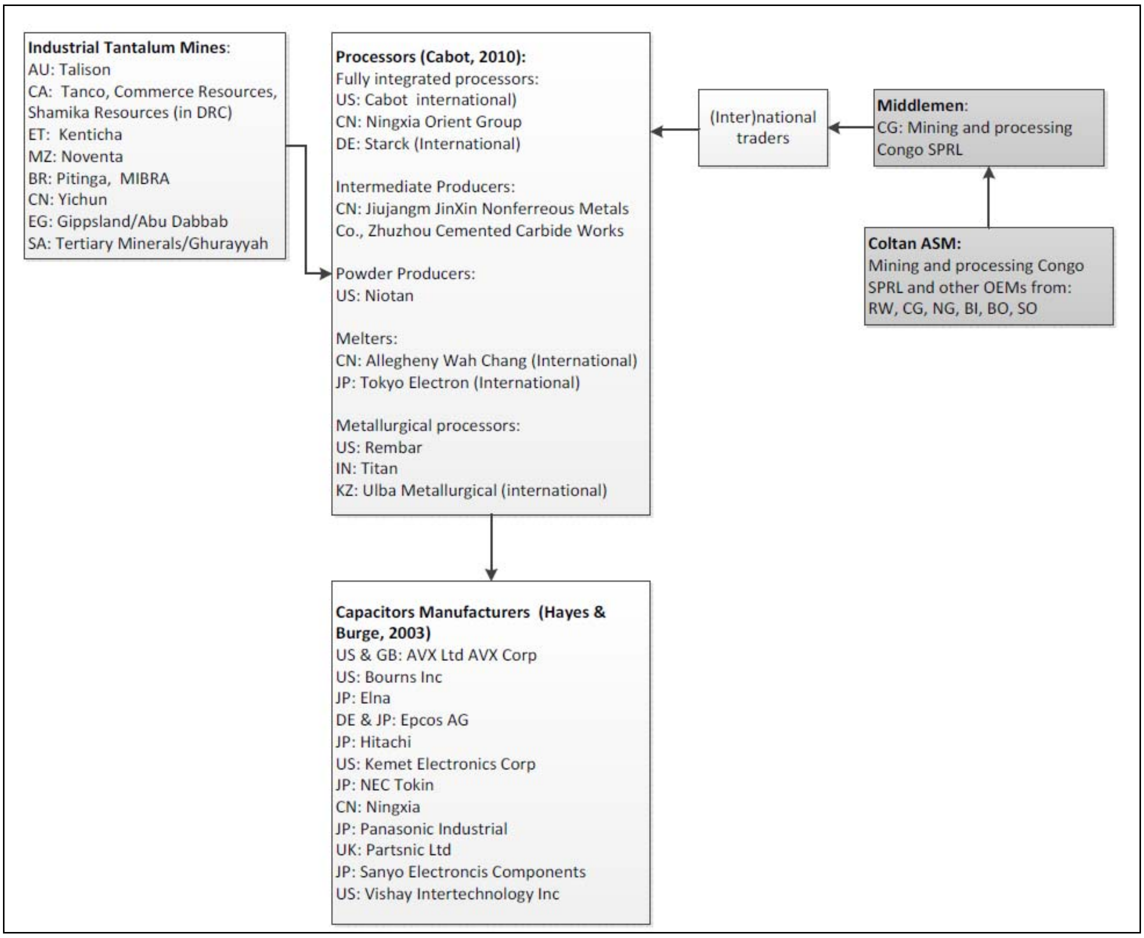

Figure 3: Examples for economic operators in the tantalum (capacitors) supply chain from mines to capacitor manufacturers

Before the 1990s, tantalum was extracted mainly as a by-product of tin mining. After having completely ceased during the First Congo War, the mining in the DRC suddenly boomed in 2000. Prices rose rapidly and reached a peak in 2000 resulting in a massive expansion of artisanal and small-scale mining (ASM) in the Democratic Republic of the Congo (DRC). According to the Enough Project (2011), the tantalum (Coltan) journey to market from DRC can be described as follows: after mining and transportation inside Central African countries, the ore is shipped to Asia for smelting and conversion to metal. Then, the processed material is shipped to Europe and the USA to produce electrical components. These components are shipped to Asia to manufacture circuit boards and consumer electronics which will be sold principally in Europe and the USA.

The extraction and refining of tantalum, including the separation from niobium in these various tantalum-containing mineral concentrates, is generally accomplished by treating the ores with a mixture of acids at elevated temperatures. According to Cabot Supermetals (2010), the tantalum refining and processors can be defined as follows: Fully integrated processors (includes those from ore to high purity products), intermediate producers, powder producers (from intermediates), smelters (from tantalum powder and metal scrap to high purity products) and metallurgical processors (further processing – cutting, bending, shaping – to custom metal products).

The key tantalum refining and processing (primary and/or secondary concentration) countries are: China, Estonia, Germany, Russia, Thailand and the USA. According to EICC, there are currently 22 tantalum smelting companies (refining and processing) which are compliant according to the Conflict Free Smelter (CFS) program of EICC and GeSI.

Tantalum can also be extracted as a by-product of tin smelter waste. Tantalum produced this way accounts for 14% of total global tantalum production (British Geological Survey, 2011a).

2.2.1.2 Involved Industry Sectors and Products

Tantalum compounds have a broad range of uses in different industries, with the economically most relevant sectors being the *refining and processing tantalum industry* (tantalum powder, chemical processing, corrosion resistant applications), the *electronic industry* (used principally as capacitors and semiconductors), including medical devices and instruments as well as the *aerospace industry*. Following the ISIC classification (See Annex 2), the uses of tantalum include the mining and quarrying, and manufacturing sections. The manufacturing of the chemical industry and the electric and electronic equipment are the relevant divisions. Other products related to tantalum products are: rods, skull plates, wire meshes, cutting tools and drill bits.

The supply chain for tantalum can be relatively lengthy and complex depending on the industry and industry-specific applications as well as the origin of the mine. Figure 4 shows an example of the tantalum supply chain including the relevant sectors (yellow) and products. After mining, the refining and processing industry (from the primary concentration until tantalum products) plays an important role in the supply chain. The capacitors, sputtering targets and high temperature alloys were chosen as relevant products (green colour) due their relevance in the following sectors: electronics, automotive and aerospace industries.

Several reports such as Hayes/Burges (2003), RAID (2004), or the UN report (2001:4), include a compilation of sector leaders and affected suppliers (producers of raw materials, tantalite traders, tantalum processors and major capacitor manufacturers). Figure 3 shows examples of relevant industries related to the tantalum supply regarding capacitors.

The principal use of tantalum in the electronics industry is in capacitors, which are found in most of the electronic devices. Superalloys (used in aerospace and land-based gas turbines) as well as sputtering targets and tantalum chemicals constitute relevant applications for tantalum products and probably will have the highest growth potential due to demand increase in the coming years. Table 4 shows a summary of the applications for tantalum. Examples of tantalum products including their HS code are included in Table 5.

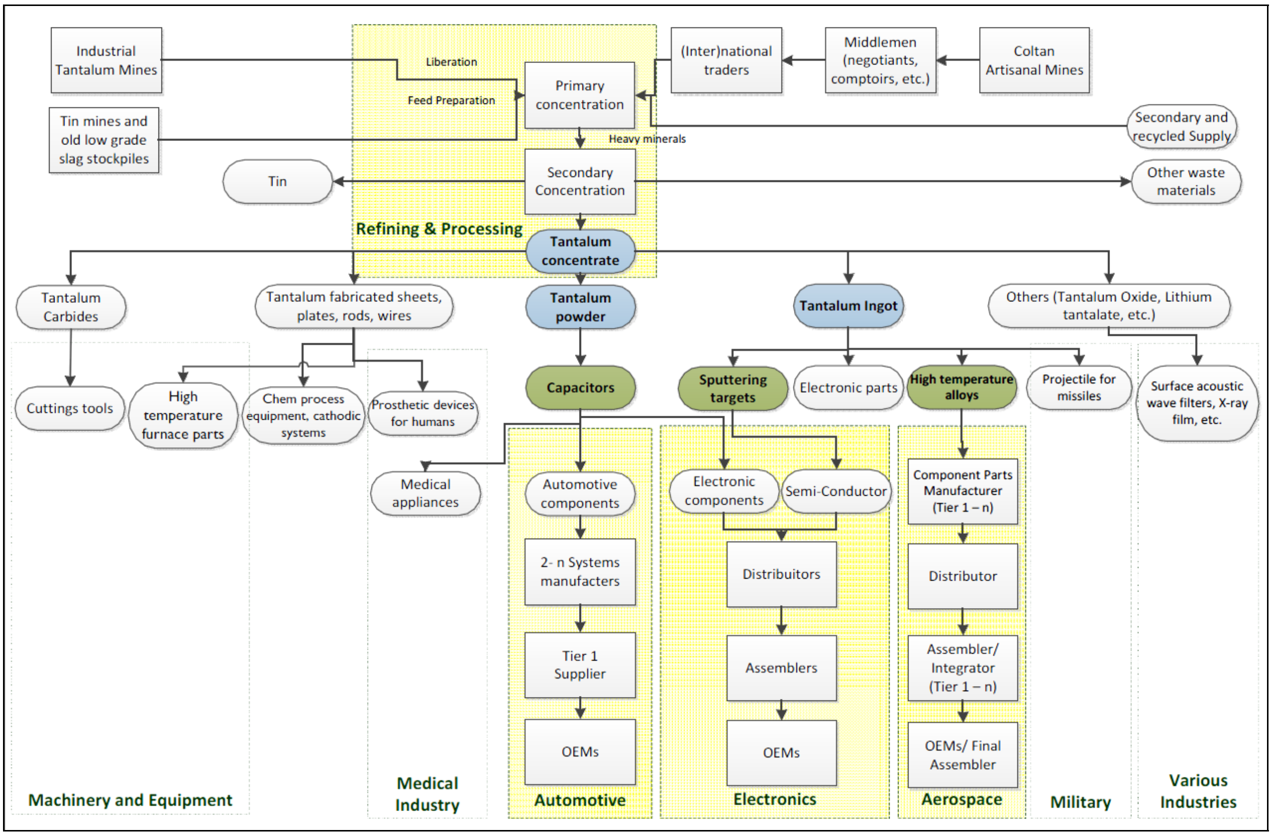

Figure 4: The tantalum supply chain matrix including the most important products (green), Tantalum compounds (blue) and relevant industry sectors (yellow)

Table 4: Applications for Tantalum (TIC, 2010)

Tantalum Product	Application	Technical Attributes/Benefits
Tantalum carbide	Cutting tools	Increased high temperature deformation, control of grain growth
Lithium tantalate	Surface acoustic wave (SAW) filters in mobile phones, hi-fi stereos and televisions.	Electronic signal wave dampening provides for clearer and crisper audio and video output.
Tantalum oxide	- Lenses for spectacles, digital cameras and mobile phones - X-ray film - Ink jet printers	- Ta_2O_5 provides a high index of refraction so lenses for a given focal strength can be thinner and smaller - Yttrium tantalate phosphor reduces X-ray exposure and enhances image quality - Wear resistance characteristics. Integrated capacitors in integrated circuits (ICs)
Tantalum powder	Tantalum capacitors for electronic circuits in: - medical appliances such as hearing aids and pacemakers; - automotive components such as ABS, airbag activation, engine management modules, GPS; - portable electronics *e.g.* laptop computers, cellular/mobile phones, video cameras, digital still cameras; - other equipment such as DVD players, flat screen TVs, games consoles, battery chargers, power rectifiers, cellular/mobile phone signal masts, oil well probes	High reliability characteristics and low failure rates, operation over a wide temperature range from -55 to +200°C, can withstand severe vibrational forces, small size per microfarad rating/electrical storage capability
Tantalum fabricated sheets and plates	- Chemical process equipment including lining, cladding, tanks, valves, heat exchangers - Cathodic protection systems for steel structures such as bridges, water tanks - Corrosion-resistant fasteners, screws, nuts, bolts - Spinnerettes in synthetic textile manufacture	Superior corrosion resistance - equivalent in performance to glass
Tantalum fabricated sheets, plates, rods, wires	- Prosthetic devices for humans - hip joints, skull plates, mesh to repair bone removed after damage by cancer, suture clips, stents for blood vessels	Attack by body fluids is non-existent; highly bio-compatible
Tantalum fabricated sheets, plates, rods, wires	- High temperature furnace parts	Melting point is 2996°C although protective atmosphere or high vacuum required
Tantalum ingot	- Sputtering targets	Applications of thin coatings of tantalum, tantalum oxide or nitride coatings to semi-conductors to

Tantalum Product	Application	Technical Attributes/Benefits
		prevent copper migration
Tantalum ingot	High temperature alloys for: - air and land based turbines (*e.g.* jet engine discs, blades and vanes) - rocket nozzles	Alloy compositions containing 3-11% tantalum offer resistance to corrosion by hot gases, allow higher operating temperatures and thus efficiency and fuel economy
Tantalum ingot	- Computer hard drive discs	An alloy containing 6% tantalum has shape memory properties
Tantalum ingot	- Explosively formed projectile for TOW-2 missile	Balance of density and formability allow for a lighter and more efficient system

Table 5: Tantalum products according to the Harmonized System (HS) codes

HS Code	Description
2615	Niobium, tantalum, vanadium & zirconium ore & concentration
261590	Niobium, tantalum, vanadium ores and concentrates
8103	Tantalum & articles thereof, include waste & scrap
810310	Unwrought tantalum, including bars and rods obtained simply by sintering; waste and scrap; powders
810390	Other tantalum and articles thereof
853221	Fixed capacitors, tantalum

The end-uses of tantalum application have slightly changed over time. For example, the capacitor grade tantalum power has considerably decreased; meanwhile the tantalum chemicals have increased from 14 to 36%. However, because of the strong competition from other materials for capacitors and microelectronic applications it is expected that the consumption of tantalum will not increase substantially in the future. This is supported by data from the Niobium-Tantalum International Study Center (TIC) on tantalum processors' shipments, which were at the same level in early 2010 as they were in 2004 and by the global production data of the United States Geological Survey (USGS), which show that global production in 2010 was more than 50% less than in 2004.

Tantalum scrap comes mostly from tantalum-related electronic components, and scrap products of tantalum-containing cemented carbides and superalloys. At the moment, the recycling of tantalum products is very limited due to technical problems concerning the scrap recovery, among others. It is expected that the recycling rate (mainly from pre-consumer scrap) will increase in the coming years.

2.2.1.3 Tantalum Production, Supply and Demand

The tantalum raw materials are all sourced from outside the EU, with the exception of minor amounts of scrap from the EU, and the European Commission has identified this metal as one of 14 critical raw materials (EC 2010). A schematic of the inputs and outputs of the European tantalum industry are shown in Figure 5.

Brazil and Canada followed by Rwanda, Mozambique, Australia and the DRC are the relevant countries producing tantalum (See Annexes 3 and 4).

According to MBendi (2013), Angus & Ross PLC from the United Kingdom is trying to develop tantalum sites in the Irish counties Carlow and Wexford and the Motfeldt Center in Greenland. In Finland, new prospecting ventures for tantalum ore are underway. And in Spain, Solid Resources Limited has formed a subsidiary holding a 60% interest in a tantalum lithium mining venture.

Depending of the kind of processor a company can cover the process from the ore to the refining or only include the refining and processing of tantalum compounds. The European tantalum processing industry comprises of a limited number of companies producing diverse chemical and metallurgical products. Their combined output is between 250 and 300 tons of tantalum per year (Espinoza, 2012).

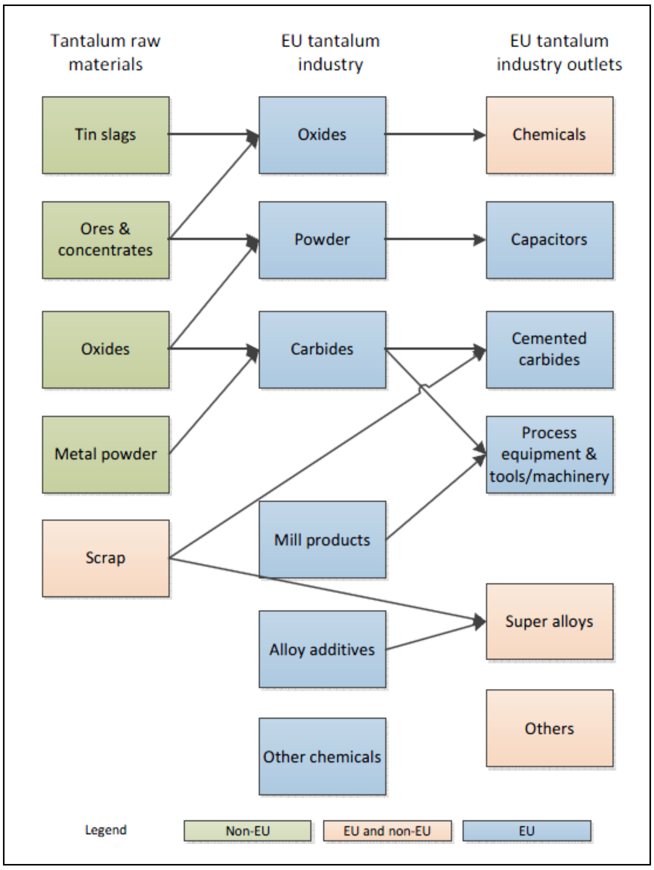

Figure 5: Raw materials and outlets of the European tantalum industry[6] (Espinoza, 2012)

According to the Tantalum-Niobium International Study Center (TIC, 2013), in the early days of the tantalum industry, almost all processors were located either in the U.S. or in Europe. With the increase of the market for tantalum, only two companies were effectively involved in integrated processing: Cabot

[6] Note that some companies offer products in more than one of the categories listed above

Corporation in the U.S. and H.C. Starck in Germany. Today, besides these two companies, which got involved in off-shore processing in Japan and Thailand, there are several other significant integrated processors in China, Estonia and Kazakhstan. In addition to the limited number of integrated processors, there are many other companies (e.g. in China, Brazil, Russia or South Africa) that specialize in just one or two stages of tantalum processing.

Figure 6 shows the estimated world consumption of tantalum. The electronics industry is accountable for 50-60% of tantalum consumption, with superalloys the other major end-use at about 20%. In 2008, world consumption of tantalum reached an all-time high, but in 2009 the global economic downturn caused demand to fall by 40%. In 2010, there was a strong recovery, especially seen in the capacitor industry, and demand returned to a level approaching that of 2008 (Roskill, 2012).

The leading suppliers of tantalum imports for consumption (by weight from 2008 to 2011) were: Australia 54%; Mozambique 22%; Canada 19%: China 31%; Kazakhstan 27%; Germany 14%; Estonia 22%; Russia 14%; and Mexico 12% (Papp, 2013).

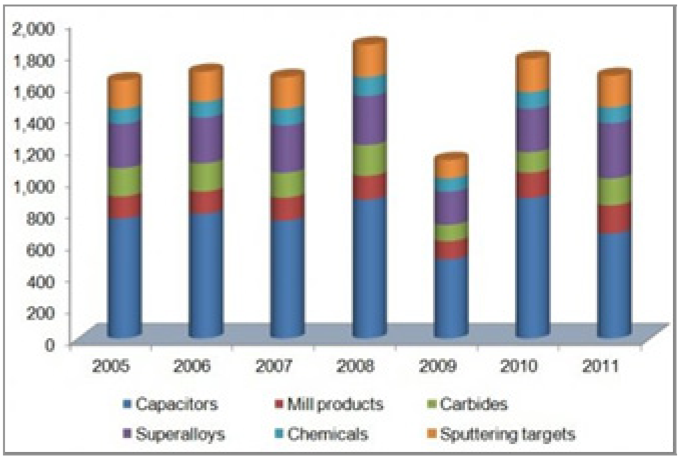

Figure 6: Estimated world consumption of tantalum, 2005 to 2011 (t Ta) (mmta, 2013)

2.2.2 Tin

2.2.2.1 Economic Operators

Tin is mainly produced from the mineral cassiterite (SnO_2), an ore which contains impurities that have to be removed through concentration, smelting or refining. The metal production of tin is divided into three stages: ore mining, smelting and refining.

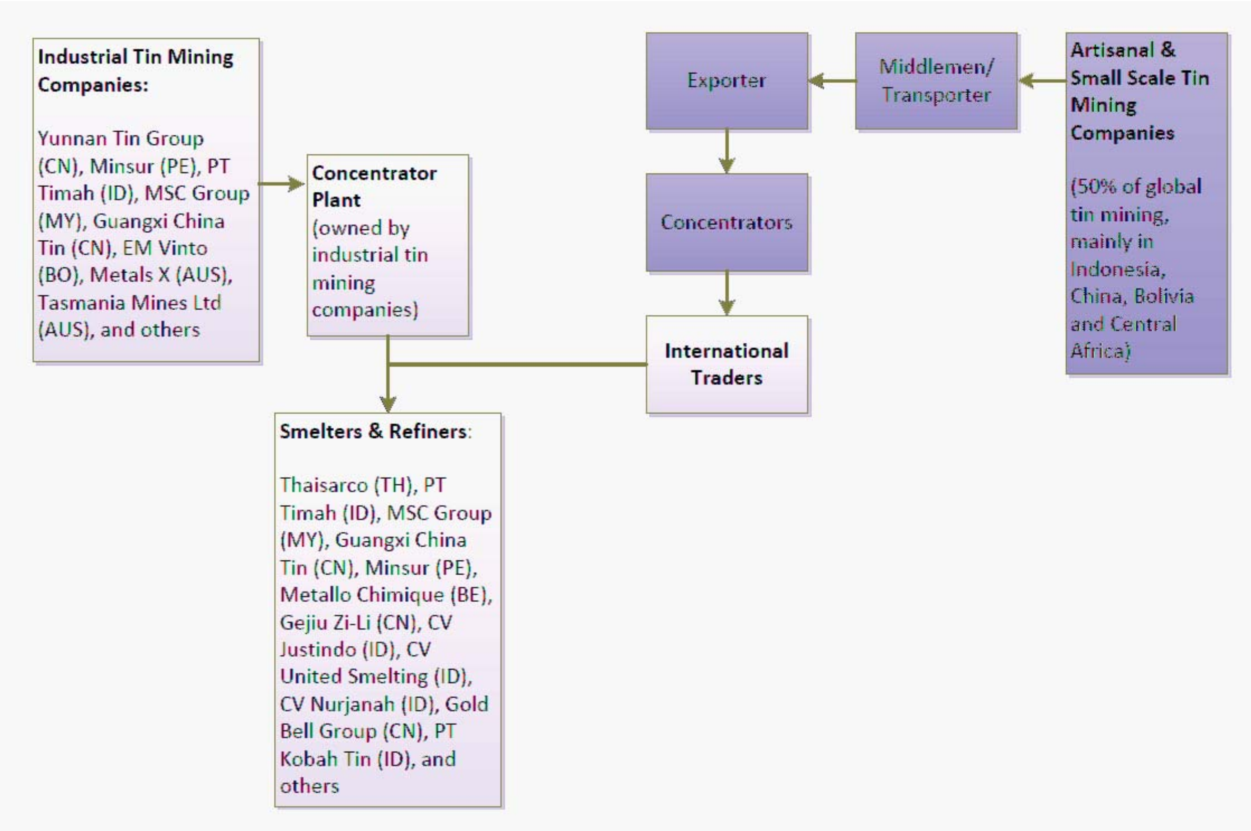

Figure 7: Examples for economic operators in the tin supply chain from mines to smelters and refiners

Mining of cassiterite is carried out in large industrial mines as well as in ASMs. Unlike other minerals, approximately 50% of the world's primary tin production is carried out in ASMs in Indonesia, China, Bolivia and Central Africa (GHGm, 2008). Four companies account for 50% of the world's production, ten companies (Minsur, Yunnan Tin, PT Timah, Thaisarco, MSC Group, Guangxi China Tin, Yunnan Chengfeng, EM Vinto, Metallo Chimique, Gejiu Zi-Li) account for 75% of global tin production.

Mining can be either carried out as hard rock underground mining (China, South America and Australia) or as alluvial mining (South East Asian tin belt and Indonesia) (ITRI, 2012b). Depending on the country of origin and the method by which tin ores are mined, several intermediate tiers can be settled between tin mines and concentrators and/or smelters. These intermediate steps are often very unclear, obscuring the origin of the mineral.

The broken ore from the hard-rock mining is transformed into a concentrate ore. This is achieved by crushing it into grinds and turning it into concentrate through gravitational methods. Processing by-products can include copper, lead, zinc and other minerals. In some mines, tin itself can be a by-product of metal extraction, including for both tungsten and tantalum as an example.

The purpose of tin smelting is to produce tin out of its ores. Once crude tin is produced by smelting, further pyromechanical refining is required, which results in tin of around 99.85% - 99.9% purity suitable for general commercial use (ITRI, 2012b). Ten main smelting companies process over 80% of the world´s tin, almost all of which are based in East Asia (for example Liuzhou China Tin Co., Malaysia Smelting Corporation Bhd or Thailand Smelting & Refinery Company Ltd.), with China and Indonesia being the world´s leading tin producers from smelters (See Annex 4) (Tulane University, 2011). As of June 21, 2013, there are five tin smelters which are compliant according to the Conflict Free Smelter (CFS) program of EICC and GeSI: Malaysia Smelting Corporation, Minsur, OMSA, PT Koba Tin and Thaisarco (EICC-GeSi CFS-Tin, 2013).[7]

Component Producers buy tin from international traders and process it either to an end product or to a component dedicated for being passed on several tiers along the supply chain to an Original Equipment Manufacturer (OEM), which manufactures the end product (see Figure 7).

2.2.2.2 Involved industry sectors and products

With 36% of global tin production, the electronics industry is the major end user of tin (RESOLVE, 2010). The main tin applications in this industry sector are tin alloys, being used to produce tin-based lead free solders (share of market 2011: 52%) (ITRI, 2012b). Solder is necessary for conductive joints in almost every electronic product, from generic personal computers (which contain 8% tin), tablets and mobile phones (containing 1% tin) to watches, radios and cameras (GHGm, 2008). As the automotive industry (besides aerospace and defence) not only uses electronic devices, but also many other tin appliances, it can be regarded as one of the most economically-relevant sectors using tin (see Figure 8).

[7] Annex 5 includes the tin World Smelter Production by Country.

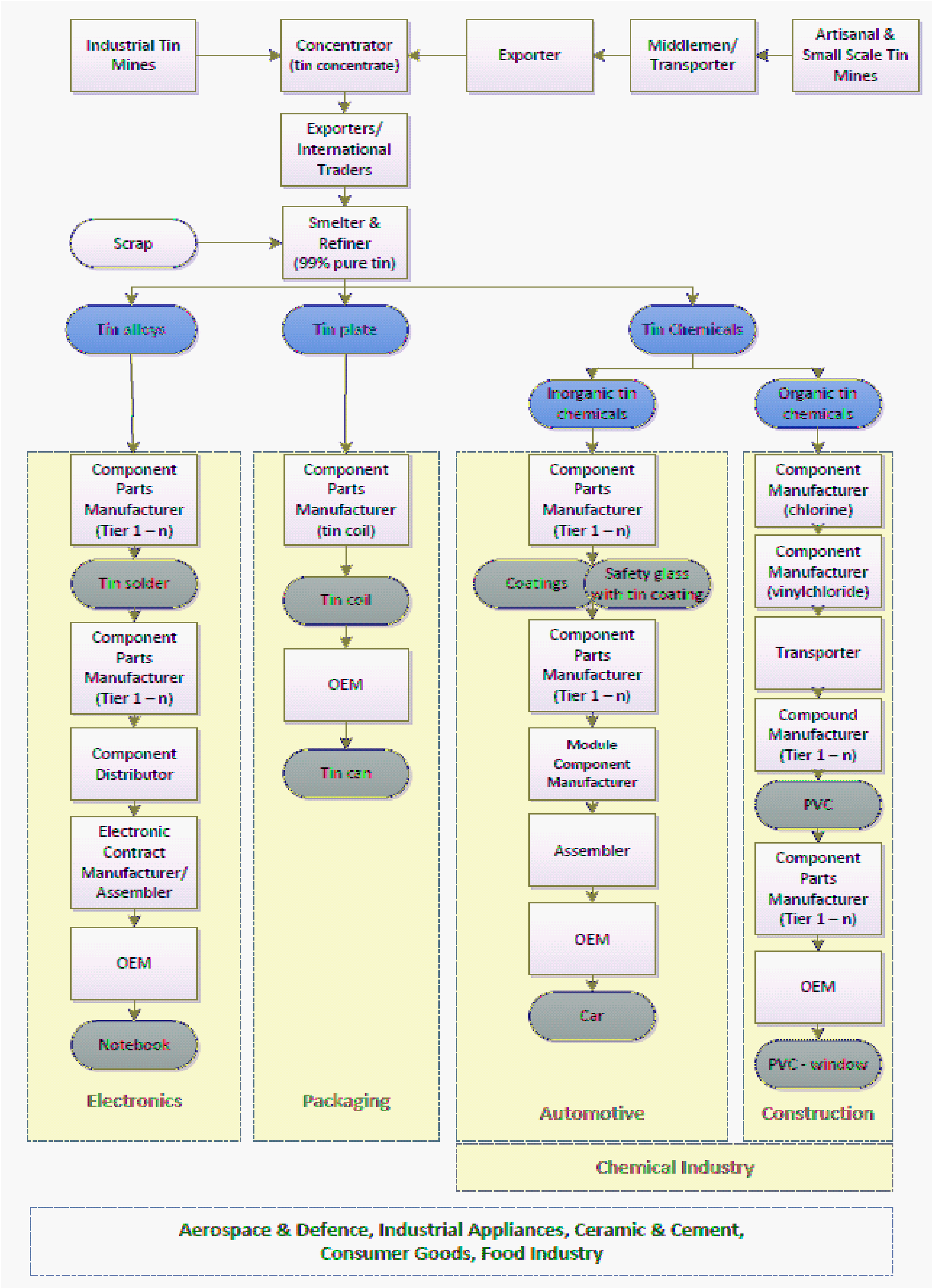
Industrial Tin Mines
Concentrator (tin concentrate)
Exporter
Middlemen/ Transporter
Artisanal & Small Scale Tin Mines
Exporters/ International Traders
Scrap
Smelter & Refiner (99% pure tin)
Tin alloys
Tin plate
Tin Chemicals
Inorganic tin chemicals
Organic tin chemicals
Component Parts Manufacturer (Tier 1 – n)
Tin solder
Component Parts Manufacturer (Tier 1 – n)
Component Distributor
Electronic Contract Manufacturer/ Assembler
OEM
Notebook
Electronics
Component Parts Manufacturer (tin coil)
Tin coil
OEM
Tin can
Packaging
Component Parts Manufacturer (Tier 1 – n)
Coatings
Safety glass with tin coating
Component Parts Manufacturer (Tier 1 – n)
Module Component Manufacturer
Assembler
OEM
Car
Automotive
Component Manufacturer (chlorine)
Component Manufacturer (vinylchloride)
Transporter
Compound Manufacturer (Tier 1 – n)
PVC
Component Parts Manufacturer (Tier 1 – n)
OEM
PVC - window
Construction
Chemical Industry
Aerospace & Defence, Industrial Appliances, Ceramic & Cement, Consumer Goods, Food Industry

Figure 8: The tin supply chain matrix including the most important products (green), intermediate products (blue), and relevant industry sectors (yellow)

Tinplate (steel with a thin tin coating) provides an essential corrosion protection and is therefore used in various industry sectors, from packaging industries, which in 2010 were using 177,100 tons of refined tin, to the automotive and consumer goods industries (ITRI, 2012b).

According to ITRI (2012b), the biggest user of tin chemicals (the third largest industrial tin application) is the construction industry (49,400 tons of refined tin in 2010). Organic tin chemicals are added to PVC in order to prevent degradation in heat and sunshine. Inorganic tin chemicals are used as catalysts in glass coatings (e.g. for low emissivity glass used in modern 'green buildings'), for the production of thermo-insulating polyurethane (PU) foam, in the ceramic and cement industries as well as in a wide range of other industrial processes (ITRI, 2012b).

Examples for principal tin products are shown in Table 6.

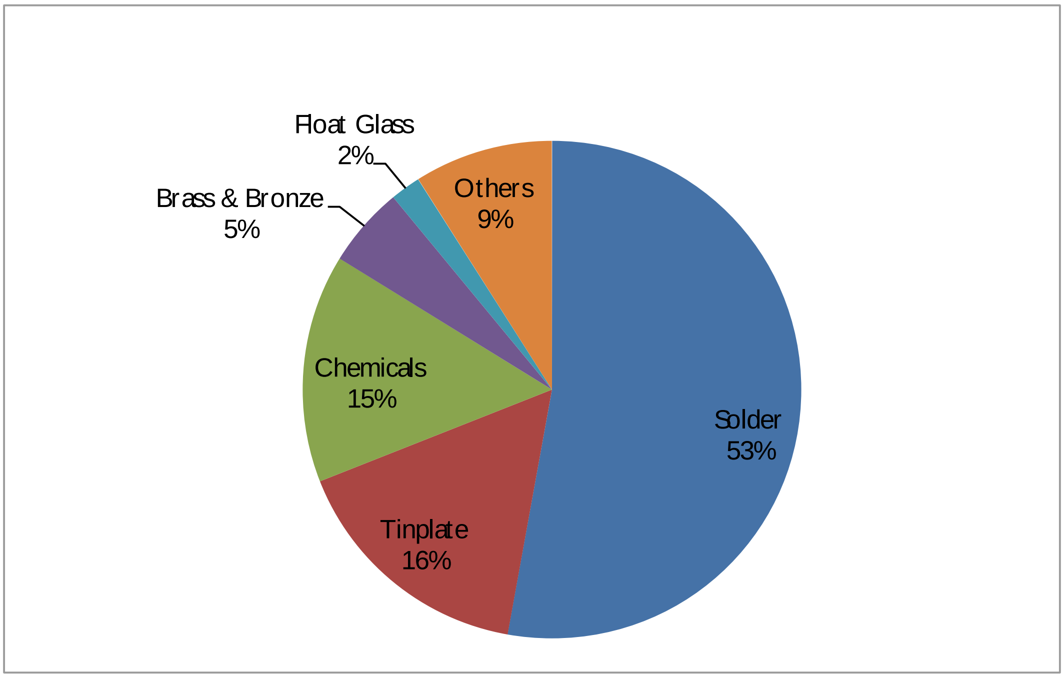

Figure 9: Refined Tin Consumption by Use, 2010 (Data Source: ITRI 2012a)

Table 6: Relevant product examples for tin

Industry	Tin product	HS Code	Example	Other applications/products
Electronics	Tin-based solders/ lead free solder block	800110	laptop	lithium ion batteries, printed circuit boards with tin finishes, circuits, connectors, capacitors, tin in stainless steel, CRTs
Automotive	safety glass	7007	cars (conductive tin coatings)	car batteries (addition of tin alloys), lithium ion batteries, radiators (brass alloys solders), wiring (tinned copper), bearings (tin alloy addition coatings), brake pads (tin additives), fuel tank (tin-zinc coating), sealants and seat cushions (tin catalyst), plastics (PVC stabilizers), electronics (solder fuses contacts), fuel catalysts, fire retardants, automotive exhaust systems (stainless steel)
Packaging	Tin can	9854		product containers, packaging for food and beverages
Construction	PVC	39042210		glass coatings in “green buildings”, PU foam

2.2.2.3 Tin Production, Supply and Demand

2.2.2.3.1 Non-EU Tin Production, Supply and Demand

Tin is predominantly produced outside Europe, with China and Indonesia being the leading tin producing countries, dominating two thirds of the tin mining (ITRI, 2012b). In 2011, China accounted for 46.82% of global tin production, Indonesia for 26.89% (see Annex 6 and 7). Furthermore, China is not only the world´s largest miner, but also the largest user of tin, having recently shifted from a net exporter to a net importer of the metal. 31% of Indonesia's crude tin is traded in significant quantities to Malaysia, China and Thailand, where it supplements domestic production and established refineries (RESOLVE, 2010). China and Indonesia are followed by Peru, Bolivia and Brazil, together producing 18% of global tin (2011). With Rwanda (8th place), the Democratic Republic of the Congo (9th place) and Nigeria (11th place), three Central African Countries are among the 15 main tin-producing countries (see Annex 7).

Powered by the rapid industrialization of China, a global boom in consumer electronics, and a rapid transition to the use of lead-free solders, world tin consumption reached a peak of over 370.000 tons in 2007. Today, after the financial crisis in 2008-2009, Chinese consumption has risen to a new peak, while demand has not fully recovered in the rest of the world. Presently, Asia accounts for over two thirds of the world's tin use, with China using over 40%. Overall, the development of new tin applications (lithium ion batteries, new stainless steel alloys and a wide range of energy-related products relying on tin chemicals) should lead to a demand of estimated 400.000 tons of tin in 2015 (ITRI, 2012b). In response to higher tin prices in 2010 and a simultaneous rising demand for tin applications, tin producers have opened and are still opening new tin mines and tin smelters as well as expanding existing operations (USGS, 2011).

2.2.2.3.2 Tin Production, Supply and Demand within the EU

Europe is strongly depending on tin imports, and the European Union was expected to be the second largest tin consumer in 2011 (The Economist, 2010). According to the World Mining Data (Reichl et al., 2013), the only European country among the 16 main tin-producing countries is Portugal (in 16th place) with a production of 39 metric tons in 2011 and a 0.01% share of global tin production. However, currently there are several projects in operation to revive mining in Europe: UK-based Treliver Minerals is exploring an area in South West England, while another UK-based company, Marine Minerals, is aiming to collect tin from waste material that has been dumped from onshore mines off the Cornwall coast. Another Canadian-owned mining firm, Solid Resources, is currently exploring the Doade-Presqueiras Mine in Northwest Spain for tin, tantalum and other rare metals (Tin Investing News, 2013). In addition, tin-research projects conducted by other companies which are encouraging tin mining in Europe are: Eurotin Inc. (Santa Maria and Oropesa/ Spain), Deutsche Rohstoff AG (Gottesberg and Geyer/ Germany) and European Metals (Cinovec/ Czech Republic).

Table 7 shows the refined tin consumption including EU and non-EU countries.

Table 7: Refined tin consumption (The Economist, 2010)[8]

('000 tons unless otherwise indicated)

	2007	2008	2009	2010	2011
China	138.2	138.5	143.0	150.1	154.8
EU	67.4	63.1	49.3	52.3	53.4
U.S.	32.7	31.4	25.9	28.4	29.3
Japan	34.2	32.2	23.0	29.8	33.4
South Korea	16.1	16.3	15.2	18.4	18.1
Taiwan	12.7	11.9	8.8	12.8	12.8
Brazil	6.0	5.5	7.7	8.5	8.8
Russia	2.3	2.8	2.3	3.0	3.2
Others	53.8	51.5	44.1	47.5	47.8
World Total	363.4	353.2	319.3	350.8	361.6
% change	-2.6	-2.8	-9.6	9.9	3.1

[8] Sources: World Bureau of Metal Statistics (WBMS); © Reproduced by the permission of The Economist Intelligence Unit.

2.2.3 Tungsten

2.2.3.1 Economic Operators

Tungsten, also known as wolfram (W), does not occur naturally as a free metal and therefore must be extracted in several steps from tungsten mineral ores such as scheelite or wolframite (Figure 10 and Figure 12).

In the first steps primary tungsten producers (mines + primary tungsten processors) extract tungsten ores either by underground or by surface open-pit mining, and perform primary mineral processing to produce tungsten mineral concentrates. Due to the metal's high melting point, tungsten cannot be processed in smelters.

Primary tungsten processors are plants which process tungsten ores chemically. These concentrates can be used directly in steel manufacture. Tungsten is often traded by undisclosed supply contracts which make traceability of the mineral difficult. This is why all intermediate supply chain tiers between primary tungsten producers, secondary processors and tertiary manufacturers are often very unclear and vary by country of ore origin.

Secondary tungsten processors are plants which use concentrates to produce a number of intermediate products (tungsten powders, tungsten carbide powders, ammonium paratungstate/ ATP, and/or tungsten chemicals). These companies are mainly based in Eastern Asia.

Tertiary tungsten product/ component manufacturers use intermediate products to produce finished tungsten metals and alloys or tungsten end products such as machine tools or wear-resistant components.

Due to the expansion of the (mainly Chinese) demand for tungsten, considerable strategical vertical supply chain integration (i.e. integration between processing and tertiary manufacturing facilities) through common ownership or contractual arrangements took place within Western tungsten industry (with a move away from exports of concentrates into downstream processing and manufacturing). Strategic mergers, acquisitions and investments were the reaction to the investment of large Chinese companies in Western tungsten projects (British Geological Survey, 2011b).

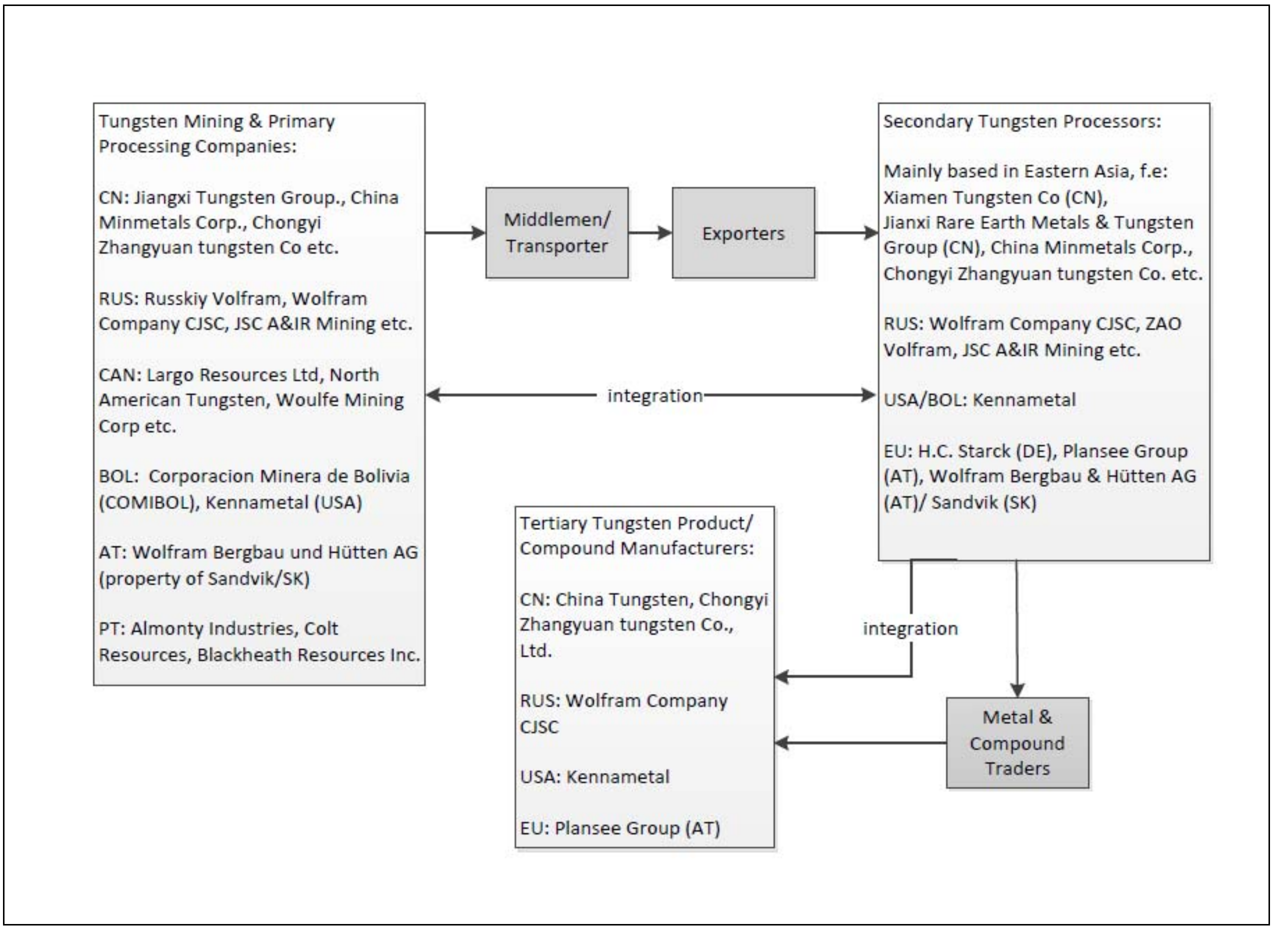

Figure 10: Examples for actors in the tungsten supply chain from mines to tungsten product/compound manufacturers

2.2.3.2 Involved industry sectors and products

Due to some unique properties like its extremely high melting point, very high density (similar to gold), and high thermal and electrical conductivity, tungsten is an essential component in a wide range of products. This fact makes it difficult to identify the main economically-relevant industry sectors, for most of the identified industries seem to be affected directly and/or indirectly by tungsten products. There are three main applications of tungsten: hard metals (cemented carbides), steel and other alloys and mill products.

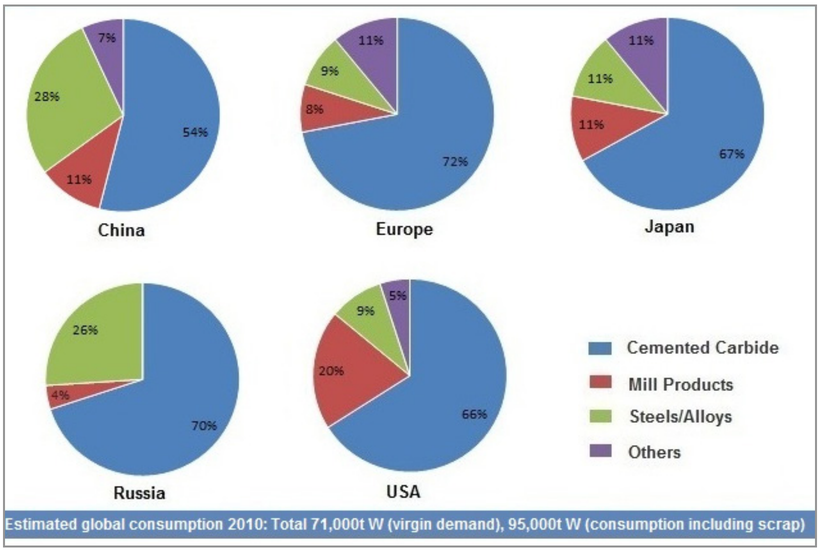

Figure 11: Primary uses of tungsten (ITIA 2011)

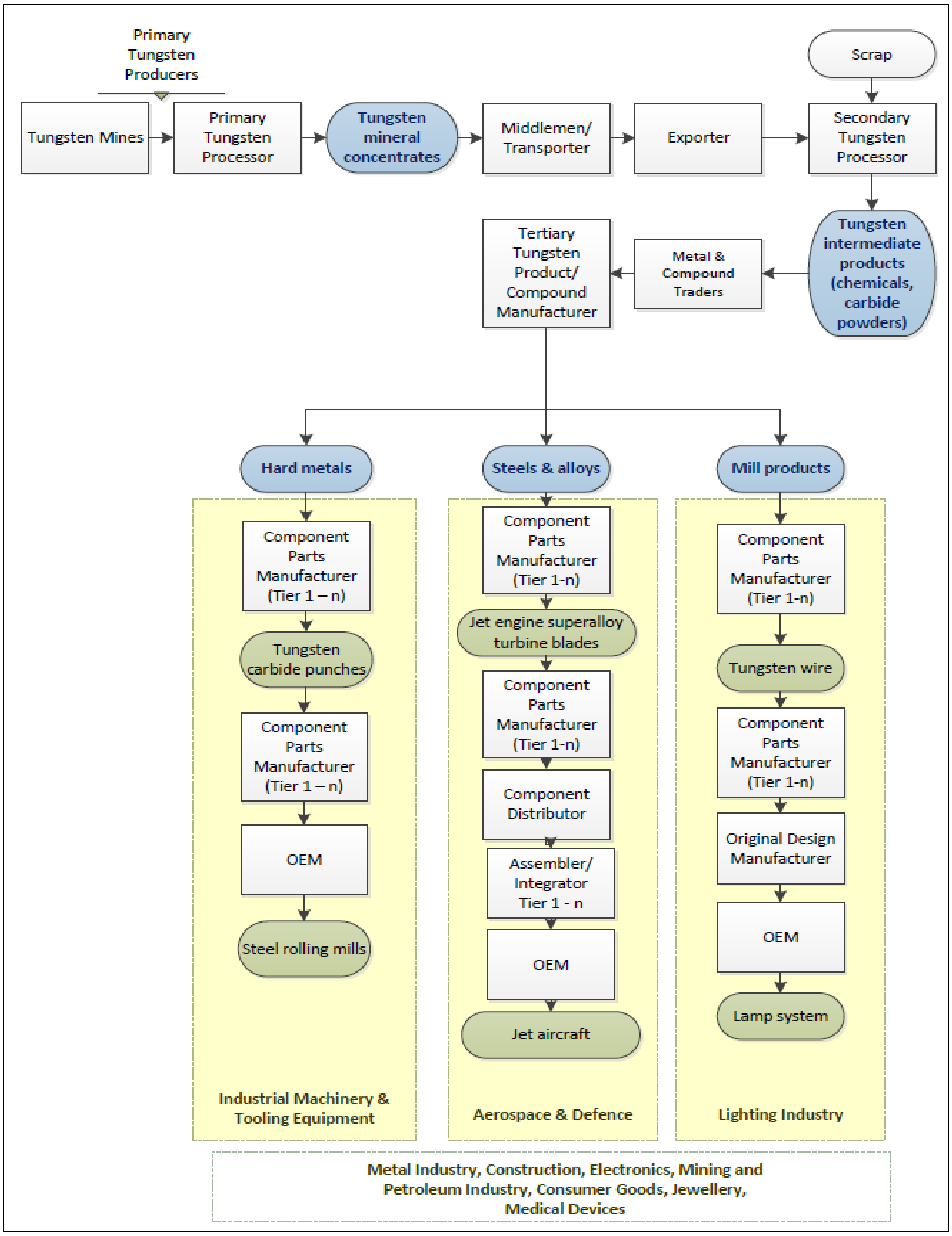

Figure 12: The tungsten supply chain matrix including the most important products (green), tungsten intermediate products (blue) and relevant industry sectors (yellow)

Hard metals, with tungsten monocarbide and cemented carbides as the main constituents are the most important uses of tungsten today. Hard metal tools are the backbones for the shaping of metals, alloys, woods, composites, plastics and ceramics. Main applications are in high tech machine tools where they need to withstand higher temperatures and have a high hardness and wear-resistance to abrasion. Therefore, tungsten hard metals are not only found in the industrial machinery industry, but in widespread industry sectors, from electronics, to construction, metal industries, mining and petroleum industries.

Tungsten is furthermore an important component of a large number of steels and alloys. Specialized steel alloys are utilized in specialist engineering application, where hardness and strength, particularly over a wide temperature range, are necessary (British Geological Survey, 2011b). Tungsten is a common heat-resisting alloying element in high speed steels, super high speed steels, heavy metal alloys, superalloys and other alloys, being used in applications in the defence and aerospace, industrial gas turbine, marine turbine, medical devices, construction, and electronics industries (British Geological Survey, 2011b).

Tungsten mill products are either tungsten metal products (lighting filaments, electrodes, electrical and electronic contacts, wires, rods and sheets) or tungsten alloys (ITIA, 2011a). The main characteristics of pure metallic tungsten – e.g. extremely high melting point, conductivity, and ductility – make it ideal for electrical and electronic applications. One of the most common uses of tungsten is the filament in incandescent light bulbs, followed by vacuum tubes, heating elements, medical X-ray tubes, electronic circuit interconnectors and distributor points in automotive ignition systems. The semiconductor industry consumes around 200 tons of tungsten hexafluoride (WF_6) per year worldwide. WF_6 is a gas, most commonly used in the production of semiconductor circuits and circuit boards (British Geological Survey, 2011b).

Table 8: Tungsten product examples

Industry	Key tungsten product	HS Code	Example	Other applications/products
Industrial Machinery and Tooling Equipment	Cemented carbides in punches for steel rolling mills	8101	punches for steel rolling mills	various high tech machine tools

Electrical and Electronics Industry	Tungsten platings	8101	mobile phone surface acoustic wave filters	electric contacts, tungsten-copper heat sinks used to remove the heat of microelectronic devices, electron guns, plasma generators, voltage regulators, semiconductors (die wire bonding, in small quantities on a chip), processors and chip sets (sputtet targets), transistors, mobile device vibration motors (shaft counterweights)
Lighting Industry	Tungsten wire	810193	incandescent filaments	tungsten wires in lamp systems, coils, coiled coils in incandescent lamps, electrodes in low- and high-pressure discharge lamps
Automotive Industry				window heating, valve seats, tungsten electrodes for car horns, motors (about 10kg tungsten heavy metal parts, located around the crankshaft for vibration damping), self-darkening mirrors (tungsten-bronze), tire studs (tungsten carbide)
Aerospace/ Defence Industry				jet engine turbine blades (tungsten-containing superalloys), weights of aeroplane's balancing flaps and ailerons (tungsten heavy metal alloys), tungsten composites as substitutes for lead in bullets (green ammunition)
Consumer Goods				ballpoint pens, golf balls and clubs, darts, trekking poles, skating blades
Medical Industry				X-ray tubes with electron gun (electrode + rotating anode made of tungsten), shielding of whole machine is done by tungsten heavy metal

Jewellery	wedding rings containing tungsten carbides, watchcases, tungsten heavy metal rotor in automatic watches
Engineering/ Construction	cemented carbides used for tool-hardfacing (steel alloys with tungsten), road construction work (cold milling machines with tungsten carbide road chisels)

2.2.3.3 Tungsten Production, Supply and Demand

2.2.3.3.1 Non- EU Tungsten Production, Supply and Demand

Major non-European tungsten deposits are found in the Far East (southern China, North and South Korea, Japan, Thailand, and Burma), the Asiatic part of Southern Siberia, Kazakhstan, Uzbekistan, Kyrgyzstan, Caucasus and the eastern coastal fold belt of Australia (see Figure 13). In Africa, tungsten deposits, either with or without tin, can be found in Rwanda, Uganda, and the Democratic Republic of the Congo (British Geological Survey, 2011b) (see Annexes 8, 9 and 10).

China is by far the largest primary tungsten producer, with a production of 69.900 metric tons. However, according to the U.S. Geological Survey, mine production from outside China is expected to increase. In order to avert dependency from Chinese mine production, numerous companies are working towards developing tungsten deposits or restarting tungsten production from inactive mines in Asia, Australia, North America and Europe (USGS, 2013e).

The world tungsten supply is dominated by Chinese production and exports. China is also the world's largest tungsten consumer. The country produces large quantities of mixed carbide powders, sintered tungsten and tungsten carbide products – most of them are for domestic consumption. In order to meet increasing domestic demand and conserve its tungsten resources, China started to regulate its domestic tungsten industry. The Chinese Government has imposed various limitations on foreign investment and export licenses as well as on exploration, mining and production of tungsten. Furthermore, China has been adjusting export quotas to favor value-added downstream materials and products, and has at the same time started to improve its tungsten-processing technology (USGS, 2013e).

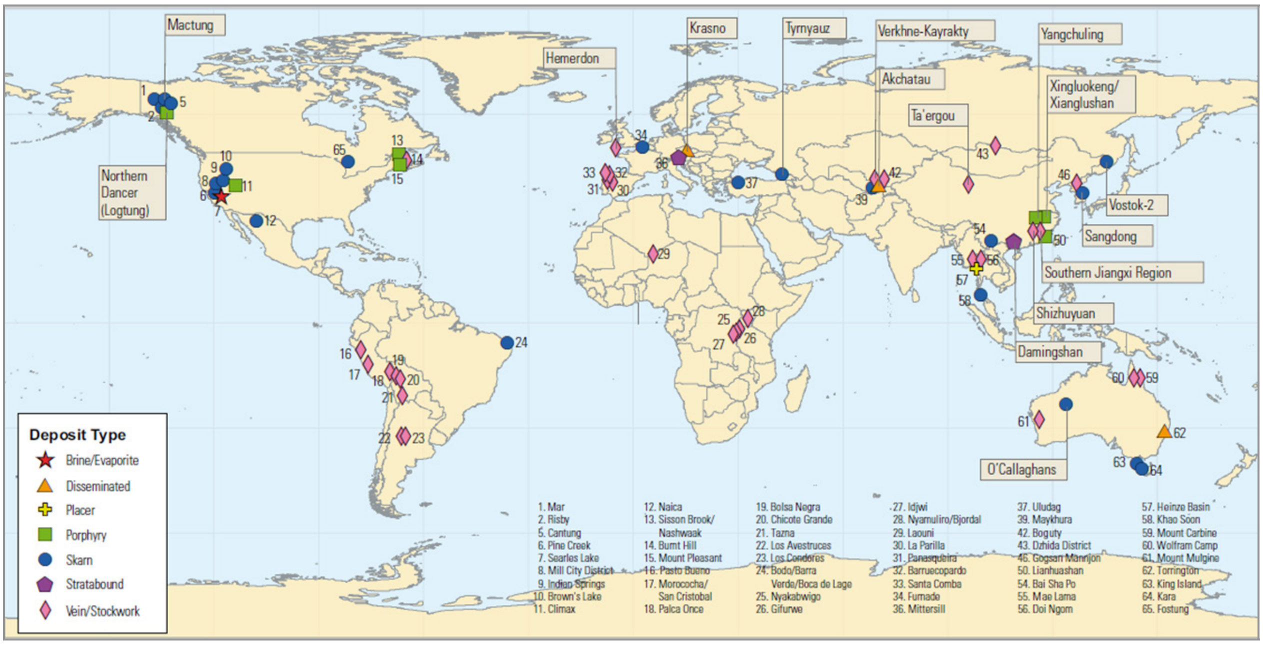

Figure 13: Location and type of major tungsten deposits and districts in the world (British Geological Survey, 2011b. CP 13/093 British Geological Survey © NERC. All rights reserved)

2.2.3.3.2 Tungsten production, supply and demand within the EU

Major tungsten deposits are found in the Alpine fold belt that arcs from Germany and the Czech Republic through France and South-West England and into Spain and Portugal (British Geological Survey, 2011b). Three European countries (Austria, Portugal and Spain) have significant mining production of tantalum as well as several tungsten mining research projects currently running (e.g. Tumi Resources' silver and tungsten research project in south-central Sweden).[9]

The EU is playing a leading role in the processing of tungsten and the development of many tungsten products for automotive, aerospace, medical and lighting applications (European Commission, 2010). Germany, Austria, the UK, Italy, France and Sweden are amongst the leading tungsten metals exporting countries, while Germany and the Netherlands are large ferro-tungsten and ferro-silico-tungsten exporters (British Geological Survey, 2011b). At the same time, Europe is heavily dependent (2010: 75%)(RPA, 2012) on external tungsten supply (EU demand 2011: 10.800 tons, global demand 2011: 79.600 tons)[10] (ITIA, 2012). China's dominance has created increased concerns for the security of the tungsten concentrate supply for western processors and industry end users.

---

[9] For further statistics concerning EU35 exports/imports of tungsten, see e.g. Brown et al. (2013)

[10] For a comparison: Russia's tungsten demand 2011: 2.306 tons (ITIA 2012)

Therefore, the European Commission has identified tungsten as one of 14 critical raw materials, implementing duty-free quotas for tungsten trioxide and tungsten catalysts (EC 2010).

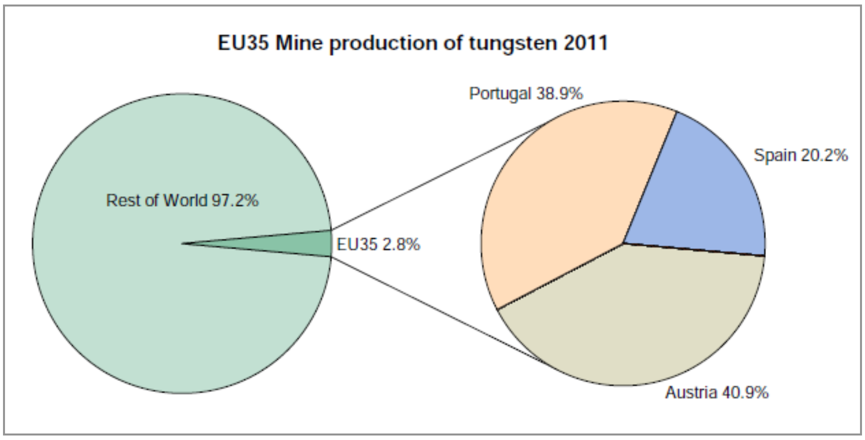

Figure 14: Mine Production of tungsten 2011 (Brown et al., 2013)

2.2.4 Gold

Gold (Au) is a precious dense and ductile metal, being produced from mines on every continent except Antarctica. Measured by value of production, the gold industry is the third largest non-ferrous metal industry, after aluminum and copper (GHGm, 2008).

The gold supply chain (which refers to the system of all the activities, organizations, actors, technology, information, resources and services involved in moving gold from the source to end consumers) can be divided into upstream supply chain/ upstream actors, and downstream supply chain/ downstream actors. “Upstream supply chain” refers to the gold supply chain from mine to the refiners. Upstream companies include miners, local gold traders or exporters from the country of origin, transporters, international gold traders and refiners. “Downstream gold supply chain” means the supply chain from refiners to retailers, including refined gold traders and gold markets, gold-vaulting entities such as bullion banks and exchanges, retailers and manufacturing companies (OECD 2013b).

2.2.4.1 Economic operators

Miners remove the gold-bearing ores from the ground. This operation is followed by complex extraction processes, either carried out by the mining companies (mine smelthouse) themselves or by processing plants (smelters).

There are several hundred gold mines operating worldwide, ranging from ASMs to large-scale gold mining companies (LSMs). Small-scale and artisanal miners (mainly working in African, Asian and Latin American developing countries) play a substantial role in the world’s gold production. The contribution of ASMs to global gold production was estimated to range from 20 to 30% annually (GHGm, 2008).

In 2010, the ten major gold companies with a production of over 0,5 million ounces gold per year were Barrick, Newmont, Anglogold Ashanti, Gold Fields, Goldcorp, Kinross, Buenaventura, Newcrest, Harmony and Yamana Gold. Intermediate companies (those producing less than 0.5 million ounces and more than 0,2 ounces gold per year) are Petropavlovsk, Agnico Eagle Mines, Rangold Resources, Hochschild, Golden Star, Eldorado Gold, Resolute, Northgate, Red Back Mining Inc. and New Gold. Small gold producers produce less than 200.000 ounces per year. The top ten among small gold producing companies are Gold Resource, Imperial, Indophil, Avoca, Guyana, Medusa, International Minerals, INT Tower Hill, Resolute and B2Gold (GoldVal.com, 2009). For the Top 20 listed companies, the Africa region is the largest producer (including South Africa), followed by the South American and North

American regions. Together, the three regions account for approximately 76% of the total world production by the Top 20 Companies.

The specifics of direct trade are often concealed behind commercial confidentiality, making the whole process of (national and international) direct selling/buying non-transparent. Neither seller nor buyer may be prepared to divulge details of transactions (GHGm, 2008).

The refiners purify gold to a commercial market quality (bullion bars with a purity of 99,5% or higher). The world´s major gold refiners are based near major mining centers or precious metals processing centers worldwide. South African Rand Refinery is the largest refiner in terms of capacity. Bullion dealers buy refined bullion bars and trade them to jewellery or electronics manufacturers, directly to or investors.

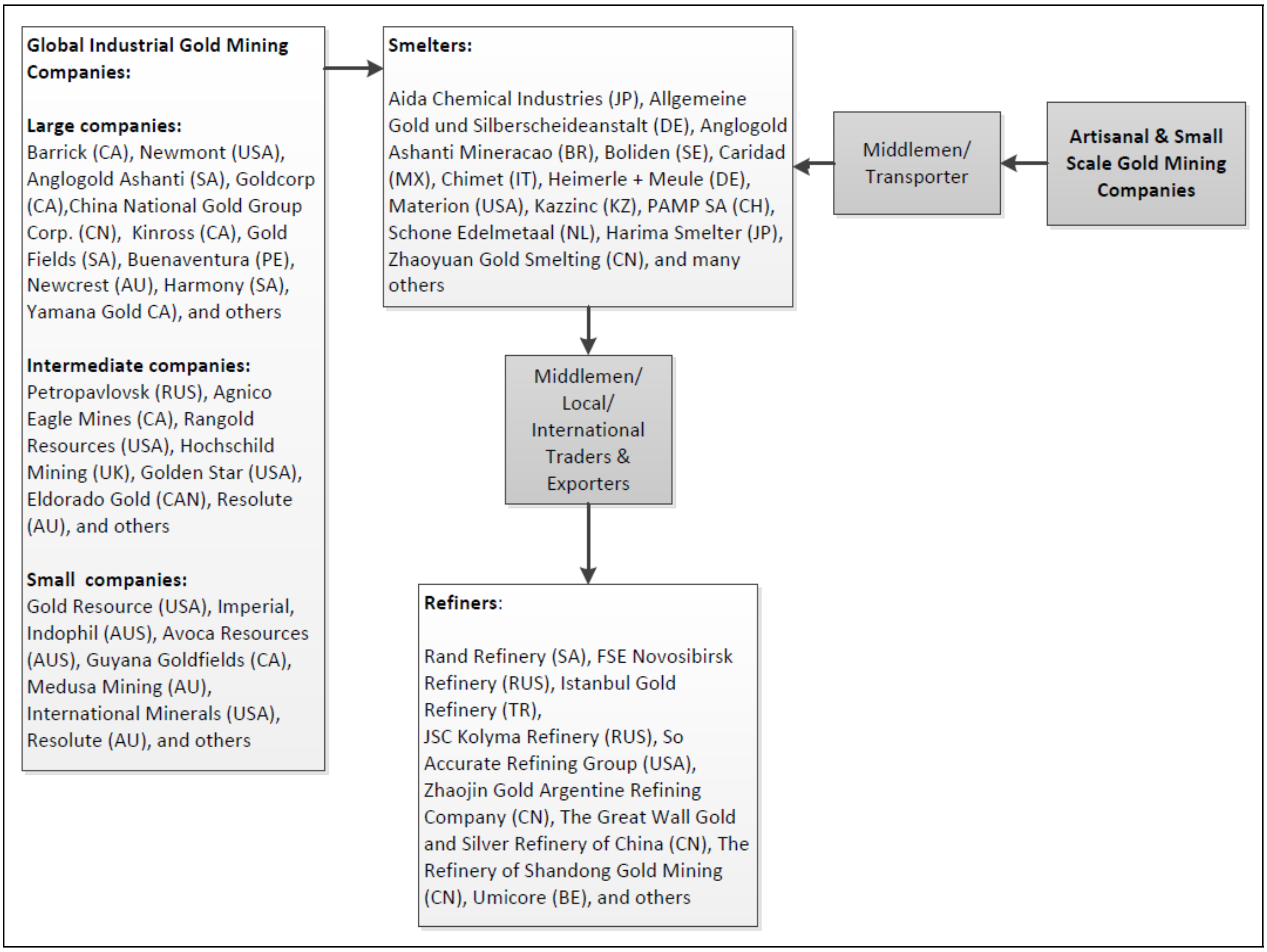

Figure 15: Examples for actors in the gold supply chain from mines to refiners

Between 2008 and 2012, recycled gold contributed an average of 39% to the annual supply flows World Gold Council, 2013-b). This and the avoidance of large bilateral contracts between miner and fabricator is typical for the gold supply chain and makes it difficult to trace the origin of the mineral. Another characteristic of the gold supply chain is that large quantities of the metal are held in stock by fabricators, dealers, banks, investment funds and state depositors (GHGm, 2008).

2.2.4.2 Involved industry sectors and products

Compared to the trade of other metals, gold trade is unique as it is both a commodity and an important financial product. Since ancient times, gold has been used for jewellery, decoration and for monetary purposes. Today, besides these traditional uses, a wide range of industrial applications are using gold because of its unique physical qualities. As Figure 16 shows, jewellery has the biggest demand for gold, followed by bar and coin and technology (subdivided in electronics, dentistry/medical applications and others).

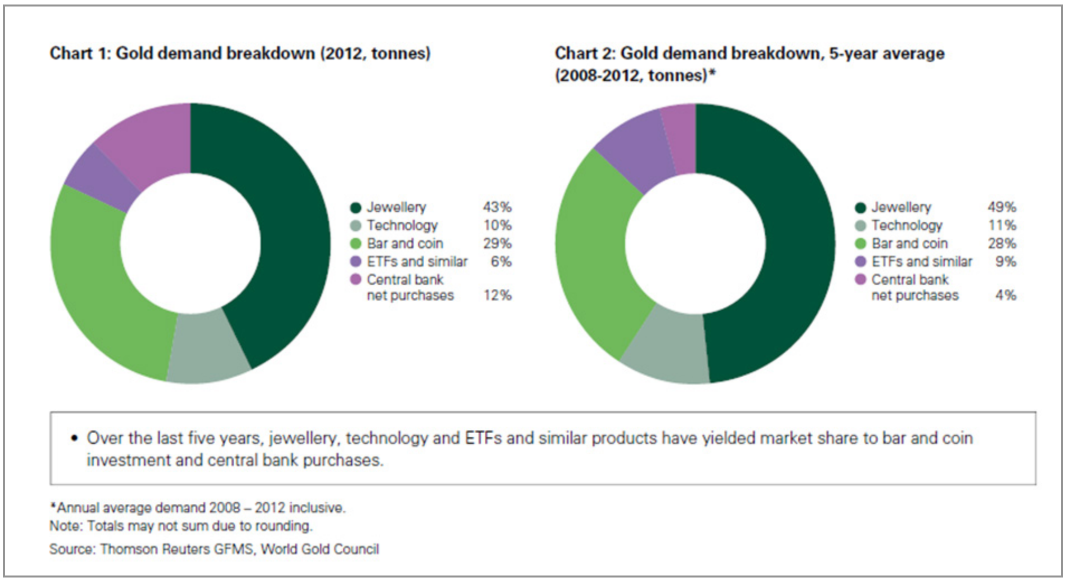

Figure 16: Gold demand breakdown 2012 and 5-year average (2008-2012) (World Gold Council 2013-c)

Jewellery is the largest component of annual gold demand. Carat jewellery and gold watches made of plain gold and gold combined with other materials are typical jewellery applications.

After jewellery and investment, the electronics industry is the most economically-relevant industry sector using gold, accounting for approximately 9% of annual gold demand (GHGm, 2008). Gold is the material of choice in many electronic applications, especially telecommunications, transportation, information technology and other high-performance and safety critical applications. Gold is an important semiconductor-component. Rapid expansion of the tablet, smartphone, MP3 player and flat display markets benefit in particular, while another electronic application using gold, micro electro-mechanical system (MEMS) pressure sensors, used for control and monitoring purposes in a wide range of applications, are becoming more and more important regarding their market share. Other important appliances are gold plating of connectors, switches and other parts (GHGm, 2008). Meanwhile, as the output of personal computers and the use of gold bonding wire continue to decline, these gold appliances begin to lose importance (World Gold Council (2013-a). Medical and dental applications can also be identified as an industry sector strongly dependent upon gold. The use of gold in medical applications reaches from various biomedical appliances to dental fillings made of gold and gold nanoparticles in cancer treatment.

Table 9: Relevant product examples for gold

Industry	Key gold product	HS Code	Example	Other applications/products
Medical Industry	high purity gold	7108	used as an implant	Gold nanoparticles in cancer therapy
Jewellery	18 carat gold	711319	Wedding ring	Watches, carat jewellery
Electronics Industry	semiconductor	8541	Tablet	Pressure sensors, gold plating of connectors, switches, bonding, wires

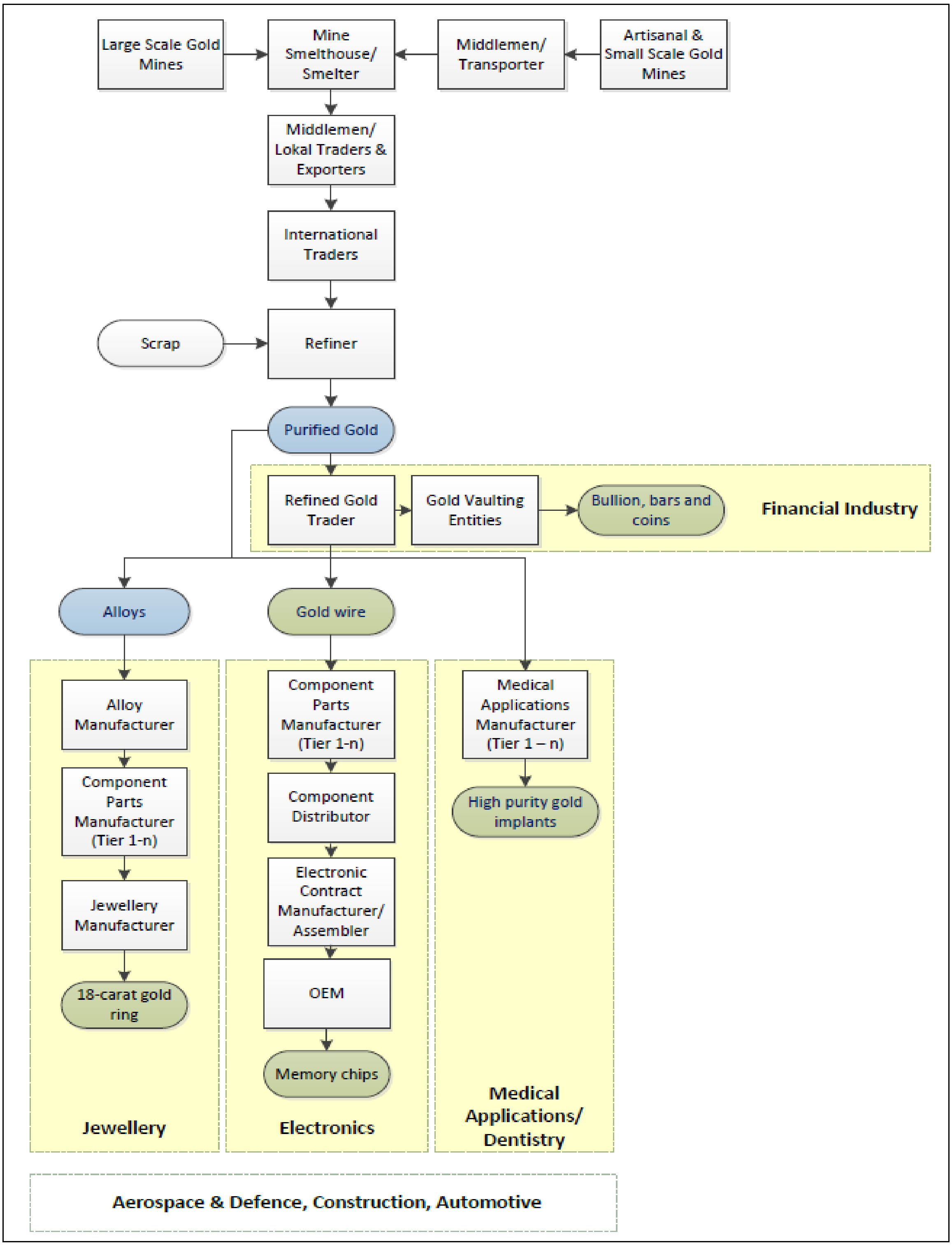

Figure 17: The gold supply chain matrix including the most important products (green), gold compounds (blue) and relevant industry sectors (yellow)

2.2.4.3 Gold Production, Supply and Demand

2.2.4.3.1 Non-EU Gold Production, Supply and Demand[11]

China, Australia, the United States, South Africa, Russia/Asia, and Peru are the six most important gold producers worldwide, with China ranking first (production 2011: 360.960 kg), followed by Australia (production 2011: 258.000 kg) and the United States (production 2011: 234.000 kg) (Reichl et al., 2013) (see Annex 12 and 13).

The main markets for gold jewellery demand are India, Greater China, the Middle East including Turkey, the Far East, and the United States (see Figure 18). Global jewellery demand in the first quarter of 2013 was at 551 tons. From 2012 to 2013, India, China and the United States experienced a strong growth in gold jewellery demand, while Russian jewellery demand was in line with its five-year quarterly average, the Middle Eastern markets experienced a post-Arab Spring-normalisation, and demand in Turkey experienced a slight growth (World Gold Council, 2013-a).

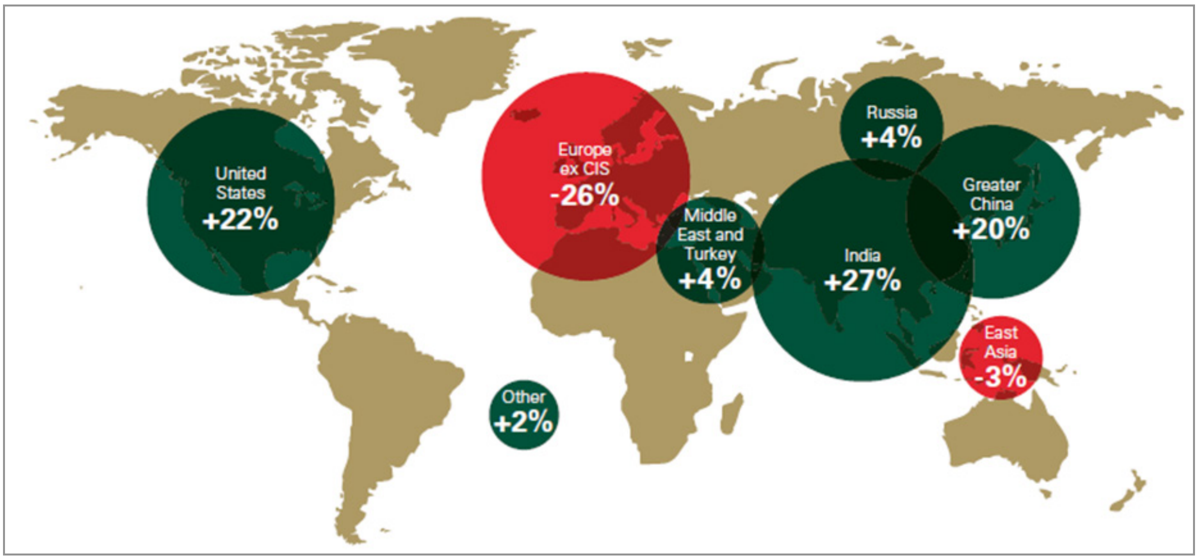

Figure 18: Year-on-year % change in total consumer demand in tons by region (World Gold Council 2013-a)

2.2.4.3.2 Gold Production, Supply and Demand within the EU

[11] Further information concerning production, demand and supply can be found under http://www.goldfacts.org/en/economic_impact/interactive_map/

According to Reichl et al. (2013), the European Community (EC) had a total gold production of 21.359 kg
in 2011. Even though the main gold-producing countries can be found on the Asian, American, African and
Australian continent, Finland (Rank 37), Sweden (Rank 43), Bulgaria (Rank 45), Poland (Rank 71), Romania
(Rank 75), Slovakia (Rank 79) and the United Kingdom (84) are among the 93 main gold-producing countries (see Annexes 12 and 13).

As to the European 2012-2013 demand for gold, most Western markets did not replicate the positive conditions of Indian, Chinese and U.S. American markets. According to the World Gold Council (2013a), the European demand for gold jewellery experienced a decline of 26% between the first quarter of 2012 and the first quarter of 2013.