SOCIO-ECONOMIC ANALYSIS

Legal name of applicant: REACHLaw Ltd as Only Representative on behalf of Joint Stock Company "Novotroitsk Plant of Chromium Compounds"

Prepared by: CTAC Consortium

Substance: *Chromium Trioxide; CAS 1333-82-0; EC 215-607-8*

Use title: *Use group 4/5: Surface treatment* ***(except ETP)*** *for applications in* ***various industry sectors namely architectural, automotive, metal manufacturing and finishing, and general engineering***

This Use includes processes that convert the surface of an active metal or coat metal surfaces by forming/incorporating a barrier film of complex chromium compounds that protects the metal from corrosion, provides a base for subsequent painting, provides a chemical polish, and/or colours the metal. This includes integrated process systems where chromium trioxide is used in a series of pre/main/post-treatments. Pre-treatment includes processes such as chemical polishing, stripping, dexodizing, pickling and etching of metals or other materials. Main-treatment includes processes such as conversion coatings, passivation and anodizing, deposition and other surface treatments where a chromium trioxide-based solution is used. Specifically, this includes continuous coil coating of steel and passivation (e.g. zinc plating, copper foils), but not passivation of tin-plated steel. Post-treatment includes processes such as rinsing, staining and sealing for final surface protection.

Use number: *4*

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NOTE TO THE READER

This document is the <u>unmodified</u> final version of the CTAC dossier of April 2015 for this use applied for, which has been developed over the course of three years.

CTAC is the Chromium Trioxide REACH Authorization Consortium, a group of more than 150 companies formed in 2012 to jointly develop draft applications for REACH authorization of several uses of chromium trioxide. Since CTAC's creation in 2012 the applicant has been a consortium member as only representative of our client, the non-EU manufacturer of chromium trioxide, *Joint Stock Company "Novotroitsk Plant of Chromium Compounds" (JSC "NPCC")* from Russia. The main purpose of joining CTAC has been to get access to the required downstream user-specific data relating to the Chemical Safety Report, Analysis of Alternatives and Socio-Economic Analysis, as reflected in the CTAC dossier, considering that JSC "NPCC" is located on top of the chromium trioxide supply chain, and only supplies to EU importers being distributors.

The present document has already been used by other CTAC Members on the same supply chain level to apply for authorisation, namely by the CTACSubmission Consortium ('CTACSub') of several upstream suppliers that act as importers / Only Representatives / formulators, with LANXESS Deutschland GmbH in its legal capacity as Only Representative of LANXESS CISA (Pty) Ltd. as the lead applicant.[1] REACHLaw, on behalf of JSC "NPCC", expressed interest in joining the CTACSub Consortium or refer to its application directly, but the membership is now closed and a reference to this previous application (REACH Article 63(1)) excluded in the CTACSub contract. Therefore, we herewith submit the document as part of an individual application for authorisation (same dataset).

In addition, we would like to note the following to support this application for authorisation:

The volume of chromium trioxide sold to EU by our client is only a fraction of the total volume covered in the CTAC dossier, and so are the described human health, environmental and socio-economic impacts.

Over and above the work done within the frame of CTAC, REACHLaw Ltd with the support of our client have engaged in intense communication with the EU customers (importers) of JSC "NPCC", all of them distributors only, with the objective of obtaining even more detailed supply chain and use-specific data from those importers as well as their customers and downstream supply chain. REACHLaw has prepared and circulated a survey document (questionnaire) to this end, and provided it in English and German language to our client's EU customers, with the request to circulate it further down the supply chain and to return responses. To date we have received some filled questionnaires, and will continue to follow-up also after submission to continuously improve the data basis in relation to actual operational conditions and risk management measures in place. To this end REACHLaw, together with our client, continue to be in close contact with our client's EU customers and their downstream supply chain, as far as accessible to us.

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[1] Consultation numbers on ECHA website: **0032-01** (formulation of mixtures), **0032-02** (functional chrome plating), **0032-03** (Functional chrome-plating with decorative character), **0032-05** (Surface treatment (except passivation of tin-plated steel (ETP)) for applications in various industry sectors namely architectural, automotive, metal manufacturing and finishing, and general engineering (unrelated to Functional chrome plating or Functional chrome plating with decorative character).

With kind regards,

Jouni Honkavaara,
CEO, Partner
REACHLaw Ltd., acting as Only Representative of Joint Stock Company "Novotroitsk Plant of Chromium Compounds"

LIST OF ABBREVIATIONS

ACEA	European Automobile Manufacturers Authorisation
AfA	Application for Authorisation
AoA	Analysis of Alternatives
APEAL	Association of European Producers of Steel for Packaging
ASTM	American Society for Testing and Materials
CAA	Chromic Acid Anodising
CASS	Copper Accelerated Salt spray test
CBA	Cost Benefit Analysis
CBI	Confidential Business Information
CCC	Chemical Conversion Coating
Cr(III)	Trivalent Chromium
Cr(VI)	Hexavalent Chromium
CSR	Chemical Safety Report
CTAC	Chromium Trioxide Authorisation Consortium
EC	European Commission
ECC	Electrolytic Chromium Coating
ECCS	Electrolytic Chromium Coated Steel
ECHA	European Chemicals Agency
EEA	European Economic Area
EFSA	European Food Safety Authority
EFTA	European Free Trade Area
ELR	Excess Lifetime Risk
ES	Exposure Scenarios
ETESS	Expert Team providing Scientific Support for ECHA

consortium

EU	European Union
EUROSTAT	Statistical Office of the European Communities
FTE	Full Time working Equivalent
GDP	Gross Domestic Product
GOES	Grain Oriented Electrical Steel
IARC	International Agency for Research on Cancer
IEC	International Electrotechnical Commission
ISCED	International Standard Classification of Education
IOM	Institute of Occupational Medicine
ISO	International Standardisation Organisation
MEK	methyl ethyl ketone
MVE	Man via the Environment
NewExt	New Elements for the Assessment of External Costs from Energy Technologies
NPV	Net Present Value
NSS	Neutral Salt Spray
NUS	Non-Use Scenario
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
PEC	Predicted Environmental Concentration
PET	Polyethylene terephthalate
PP	Polypropylene
RAC	Risk Assessment Committee
SEA	Socio-Economic Analysis

SEAC	Socio-Economic Analysis Committee
Surface treatment for miscellaneous sectors	Surface treatment (except ETP) for applications in various industry sectors namely architectural, automotive, metal manufacturing and finishing, and general engineering
SVHC	Substance of Very High Concern
TFS	Tin Free Steel
UG	Use Group
VOLY	Value of Life Years lost
VSL	Value of Statistical Life
WTP	Willingness to Pay

1. SUMMARY OF SOCIO-ECONOMIC ANALYSIS

The Socio-Economic Analysis (SEA) has been performed for the use of Chromium Trioxide in surface treatment (except ETP) for applications in various industry sectors namely architectural, automotive, metal manufacturing and finishing, and general engineering (hereafter referred to as surface treatment for miscellaneous sectors).

For the purpose of this SEA, a time frame of **7 years** after the sunset date (review period) is assessed.

The outcomes of this SEA are briefly summarised in the following.

Monetised residual risks to human health and the environment of a granted authorisation based on the ECHA guidance will be lower than:

- € 151 million (including impacts to workers in the supply chain and to the public "Man via Environment")

For the investigation a methodology has been used that is described in ECHA 2013 and ECHA 2011 (1) (2). However, the applicant, CTAC UG 4/5 consortium members and companies in the supply chain that may directly or indirectly rely on the Application for Authorisation (AfA) do not and should not by preparing this quantified Cost-Benefit Analysis or otherwise be construed to endorse, support, or otherwise accept the approach to the monetisation of health impacts. Data have been collected directly at CTAC UG 4/5 member companies and are compatible with the results of the Chemical Safety Report. Despite extensive data collection for more than one year uncertainties and data gaps still exist. They have been tackled in the methodology in a way that the risks to human health and the environment are in no way underestimated.

This justifies the statement "lower than € 151 million". Uncertainties and the influence of different parameters on the results are documented in an extensive sensitivity analysis.

Socio-economic impacts of a non-granted authorisation:

- Social impacts related to job losses amounting to at least € 1,354.1 million (see section 7.2)
- Economic impacts related to lost purchasing volumes amounting to at least € 701.1 million (see section 7.3)
- **Total socio-economic impacts: > € 2,055.2 million**

Also for the calculation of socio-economic impacts intensive data collection was done in all Member States. The data for job losses were based on clear causal chains for the case of a non-granted authorisation and were confirmed by single CTAC UG 4/5 member companies. Uncertainties and potential variations are investigated in the sensitivity analysis that comes to the conclusion that the result is stable and defines an underestimation of real impacts to be expected. Economic impacts were calculated on the basis of information provided by CTAC UG 4/5 members only. Following the underestimation approach, no extrapolation of economic impacts was done.

Referring to the figures above, the benefits of continued use clearly outweigh the risks to human health and the environment in monetary terms (see summary table of the impact assessment in section 8.1). By the modelling parameters chosen, health impacts are most certainly vastly overestimated and socio-economic impacts are intentionally underestimated.

Apart from the outcomes of the quantitative impact assessment conducted in this SEA, the following factors are relevant for the assessment of the review period, and these are further evidenced in the SEA report:

- The large number of complex supply chains involved, and associated challenges in terms of accurately identifying and quantifying impacts in the supply chain (see section 5).
- The economic and strategic importance, both resulting from industry's aim to deliver services that meet the most stringent criteria for health and safety, of several key industry sectors (e.g. automotive, steel, architecture) within the European Economic Area (see section 3.2).
- Rigorous and extensive regulations and requirements governing adaptation processes (see section 5).
- Long lifecycles of many products that are treated with Chromium Trioxide (see section 5).
- Wider economic impacts, *inter alia*:
    - migration of the concerned European industry to non-EEA countries
        - negative impacts on trade and distortion of competition
        - negative impacts on national budgets due to loss of taxes paid
        - supply disruptions, leading to increasing dependence on non-EEA imports of Chromium Trioxide surface-treated articles
        - know-how loss in the supply chain
        - possible negative impacts on the quality of components

Considering all factors elaborated in this SEA, a review period of not less than **7 years** is clearly justified.

2. AIM AND SCOPE OF SEA

2.1. Aim

Chromium Trioxide is classified under REACH as a Substance of Very High Concern (SVHC) (according to Article 57(a) of Regulation (EC) No 1907/2006 (REACH) (3). It was included in the list of substances subject to authorisation (Annex XIV) in the course of the third recommendation of ECHA for the inclusion of substances in Annex XIV from 20th December 2011. Furthermore, Chromium Trioxide is categorised as a non-threshold substance and therefore the so-called Socio-Economic Analysis (SEA) route is foreseen under REACH (4).

The applicant #, as a member of the Chromium Trioxide Authorisation Consortium (CTAC) use group 4/5, applies for authorisation to continue the use of Chromium Trioxide in surface treatment for miscellaneous sectors, after the sunset date in September 2017.

This Socio-Economic Analysis (SEA) forms part of the Application for Authorisation (AfA) for the use of Chromium Trioxide in surface treatment for miscellaneous sectors within the scope of the Chromium Trioxide Authorisation Consortium (CTAC) and its supply chain. Other documents prepared as part of the AfA include a Chemical Safety Report (CSR) and an Analysis of Alternatives (AoA). These documents are referenced here to provide context for the SEA.

The Analysis of Alternatives (AoA) demonstrates that there are no available substitutes (qualified and industrialised**)** for Chromium Trioxide in surface treatment for miscellaneous sectors until and beyond the sunset date (see corresponding AoA document). The aim of this Socio-Economic Analysis (SEA) is to demonstrate that the socio-economic benefits associated with the continued use of Chromium Trioxide in surface treatment for miscellaneous sectors outweigh the remaining risks to human health and the environment associated with prevalent use conditions (see corresponding AoA and CSR for further details on the availability of alternatives and use conditions, respectively).

2.2. Scope

Surface treatments within the scope of this document include processes that convert the surface of an active metal by delivering a barrier film of complex chromium compounds that provides various critical functions, including protecting the metal from corrosion, providing resistance to wear by increasing the hardness of the surface or an adhesive base for subsequent painting, or a chemical polish, and / or colouring the metal.

Amongst others these surface treatment processes include conversion coatings, deposition and other surface treatments where a Chromium Trioxide based mixture is used. They also include continuous coil coating of steel and passivation (e.g. zinc plating as an example for CCC) where Chromium Trioxide is used to deposit a film (typically 0.1-2 µm in thickness) primarily to enhance corrosion protection and adherence properties.

The surface treatment processes, as described, may also include the use of Chromium Trioxide in pre-treatment steps such as brightening, electrolytic de-burring, chemical polishing, pickling and etching of metals.

Further background to these uses and their application in specific industry sectors is provided in the following sections of this document.

European industry has evolved over many decades and is characterised by a broad, integrated, complex and multi-tiered supply chain. Recognising the need to secure the use of Chromium Trioxide to ensure continued availability of critical components beyond the sunset date, the severe consequences associated with failing to do so, and the challenges associated with working with a mature and complex supply chain, several companies organised a consortium (CTAC) as a platform to facilitate an application for authorisation of Chromium Trioxide. The CTAC membership includes 150 importers, formulators, distributors, users and customers from across the industry; many members do not use Chromium Trioxide themselves, but are reliant on the availability of Chromium Trioxide for their business. Reference to the CTAC, which provided the platform for collaborative efforts to prepare data necessary to support application, is given within this document.

Information from members of the CTAC and the public domain have been used as the basis for evidence supporting this application. 72 member companies of CTAC UG 4/5 support surface treatment for miscellaneous sectors and surface treatment for the aero sector[1].

The scope of analysis geographically concentrates on the territory[2] of the European Economic Area (EEA), which is comprised of the current twenty-eight Member States and the states of Iceland, Liechtenstein and Norway. Thus, the impact assessment covers this area specifically.

Impacts considered in this SEA include (1) health and environmental impacts related to the continued use of Chromium Trioxide and (2) social impacts and (3) economic impacts linked to a decision not to authorise the continued use of Chromium Trioxide in surface treatment for miscellaneous sectors.

1 For the use of Chromium Trioxide for the aero sector a separate Application for Authorisation is filed.

2 Means the 'customs' territory of the Community as defined in the REACH Guidance for the Navigator. The customs territory of the Community comprises the territory of: Austria; Belgium, Bulgaria, Croatia, Cyprus, The Czech Republic, Denmark (except the Faroe Islands and Greenland), Germany (except the Island of Helgoland and the territory of Büsingen), Estonia, Finland (including the Aland Islands), France (except New Caledonia, Mayotte, Saint-Pierre and Miquelon, Wallis and Futuna Islands, French Polynesia and French Southern and Antarctic Territories), Greece, Hungary, Ireland, Italy (except the municipalities of Livigno and Campione d'Italia and the national waters of Lake Lugano which are between the bank and the political frontier of the area between Ponte Tresa and Porto Ceresio), Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovenia, The Slovak Republic, Spain (except Ceuta and Melilla), Sweden, The United Kingdom of Great Britain (including Northern Ireland and the Channel Islands and the Isle of Man). The customs territory of the Community includes the territorial waters, the inland maritime waters and the airspace of the Member States and the territory of the Principality of Monaco, except for the territorial waters, the inland maritime waters and the airspace of those territories which are not part of the customs territory of the Community as listed above.

For the purpose of this SEA, a review period of 7 years is assessed. Since the sunset date for Chromium Trioxide is in September 2017, the period of time covered by the SEA runs from 2018 to 2024 (taking 2017 as a base year for calculations).

3. DEFINITION OF THE APPLIED FOR USE SCENARIO

As described before, Chromium Trioxide is used in surface treatment for miscellaneous sectors for a broad range of applications.

The main functionalities achieved by surface treatment with Chromium Trioxide are corrosion and chemical resistance, increase of hardness, adhesion, and / or conductivity.

Surface treatment with Chromium Trioxide involves complex chemistry and complex processes. Articles that have been surface treated with Chromium Trioxide are used in several industry sectors, as described below. The use of such surface treated components is often mandated where components are required to operate in challenging environments to ensure quality and safety of the end product over decades. Examples of specific surface treatment applications are provided below (for further information please refer to the AoA):

- **Passivation:** Changing of metal surface conditions usually forming a barrier film. This is applied e.g. on stainless steel, galvanised steel, aluminium, copper foils.
- **Chemical Conversion Coating (CCC):** Treatment of cadmium, magnesium, aluminium and zinc substrates or other metal substrates and coatings to provide properties like paint adhesion, corrosion resistance and conductivity.
- **Chromic Acid Anodising (CAA):** Forms an oxide layer by an electrochemical process for corrosion protection of aluminium components, increase of their intrinsic hardness, their electrical insulation and for paint adhesion.
- **Grain-Oriented Electrical Steel insulation:** A generally inorganic coating, applied to steel strip or steel sheet for the manufacture of electrical apparatus.
- **Electrolytic chromium coated steel:** Steel electrolytically coated with a very thin layer of chrome, also known as Tin Free Steel (TFS).
- **Sacrificial and diffusion coatings and paints for corrosion protection:** Inorganic aluminium based slurry coating on steels or a diffused slurry aluminide coating for sulphidation protection.
- **Standalone processes:** Material removal such as pickling, etching, and stripping.

There may or may not be measurable amounts of Cr(VI) on the surface coating. The CSR has evaluated worker exposure to Cr(VI) during post-treatment activities such as polishing and drilling.

The following non-conclusive list shall give an overview of the wide range of sectors in which Chromium Trioxide is used for surface treatment for miscellaneous sectors. All these sectors depend on Chromium Trioxide to meet their high requirements on products used under a broad variety of conditions.

- **Automotive:** various surface treatments in the automotive sector, e.g. anodising of aluminium
- **Building and Construction:** Facade construction, roofs, street furniture (fences, bicycle stands, bus shelter, noise protection dams, outdoor sports equipment)
- **Energy:** Gas turbines, compressors, electrical steels for transformers, generators and electric motors
- **Packaging industry:** Steel for packaging for example food, beverages, aerosols, cosmetics, caps and crowns
- **Marine:** Power and propulsion equipment
- **Electronic devices:** microelectronics, printed circuit boards, battery industry
- **Steel and non-ferrous metal**: coil coated and colour coated metals
- **Other sectors,** e.g. personal care products, scientific instruments (e.g. for use in electron microscopes), medical equipment, electronics, security equipment (e.g. for use in body scanners)

3.1. Supply chain

As seen before, companies involved in surface treatment for miscellaneous sectors with Chromium Trioxide can supply a broad range of industries. Figure 1 presents a generalised supply chain of Chromium Trioxide in this use.

Parts that have been treated with Chromium Trioxide during surface treatment for miscellaneous sectors are required for a wide range of applications, for *in-house use* or for use across diverse and complex supply chains, serving a vast number of downstream users and, ultimately, consumers.

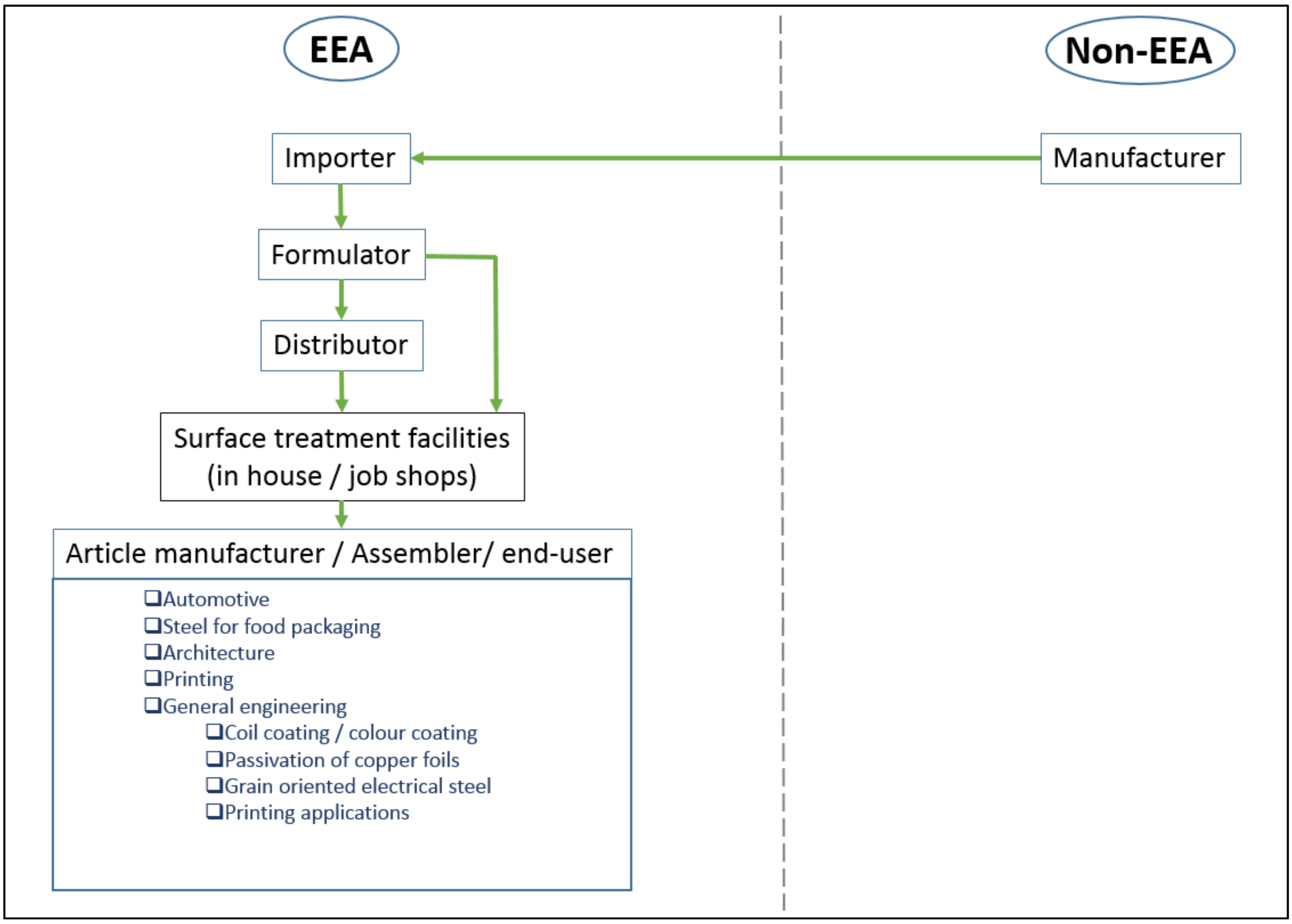

Figure 1: Generalised supply chain for Chromium Trioxide

Chromium Trioxide is now manufactured outside the EEA, imported, and distributed to users as pure substance or to formulators or distributors that produce mixtures containing Chromium Trioxide. These mixtures are then sold either directly or via distributors to the surface treatment shops, using the mixtures for surface treatment, either in-house as part of the production line or as contracted work (job shops). The treated parts and components may then be processed further and assembled at article manufacturers, assemblers or end-users comprised of different industrial sectors.

3.2. Applications of surface treatment in specific industries

As indicated above, Chromium Trioxide is essential for a vast range of industry sectors. The most commonly identified sectors are described in the following sections.

3.2.1 Automotive industry

The EU is one of the world's largest producer of motor vehicles. The automotive industry is therefore central to Europe's prosperity[3]. 6.6 million vehicles are exported to almost all countries around the world (34% to Asia and Oceania, 26.8% to North America, 25.1% to EFTA and Eastern Europe, 6.8% to Africa, 4.8% to the Middle East and 2.4% to South America and the Caribbean).

The European Automobile Manufacturers Association (ACEA) advises that the manufacturing of motor vehicles accounts for € 840.5 billion in turnover in 2011, and employs 3 million people in automotive manufacturing. Overall it contributes to 12.9 million people employed (5.3% of the EU employed population). This includes activities from manufacturing, automobile use, maintenance and repair, as well as activities such as transport by road, and construction of roads that may not be impacted by a decision not to authorise. Nevertheless, the economic importance of this market is clearly very substantial. Moreover, the European automotive industry represents 23% of world production of passenger cars, accounting for more than 14.6 million units in 2012, supporting a vast supply chain and generating a vast array of business services (5).

In addition, the automotive industry is a key R&D investor leading in innovation worldwide, spending over € 32 billion and producing 9,500 patents per year.

Chromic acid anodising is applied on aluminium surfaces in the automotive sector. Aluminium as a light metal is crucial in this sector as automotive manufacturers have to comply with emission regulations.

As stated in the corresponding AoA, wear and corrosion protection are very important functionalities of Cr(VI) surface treatments in the automotive industry. These are required for a variety of automotive parts including but not limited to shock absorbers, gas springs, engine driven trains, steering and differential components, power trains, piston rods, hydraulics, fuel injection components, piston rings, break pistons, cold roll cylinders, and bearings are all of these relevant to UG 4/5. Depending on the application, further functionalities are required such as anti-adhesive properties, high hardness, chemical resistance, and variable thickness (6).

3.2.2 General engineering (including steel)

The steel processing industry utilises several surface treatment applications requiring Chromium Trioxide.

[3] http://ec.europa.eu/growth/sectors/automotive/index_en.htm [cited on 16 February 2015].

Colour coating / Coil coating

Colour coating / coil coating is a continuous process for providing paint or film coating to strip metals, primarily steel and aluminium, before fabrication of finished components. Up to three separate coating layers are applied onto one or both sides of the metal strip surface. The relevant process steps with regard to the use of Chromium Trioxide are cleaning and pre-treatment. Acid or alkali cleaning is used to achieve a high level of cleanliness ensuring a high quality finish. Chemical pre-treatment must be applied to ensure good adhesion between the metal surface and the paint or film (7). The paint has to be applied on a perfect homogenous surface without any imperfections, free of cracks and wrinkles. As mentioned, by applying Cr(VI) a passivation layer is achieved after a series of pre-treatments to increase corrosion resistance and to improve adherence of subsequently applied coatings. After drying of the passivation layer, the colour coating follows in several subsequent steps (layers) by alternation of heating and cooling. In general, there are layers which include a Cr(VI) containing primer (first coating) and a Cr(VI)-free topcoat. One or more organic paint layers are applied to achieve durability and appearance of the products.

Colour coated/coil coated products are used in a variety of applications. By far the largest market for coil coated steel and aluminium is the construction market where the building cover represents the main use.

Outside the building industry, the range of applications for coil coated metals is vast. Coil coated metals are used wherever the end use demands a high-quality painted finish on a component fabricated from sheet metal. In the transport sector, coil coated materials are used in parts such as trailer bodies and recreational vehicles, but also in a variety of components such as oil filter caps and wiper blade assemblies. Coil coated metal is used as a pre-primed surface for the body-in-white of cars, providing a high-quality base for application of customised automotive paint coatings.

As of 2012, the turnover of the European coil coating industry was estimated to be € 5.5 billion, with an output of 1,240 million m^2 of coated metal. An estimated number of 5,100 employees is employed directly in the coil coating process in Europe (7).

Chromate conversion coatings

Chemical Conversion Coating (CCC) is a chemical or electrolytic process applied to a substrate producing a superficial layer containing a compound of the substrate metal and the process chemistry. In general Chemical Conversion Coatings form an adherent, fixed, insoluble, inorganic crystalline or amorphous surface film of complexes from oxides and chromates or phosphates as an integral part of the metal surface by means of a chemical reaction between the metal surface and the immersion solution.

There are two main classes of products which are subject to a CCC treatment, the first are products made of aluminium and its alloys (Al CCC) and magnesium and its alloys (Mg CCC). The second are metallic coatings such as aluminium coatings, zinc coatings, zinc-coatings, zinc-nickel-coatings and cadmium coatings applied on steel substrate where CCC is to provide corrosion protection. For further technical details and applications, please refer to the corresponding AoA (6).

Grain oriented electrical steel insulation

Chromium Trioxide is used as a component of the final coating which is put on grain oriented electrical steels. There is no Cr(VI) (below detection limit) present in the final coating of grain oriented electrical steel. This phosphate based coating is designed to provide electric insulation to the steel and tension as well. Other properties are also important. Chromium Trioxide is known to take part to the tension imparted to the steel by the coating and to avoid the coating to separate from the surface.

Grain oriented electrical steels are produced mainly for electrical transformers (power and distribution transformers) for which they offer vital properties. Cr(VI) is applied in the insulation layer which has to be resistant to corrosion and chemicals such as transformer oils and to withstand working temperatures (up to 300°C). Besides that, lower noise levels and smaller core sizes in transformers can be achieved with the use of Chromium Trioxide.

With regard to energy efficiency and the increasing production of electric cars, the importance of grain-oriented steel is expected to further increase in the future.

Passivation of copper foils

Copper foils are used in the production of Printed Circuit Boards (PCBs), which are widely used for electronic, automotive and industrial equipment. Conversion coating with Cr(VI) is applied to protect copper foils from corrosion and tarnishing under harsh conditions. Copper foils are treated through several processes to improve their reliability and processability. Heat resistance, no oxidation and compatibility with different substrates is necessary, since the passivated cooper foil has to be laminated with various resins. Copper foils must be weldable to prepare circuit boards and have to show a certain surface roughness to promote adhesion to dielectric materials or to photo resists during PCB fabrication. For further details, the reader is referred to the corresponding AoA (6).

3.2.3 Architecture

Within the architectural sector, Chromium Trioxide is used for chromating of aluminium or galvanised steel. This process provides corrosion protection and prepares the surfaces for powder coating and / or liquid paints. Architectural applications in general products have to comply with Qualicoat and the more demanding specifications from GSB, an international organisation for quality surface coating (please refer to the AoA for further details). The coated building materials must be corrosion resistant in acidic (e.g. harsh maritime climate) and neutral conditions. Long warranty times are common for this sector and a minimal end-of life period of 20 years for most materials is usual.

3.2.4 Steel for packaging

Data provided by the steel industry reports 5,100,000 tonnes of packaging steel produced in 2012. This is an overcapacity in the European market, which results in an export of nearly 20% of the produced volume. The steel packaging market is diverse and versatile; ever-changing import and export volumes demonstrate a dynamic and viable market (8).

Electrolytic Chromium / Chromium oxide Coated Steel (ECCS) is mainly used for packaging of food and beverages. Other packaging applications are for example closures, cans, aerosol containers and paint cans. Each packaging use has specific requirements and unique performances (shelf life, pack and cycle performance). A well-known application is the heat treatment of packed food, which can easily be done with a steel packaging (9).

Chromium Trioxide is a key substance to achieve essential properties required for packaging steel.

Electrolytic Chromium / Chromium oxide Coating (ECC) was developed by the industry as an alternative for tin plating, due to the lack in tin reserves.

As stated in the AoA, ECC is always used with an additional coating such as a lacquer or polymer coating. Polymer-coatings (PET or PP) are applied either by laminating film or extruding polymer directly onto the substrate, usually on both sides. Furthermore, it is very resistant to heat, to alkali milieus and to black sulfide stain. The latter makes it the most suitable material for fish cans.

Regarding possible alternatives for ECC, it is indicated by the industry (Association of European Producers of Steel for Packaging -APEAL-) that despite ongoing research on Cr(III), and other solutions, no solution has been found that fulfils, amongst others, the following criteria for food packaging (please also refer to the AoA) (10):

- ensuring organic coating adhesion and
- protection of steel from sulfuration by the can content

Furthermore, in case of existence of potential substitutes, those need to be validated over the entire life cycle of the can, including storage at can manufacturing sites and shelf life (normally from two to three years) (10).

3.2.5 Summary

The market for surface treatment with Chromium Trioxide for miscellaneous sectors is very valuable to the EEA. The figures for production values are not available for this use as a whole but the various applications demonstrate the importance of this use for the overall value chain. Chromium Trioxide surface treatment is an important part of cross-sectorial manufacturing of products in the European economy. It concerns a wide variety of sectors, of processes on numerous types of parts and substrates, being new parts, spare parts or worn parts in service needing to be repaired.

4. DEFINITION OF THE NON-USE SCENARIOS

The non-use scenarios were developed through multiple channels. In the first instance, members of the CTAC use group 4/5 prepared a description of the non-use scenario. These were then developed through a series of bilateral discussions, site visits and meetings, conducted by independent consultants experienced in the process of developing such scenarios for EU regulatory purposes, in order to test the robustness of, validate and elaborate these scenarios. Member companies from across all sectors directly and indirectly affected were involved in the process.

It is notable that the non-use scenarios described by the CTAC use group 4/5 member companies are significant. This can be seen to reflect the critical function that Chromium Trioxide plays for many industry sectors.

Since a detailed description of all non-use scenarios prepared by CTAC use group 4/5 members would not be feasible, consolidated non-use scenarios representative for the responses of affected industry sectors are presented below.

Non-use scenarios developed by CTAC UG 4/5 members include:

- Partial shutdown / shutdown of production facilities
- Relocation of production facilities to non-EEA countries
- Subcontracting to non-EEA suppliers

Given the fact that there is no alternative to Chromium Trioxide in surface treatment for miscellaneous sectors, activities related to Chromium Trioxide that are carried out by **importers, formulators and distributors** of Chromium Trioxide will become obsolete within the EEA in case of non-authorisation. Import to the EEA will cease. Formulation would be relocated to non-EEA countries, and distribution channels will respond accordingly.

Surface treatment facilities would shut down their activities related to Chromium Trioxide in the EEA. Companies that additionally offer other surface treatment or business activities without Chromium Trioxide may partially shut down their facilities or seek to apply non-mature technologies. Based on existing information from industry, these ‘emerging’ technologies are unlikely to fulfil the customers’ requirements: therefore it is very likely that customers will look for other sources (non-EEA suppliers) of chromium surface treatment to cover their demand. Consequently this may result in shutdowns or relocations of companies due to decreasing demand, finally resulting in losses for the EEA. However, there are also surface treatment facilities which report that they cannot afford a relocation, and therefore “simply” cease their business activities.

Article manufacturers and assemblers of Chromium Trioxide treated components that operate in-house surface treatment will either (partially) shutdown their facilities, subcontract these operations to companies outside the EEA, or relocate their chromium-related production lines to non-European territory. In the latter case, further sub-assembly steps are likely to be relocated as well. Therefore, even larger parts of their businesses will migrate to non-European countries. Those companies that do not operate in-house surface treatment facilities will subcontract these operations to companies outside the EEA.

Some companies note that, considering the negative impacts in the non-use scenario, they might not be able to stay competitive. In these cases, the non-use scenario will result in a complete shutdown of all activities. This will result in loss of revenue and cancelation of contracts.

Relocation of surface treatment (and, potentially, sub-assembly) activities will have important implications for product quality, supply times and security of supply.

Further negative impacts to the European economy include leakage of know-how and technology transfer to non-EEA countries, affecting Europe´s position as a technology leader. Furthermore, all non-use scenarios lead to increased imports of products.

In summary, all non-use scenarios lead to a different extent to losses for the EEA, jeopardising European competitiveness and work places.

4.1. Summary of impacts of non-authorisation on the supply chain

Non-authorisation of the continued use of Chromium Trioxide in surface treatment for miscellaneous sectors will have a series of severe impacts on the European supply chain. Firstly, job shops as well as in-house surface treatment facilities will not be able to carry out their work anymore, shutting down their production lines in the EEA and ceasing delivery of parts. Companies that can afford to relocate to a non-European country will do so; all other companies will shut down and cease production.

Regardless whether companies will shut down or relocate, their non-use scenarios lead to considerable welfare losses to the EEA.

Being unable to source parts and components in the EEA, assemblers and end-users of Chromium Trioxide surface treated parts and components will cover their demand at non-European suppliers and possibly relocating parts of their assembly lines to non-European countries (partly assembling subunits outside the EEA and importing these). This will further increase the loss of value-added within the EEA.

As a final consequence, the entire European supply chain from the Chromium Trioxide surface treatment facilities upwards will move to a non-European country (see Figure 2). Also subsequent parts of the supply chain may relocate over the time.

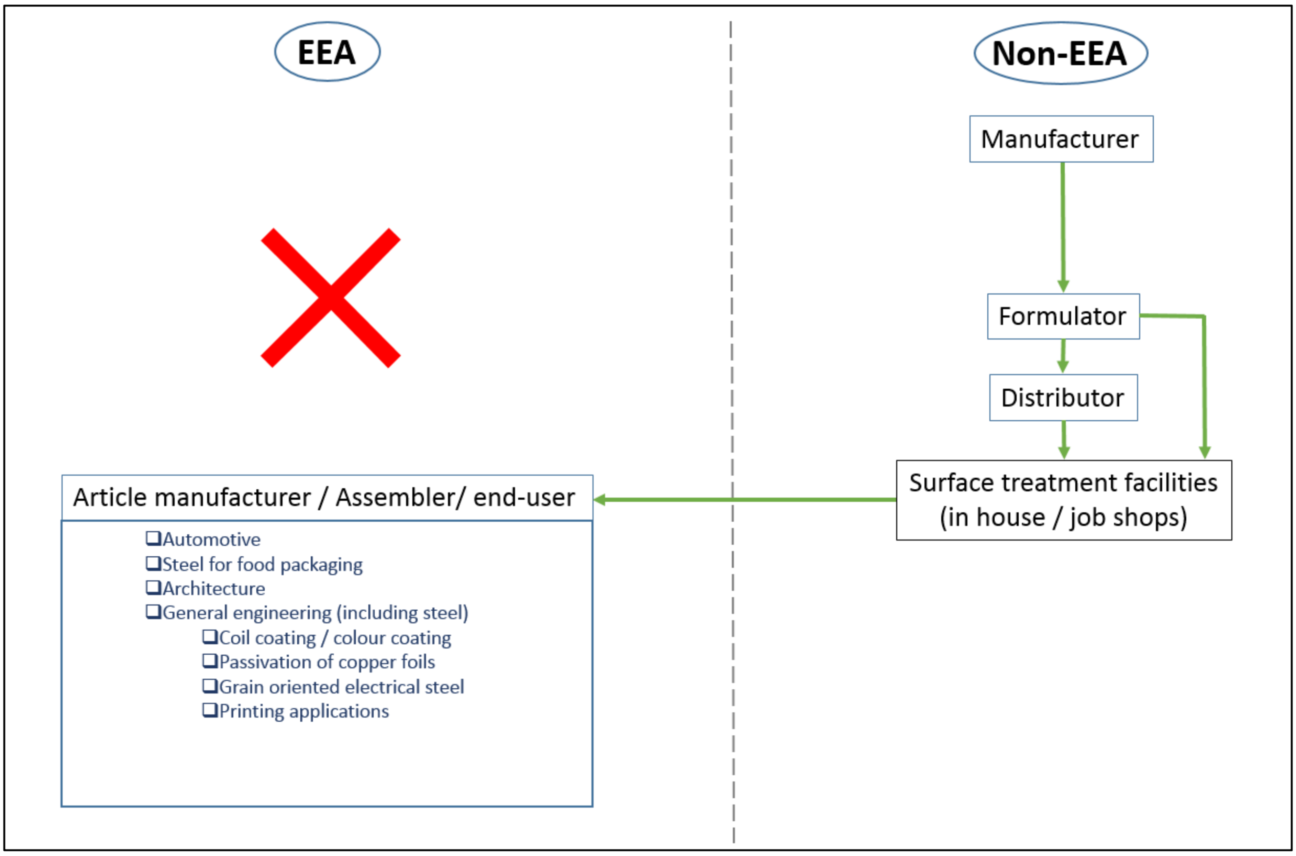

Figure 2: Effects of the non-use scenarios on the European supply chain

The sections below present the sector-specific challenges and consequences in the non-use scenarios as additional information for the determination of the length of the review period.

5. INFORMATION FOR THE LENGTH OF THE REVIEW PERIOD

In addition to the findings of the AoA, the following sections shall highlight the special characteristics inherent to the affected industries to justify a review period of not less than **7 years** for the use of Chromium Trioxide for surface treatment for miscellaneous sectors.

5.1. Automotive industry

For surfaces treated by chromic acid anodising, the automotive sector reported minimum requirements ranging from 48 h in the CASS to 240 h in the NSS according to ISO 9227. Specifications for anodized surfaces require a layer thickness <15 µm. For testing of resistivity, the STEP test according to ASTM B 764 is performed. The adhesion properties are assessed by the peel test according to ASTM B 764, TL 528 or ISO 1464. No delamination of the layer should be observed. For further information regarding approval processes in the automotive industry, please refer to the corresponding AoA (6).

5.2. General engineering (including steel)

Grain oriented electrical steel insulation

Chromium Trioxide is vital for producers of grain oriented electrical steels regarding the so called core losses level that can only be achieved by using Chromium Trioxide.

Chromium Trioxide is vital because at the time being tested alternatives (the most elaborated is the use of Cr(III) instead of Cr(VI)) do not fulfil the requirement concerning regarding magnetic properties (core losses) and visual appearance.

Grain oriented electrical steels must comply with IEC 60 404. In this standard the most important part are the core losses. As mentioned above, alternatives do not achieve the sufficient coating tension to the steel increasing the core losses to levels which are still in the standard but not demanded by the market. For further information please refer to the corresponding AoA.

Consequently, if European grain oriented steel producers would not be able to use Chromium Trioxide anymore, their market shares would be taken up by non-European competitors due to market demands that can only be achieved with Chromium Trioxide.

Passivation of copper foils

As stated in the AoA, for passivated electrodeposited copper foils used in electronics, industry requires no oxidation after one year assessed by visual inspection. Testing of heat resistance is carried out, with a 2 h thermo cycle treatment at 200 °C. No oxidation should be observed. Compatibility with different substrates is necessary, since the passivated copper foil has to be laminated with various resins. Specifications for these surfaces require a layer thickness <0.7 nm. No change of copper conductivity should be observed. The material must be weldable, to prepare e.g. circuit boards. Regarding the scalability, passivation of cooper foils is a high speed process, requiring a completed dipping in less than 20 seconds from roll to roll (6).

Chromate conversion coatings
Regarding conversion coated surfaces, the steel processing industry stated minimum corrosion resistance of 1000 h according to ISO 9227 and ASTM B117. When corrosion performance is tested according to SST STN EN 13523-8, 350-500 h should be achieved, where delamination should not exceed 2 mm at the vertical scribed mark. Furthermore, chemical resistance against solvents is tested according to EN 13523-11. Testing is performed by rubbing the coated surface with a tissue impregnated with a solvent (methyl ethyl ketone, MEK). Importantly, optical properties also play a crucial role. Customers in the current highly competitive market are very sensitive to aesthetic aspects. Consequently, candidates for substitution will have to fulfil the same aesthetic criteria as the current Cr(VI) based coating (6).

5.3. Architecture

Procedures applied to produce architectural products are required to pass qualification prior to their implementation.

Therefore, several national associations encompassing coaters of architectural parts formed a quality label organisation called Qualicoat. They committed themselves to maintaining and promoting the quality of coating on aluminium and its alloys for architectural applications. Qualicoat defines comprehensive quality requirements and monitors their compliance. This assures purchasers of coated aluminium to receive a premium-grade product, delivering long-term value and consistent quality. Through its efforts over the past 20 years, Qualicoat has been playing a key role in assuring the quality of aluminium parts used in architecture. The Qualicoat quality label is a product certification scheme. Qualicoat has granted general licenses to national associations to issue these certificates and inspect the licensed plants. Coating plants that fail to meet the requirements lose their licence (11).

Several testing requirements have to be fulfilled and (long-term) outdoor exposure tests under real conditions have to be passed before an alternative treatment can be regarded as feasible alternative. Since periods of warranty in the building sector are usually granted for more than 20 years, finding and approving an alternative treatment takes a long time. The reliable positive outcome of the testing phase is important for producers of coated aluminium as otherwise they may see themselves confronted with high guarantee claims.

5.4. Steel for packaging

Steel for packaging is particularly essential for food packaging. Food packaging must be safe, maintain nutritional value and be responsible with environment (e.g. allowing recycling). It is a sustainable solution that offers significant advantages over alternative food packaging systems (12). Indeed, it is the most recycled packaging material in Europe with a recycling rate of more than 72% (in 2009) (8).

Global demand is expected to increase due to emerging markets (13), also asking for additional products from Europe.

As a packaging material, steel is unique by its strength, formability and durability, which offers numerous benefits for the packaging of a wide variety of products. Many industries rely on the availability of steel packaging to be able to handle, process and store large volumes of products with high levels of reliability for consumer and industrial markets (8).

The steel packaging industry has to fulfil strict regulations for food packaging. Migration of metal particles to the food and corrosion of the can´s steel has to be prevented. Regulation (EC) No 1935/2004 (14) establishes the rules for placing on the EU Internal Market materials and articles in contact with food, providing the basis for protection of consumers and human health. Metals and alloys are included in the list of materials and articles regulated by this regulation.

Additionally, customers' requests as well as industry expectations have to be met. It has to be noted, that steel for packaging is a globalised and standardised product, which has to fulfil all downstream users' requirements (e.g. high speed filling operations and long storage times of the packed material) (8).

European can makers will resort to imports of Chromium Trioxide treated packaging steel until food safety and industrial usability of alternatives is proven. It is a debatable point, whether the demand of Chromium Trioxide treated packaging steel can be answered from non-EEA countries. A price increase is expectable and also supply disruptions cannot be excluded.

For ECCS, the food contact industry reported that the surface has to resist corrosion for at least 3 years. Furthermore, lacquer adhesion is a crucial requirement, beside visual inspection of the optical properties. For evaluation of these critical endpoints, tests with simulants and pack tests required by customers are carried out. Moreover, coated materials have to withstand temperatures of at least 100°C for pasteurisation and sterilisation purposes. Food contact materials must not create any unacceptable risks for consumer of packed food. Therefore, tests with microorganisms certified by authorities have to be passed, before a material is approved (6).

Articles intended for contact with foodstuffs have to meet a number of concrete requirements so they can be used without any danger that they unfavourably affect the safety and quality of foodstuffs and thereby also the health of the consumer. In the assessment of the food contact materials and articles, attention is mainly focused on the danger of food contamination with chemical substances present in the material the object is made of (migration).
The foods packaging must comply with the EU requirements for food contact materials. Products that do not comply cannot be placed on the EU market. The requirements relate to materials and substances used.

5.5. Conclusion

While negative effects to the European economy resulting from shutdown and / or relocation of directly affected companies (surface treatment companies) alone are significant, the negative impacts for indirectly affected companies, such as article manufacturers / assemblers / end-users from the various industries will be even more severe.

These effects will lead to competitive disadvantages compared to non-European competitors making European industry less and less competitive and triggering cost increases that will yield unemployment (see section 7.2 for an assessment of expected job losses in the non-use scenario).

The use of Chromium Trioxide in surface treatment is extensive in a wide range of industry sectors and often plays a critical role in meeting the technical requirements given by the applications for surface treatment of components.

Furthermore, the supply chain for Chromium Trioxide surface treatment is highly integrated, complex and inter-dependent. The surface treatment sector is well established to function across industry sectors, relying on economies of scale to operate effectively. Industry is highly concerned that impacts to part of this supply chain may have negative (even devastating) consequences elsewhere in the supply chain that could threaten further operations.

For all the reasons stated and with reference to the findings of the AoA, a minimum review period of at least 7 years is considered necessary for the continued use of Chromium Trioxide, as defined in section 3.

6. METHODOLOGY

ECHA (2011) makes it clear that a quantitative analysis is strongly recommended to underpin an Application for Authorisation[4] and recommends a Cost-Benefit Analysis (CBA) as the preferred tool for quantitative analysis[5] (1). This preference has further been underlined in the current practice of Applications for Authorisation where both the costs and benefits have been quantified and compared[6]. Furthermore, it has been clear in the seminars and presentations given by ECHA that a full Cost-Benefit Analysis, i.e. a fully quantitative SEA including the monetisation of the health impacts, would make it much easier for the Socio-Economic Analysis Committee (SEAC) to compare the costs of non-authorisation with potential remaining risks in the case of authorisation. For that reason, as it is highly recommended by ECHA Guidance, a monetisation of the different impacts is carried out in order to provide a more reliable assessment for this SEA.

Therefore, an analysis of the (1) monetised health impacts, (2) social impacts and (3) economic impacts is presented here to allow an easier evaluation of the risks related to the authorisation. The aim of this analysis is to support the findings of the qualitative description, where it has been concluded that the benefits of continued use of Chromium Trioxide would be substantial, while the remaining risks would be very well managed and limited, following an authorisation. The analysis is built on and takes into account evidence gathered during the preparation of the CSR, AoA and SEA.

The applicant refers to and utilises the processes, methods, tools and values (e.g. the dose-response relationship) prescribed under ECHA (2011) and ECHA (2013) (1) (2). However, the applicant, CTAC UG 4/5 member companies and companies in the supply chain that may directly or indirectly rely on the Application for Authorisation do not and should not by preparing this quantified Cost-Benefit Analysis or otherwise be construed to endorse, support, or otherwise accept the approach to the monetisation of health impacts. Independent studies such as Willingness to Pay reports have been referenced as required in order to give an estimate of the order of magnitude on the remaining risk of the authorisation in the Cost-Benefit Analysis framework. This is done in accordance with ECHA (2011). Given that the purpose of this analysis is to give an order of magnitude estimation, the applicant, CTAC UG 4/5 member companies and companies in the supply chain consider that the monetised health impacts have no real-world, commercial or legal relevance or merit.

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4 For example, the 4th paragraph of the box titled 'How to identify and assess impacts?' at page 22 of the Guidance on the Preparation of Socio-Economic Analysis as part of an Application for Authorisation which states monetisation should ideally be carried out.

5 Section 4.1 of the Guidance on the Preparation of Socio-Economic Analysis as part of an Application for Authorisation.

6 See e.g. the public versions of the applications available at http://echa.europa.eu/addressing-chemicals-of-concern/authorisation/applications-for-authorisation-previous-consultations and http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/applications-for-authorisation [Cited: 15 November 2014].

In order to evaluate impacts, data from across the supply chain is needed. An individual analysis of all suppliers / subcontractors or customers of the CTAC UG 4/5 member companies that use Chromium Trioxide in surface treatment for miscellaneous sectors is not possible due to the large number of companies and the highly complex supply chain. Therefore, for the assessment of health and social impacts an extrapolation approach for the entire supply chain was chosen based on available data from CTAC UG 4/5, public available data and expert consultation. The assessment of economic impacts is limited to CTAC UG 4/5 member companies that provided information. Economic impacts have not been extrapolated.

6.1. General approach

The SEA has been conducted in accordance with the approach set out in the Guidance on the Preparation of Socio-Economic Analysis as part of an Application for Authorisation (1). The reader is referred to the guidance for appropriate context and general information on approach to the SEA, while more specific aspects relevant to this document are discussed below.

Specific data used for the analysis of impacts in the SEA at hand was gathered by the use of questionnaires sent out to all CTAC UG 4/5 member companies. Formulators of Chromium Trioxide received separate questionnaires that allowed more detailed analysis of use-group specific differences.

In addition, site visits at CTAC members representative of particular industry sectors provided supportive information to be able to reflect the on-site situations in the authorisation dossiers. Additional benefits from the site visits were e.g. clarification of questions of details, discussion of non-use scenarios and maximisation of understanding of the uses of the substances and the production processes.

As an underlying basis for the assessment of impacts in this Socio-Economic Analysis, the estimation of health impacts was based on worst-case assumptions compared to purposefully conservative calculations of social and economic impacts.

For example, the calculation of health impacts is based on upper bound estimates of people potentially exposed (maximum number of potentially exposed workers as stated in the questionnaires) and the upper bound of exposure times and values (combined worker exposure), as elaborated in the CSR. In addition, sensitive (upper bound) values instead of central (average) values[7] representing costs of health impacts, as reported in studies specified for use in Cost-Benefit Analysis, have been used in the health impact assessment. These derived values, therefore, can be considered worst-case estimates. In this sense, while the values themselves have no real-world,

[7] Central value is the median value (lower bound) of the Willingness to Pay; sensitive value is the mean value (upper bound) of the Willingness to Pay to monetise health impacts (see section 6.4.4).

commercial or legal relevance or merit, the broad comparison of the health impact with social and economic impacts can be considered a relative measure of their scale.

By contrast, the calculation of social impacts is based on the lower bound values provided by the CTAC UG 4/5 member companies (lower bound of job losses as stated by the CTAC UG 4/5 member companies used for the assessment of social impacts). Also, the calculation of economic impacts is based on the lower bound values provided by the CTAC UG 4/5 member companies.

As a consequence, human health impacts are highly overestimated and socio-economic impacts are very likely to be underestimated.

It should be noted that the collection of data from members of CTAC UG 4/5 for the purpose of the SEA was subject to competition rules and data are therefore necessarily aggregated and neutralised.

6.2. Assessment of social impacts (salary cost method)

The primary social impact evaluated during this study is the impact of loss of earnings relating to job losses following production stop or relocation. Other social impacts are more difficult to quantify and have not been considered in the Cost-Benefit Analysis, but may include:

- foregone productivity of the workers (value-added that would have been generated by the workers)
- secondary and tertiary job losses
- additional costs for the society due to unemployment
- impacts of loss of purchasing power

In the course of the data gathering via the questionnaires, CTAC UG 4/5 companies were asked if and how many jobs related to the Chromium Trioxide use would be lost as a consequence of their individual non-use scenarios. At the same time, CTAC UG 4/5 companies were asked to classify the jobs that would be lost according to their education levels low skilled / high skilled / academic.

In case CTAC UG 4/5 member companies were not able to specify the job losses according to the education levels, impacts of job losses were calculated for the lowest education level 2 (low skilled).

The economic impact of lost jobs that were classified as low skilled, high skilled or academic by the CTAC UG 4/5 companies were monetised using the hourly earnings for workers with education levels 2, 3 / 4 and 5A in the EU-27, according to ISCED (derived from EUROSTAT as of 2010) as a basis[8] [9]. Average social contributions and other labour costs paid by employers in the EU-27 (as

[8] http://www.uis.unesco.org/Library/Documents/isced97-en.pdf [Cited on 04 June 2014].

of 2010) of 22.7% were added. Hourly earnings were brought to salary costs per year by multiplying by 40 hours per week and 52 weeks per year (see Table 1).

Table 1: Salary costs according to educational level EU-27 (EUROSTAT Data as of 2010)

ISCED Level	Description	Hourly earnings EU-27	Incl. social contribution and other labour costs paid by the employer (rounded)	FTE salary costs per year (rounded)
2	Lower secondary or second stage of basic education	€ 11.14	€ 13.67	**€ 28,434**
3 / 4	Upper secondary and post-secondary non tertiary education	€ 12.45	€ 15.28	**€ 31,782**
5A	First stage of tertiary education, programmes that are theoretically based / research preparatory or giving access to professions with high skills requirements	€ 21.54	€ 26.43	**€ 54,974**

To be able to reflect the real values of the jobs lost due to non-authorisation for the entire review period, the Net Present Value method (NPV) is used.

The NPV is a common methodology applied in economics. It is calculated according to the following equation:

$$NPV\ (i) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

where

i is the discount rate

N is the number of years for which the NPV is to be calculated (review period)

[9] Eurostat. Earnings labour market, code [earn_ses10_16] and http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tps00114&language=en [Cited on 9 February 2015].

R_t is the cash flow / the amount of money in year t (e.g. social impacts)

An inflation rate of 1.517%[10] (geometrical mean of annual price increase rate from 2003-2013) was employed to inflate the 2010 values to the base year (2017). To discount the values from 2018-2024 to 2017 values (base year) a discount factor of 4% was employed. See section 7.2 for practical application of the NPV methodology.

6.3. Assessment of economic impacts

Similar to the calculation of social impacts, economic impacts considered in this SEA are calculated using the Net Present Value (NPV). The calculations are based on purchase losses of the CTAC UG 4/5 member companies to their European suppliers (see section 7.3).

6.4. Assessment of health impacts

The worst-case assessment of health risks within this SEA utilises the results of a study endorsed by ECHA identifying the reference dose-response relationship for carcinogenicity of Cr(VI) (2)[11]. This paper has been agreed on at the RAC-27 on 04 December 2013. Therefore, it can be applied to describe the final outcome of a service request on behalf of ECHA on the assessment of remaining cancer risks related to the use of Cr(VI) containing substances. These results on the carcinogenicity dose-response analysis of Cr(VI) containing substances are acknowledged to be the preferred approach of the RAC and SEAC and therefore have been used as a methodology for the calculation of health risks in this SEA.

Accepting this, the following steps are necessary to complete the health impact assessment according to the ECHA methodology and a worst-case approach:

1. Evaluation of potential work exposure
2. Estimation of additional cancer cases relative to the baseline lifetime risk of developing the disease
3. Assessment of fatality rates (%) with reference to available empirical data
4. Monetary valuation of fatal and non-fatal cancer risks

These four consecutive steps are explained in detail in the following.

[10] This inflation rate is used for the entire impact assessment (see section 6.4.4 for further details).

[11] By reference to this, the applicant neither agrees nor disagrees with this dose-response relationship. However, the applicant acknowledges that the dose-response relationship is likely to be conservative and protective of human health, particularly considering the extrapolated linear relationship at low dose exposure concentrations.

6.4.1 Data gathering on potential work exposure

Following the worst case approach, combined worker exposure values from the corresponding CSR (15) are taken for the assessment of health impacts. For further information regarding exposure values, please consider the corresponding CSR.

6.4.2 Estimation of additional cancer cases in relation to baseline

ECHA has prepared a quantitative assessment of the dose-response relationship for Cr(VI) based on epidemiological studies and experimental findings in rodents for inhalation, dermal and oral exposure (workers) and oral exposure and inhalation exposure (general population).

The dose-response relationship for Cr(VI) with regard to lung cancer and intestinal cancer has been discussed in recent research published by ECHA (2). These dose-response functions of an excess risk for carcinogenic effects have been used as the basis for this assessment.

According to the exposure scenario stated in the CSR and in accordance with the ECHA paper (2), p. 4 ("in cases where the applicant only provides data for the exposure to the inhalable particulate fraction, as a default, it will be assumed that all particles were in the respirable size range"), only lung cancer is considered in this assessment. The share of particles that enter the gastro-intestinal tract is therefore assumed to be zero.

For dermal exposure to Cr(VI) compounds, no evidence for skin or other tumours in humans is proposed by ECHA. The ECHA report concludes that exposure of the general population outside of the working site can also be regarded as negligible for skin or intestinal cancer.

For the calculation of health impacts related to lung cancer, **Excess Lifetime Risk** (ELR) is defined as the additional or extra risk of developing cancer due to exposure to a toxic substance incurred over the lifetime of an individual. Note that developing cancer may occur during working life or after retirement.

Linear exposure-risk relationship for lung cancer as estimated by ECHA (2):

$$Unit\ occupational\ excess\ lifetime\ risk = 4\ \times 10^{-3}\ per\ \mu g\ Cr(VI)/m^3$$

The exposure-response relationship agreed upon by RAC refers to a working lifetime exposure with continuous working-daily exposure. As an average over different countries and economic sectors, full-time employee contracts (8 hours per day) and a working lifetime of 40 years are taken as a basis (2). Note that 8 working hours per day or 40 working hours per week, as well as 40 years per working life are explicit parameters used for the Full-Time working Equivalent underlying the exposure-response functions (2), p. 5, whereas 260 working days per year are given through the dose-response curve.

Adaptation factors for time frame of exposure

In order to apply this exposure-risk relationship to the case of authorisation, it has to be adapted according to the time frames used in this Application for Authorisation.

Therefore, the following factors are used to adapt the exposure-risk relationship to the respective situation of this Application for Authorisation:

- Factor for adaptation to the respective review period (years of authorisation granted up to the next revision envisaged)

$$\frac{review\ period\ [years]}{40\ years}$$

- Factor for adaptation to the actual hours of potential exposure per day

$$\frac{working\ hours\ per\ day}{8\ hours}$$

Methodology for the estimation of additional lung cancer cases

For an individual person, the excess lifetime lung cancer mortality risk derived in the ECHA paper (2) indicates the differential in probability to die of lung cancer during the future life, i.e. the increase in probability compared to the baseline risk for an individual to die from this disease.

As described above and in line with ECHA, Excess Lifetime Risk (ELR) of mortality associated with lung cancer = 4 * 10^{-3} * concentration [µg Cr(VI) /m^3] (due to an exposure over the whole working lifetime of 40 years, which is higher than the relevant time frame for the intended authorisation).

Excess risk used in this equation is defined as:

$P_{excess} = P(x) - P(0)$

with

$P_{excess}(x) = Excess\ risk\ at\ exposure\ x$

$P(x) = lifetime\ risk\ of\ persons\ exposed\ for\ dying\ from\ lung\ cancer$

$P(0) = Background\ risk\ (lifetime\ risk\ of\ a\ non-exposed\ comparison\ group)$

It has to be emphasised that $P_{excess}(x)$ is an additional risk, the unit is the expected number of additional lung cancer deaths of a population exposed by a concentration x in the sum (2).

In the source of ECHA (2), based on the research of the ETESS consortium (16), and in underlying studies, excess risk is used in absolute terms, not percentage points. This is not always used uniformly in other epidemiologic studies. The excess risk $P_{excess}(x)$ is linear, i.e. proportional both to individual exposure and to persons exposed. Therefore, exposures of different persons can be added.

Consequently, the aggregated excess risk is the expected value of additional lung cancer deaths due to an exposure. The cumulative and weighted index of total exposure of the sum of workers affected is calculated as a total Cr(VI) concentration [$\mu g/m^3$]. This value will be used as an input factor for the calculation of the excess risk (i.e. additional lung cancer deaths) over all employees exposed. The estimated amount of additional lung cancer deaths is the expected value due to a continued use of Cr(VI) for the respective time frame allowed by an authorisation up to the next revision.

According to the ECHA document (2), it is explicitly spoken of an "excess lifetime lung cancer mortality risk". This is also consistent with the results of ETESS (2013) (16) where the respective table of a preliminary report is titled "unit occupational Excess Lifetime Risks (ELRs) of lung cancer death determined by different authorities or publications". This signifies that the dose-response function developed refers only to additional lung cancers ending fatal. In this study, only data on deaths caused by lung cancer has been taken into account for the estimation of the dose-response relationship. This will be included in step 4 of this methodology (Monetary valuation of fatal and non-fatal cancer risks).

6.4.3 Estimation of average fatality rates in %, based on empirical data from EU-27

The individual development of cancer diseases may be fatal or non-fatal. Non-fatal cancer is defined as cancer not causing a premature death, i.e. life expectancy is not reduced due to the cancer disease, whereas fatal cancer is defined as cancer leading to premature death. This distinction is important when applying the ECHA guidance on Socio-Economic Analysis (1) in order to use consistent categories of monetary values.

For the determination of fatality rates for lung cancer, demographic data on age-specific cancer incidences and mortality rates have been taken into account; these are mainly:

- age profile of a population
- gender profile of a population
- relationship of risk of developing the disease and risk of dying from the disease

For lung cancer, data of the International Agency for Research on Cancer (IARC) (17) for the EU-27, as well as data for the EU Member States, showing the age and gender profile of cancer risks in more detail have been analysed and compared to selected other EU Member States with similar data collection sets (18).

Data show that, although the incidence risk and the mortality risk themselves are higher for men than for women, the relationship between incidence and mortality risk (i.e. the fatality rate) shows, apart from random fluctuations, no major differences between males and females.

It has to be emphasised that any structural differences in the baseline risks (e.g. between men and women, between different EU Member States or between different age groups) do not influence the estimation of incremental cancer risks due to Cr(VI) exposure. Therefore, neither the share of male and female workers exposed at work nor the exact age of workers influence the outcome of the estimations.

The fatality rate is an important parameter for a monetary-based valuation of cancer risks. The reference dose-response relationship estimates additional fatal cancer risks only. A full health impact assessment will also consider lung cancer cases that do not result in fatality. Average mortality rates for lung cancer in the EU-27 are **82.8%** for both sexes (17). This value will be used for further analyses in this SEA.

6.4.4 Monetary valuation of fatal and non-fatal cancer risks

In order to evaluate the additional cancer cases in monetary terms, monetary values as suggested by ECHA are used.

In the current ECHA guidance on Socio-Economic Analysis (1), a Willingness to Pay (WTP) to avoid a cancer case of € 400,000 (2003) per non-fatal case and € 1,052,000 (2003) or € 2,258,000 (2003) per fatal cancer case (lower bound based on the median, upper bound based on the mean; see Figure 3) is given and recommended to be used. These rounded values are based on an empirical WTP study from the year 2003, derived from a research project on external costs during this year, published as NewExt Final Report (New Elements for the Assessment of External Costs from Energy Technologies)[12] (19). In NewExt, empirical Values of a Life Years lost (VOLYs) have been derived from a contingent valuation survey. Using this VOLY and estimations of Life Years Lost in case of a fatal cancer, the monetary Value of a Statistical Life (VSL) has been re-based and applied for the physical health endpoint of a fatal cancer.

To be consistent with ECHA guidance, this methodological approach is also used in the analysis of health impacts in section 7.1.

Since values are based on the year 2003, they are adjusted to the respective year of the sunset date (the base year for the calculation of Net Present Values of costs and benefits) by using Gross Domestic Product (GDP) deflator indexes. This will be explained in the following.

[12] It has to be noted that the ExternE project series stems from a different context of research, the external costs of energy and transport. However, the ECHA guidance suggests transferring these values to external costs of chemicals in the context of REACH, since more context-specific monetary values are not available.

Implementation of a price adjuster

In this SEA, costs and benefits are made comparable by basing them to the year of the sunset date (the sunset date is used as the reference year for all cost estimations of the SEA). Therefore, health risks as well as additional costs relating to the continued use of Chromium Trioxide in case of the authorisation are based to the year of the sunset date.

To adjust the WTP values to the base year, these values are multiplied by a price adjuster, which is the appropriate price index of the reference year divided by the appropriate price index of the year 2000. When using as appropriate price index the Gross Domestic Product (GDP) deflator of the EU-27 issued by EUROSTAT, data could be gathered up to the year 2013. The quarterly deflator is calculated from seasonally adjusted GDP values and rescaled so that 2000 = 100. For 2013, which is the last year with complete data sets, the deflators of the four quarters range from 121.4 (first quarter) to 122.1 (fourth quarter), with an arithmetic mean of 121.6 for the four quarters.[13] A price index development from 100.0 (in 2000 as the starting point where the index is based on) up to 121.6 in 2013 is equivalent to an average annual growth factor of 1.01517 (geometric mean over 13 years). We assume that in the average the calculated rate of price increase will continue in future from 2013 up to the reference year; therefore, the factor of 1.01517 per year is applied to extrapolate the price index development into the future, i.e. between 2013 and the reference year.

Adjusting the WTP values by the GDP deflator from 2003 to the year for which the sunset date is scheduled (i.e. it is implicitly assumed that Willingness to Pay increases by the same rate as the Gross Domestic Product in average) leads to the respective range of lower bound and upper bound values for average cancer cases. The share of non-fatal cancers has to be added to the estimated number of fatal cancers (see Table 2).

As illustrated in Figure 3, the Willingness to Pay has a skewed probability distribution (f on the y-axis) – its minimum is zero but high runaway values emerge to the right. Therefore, median values are typically smaller than mean values.

13 http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tps00114&language=en [Cited: 9 February 2015].

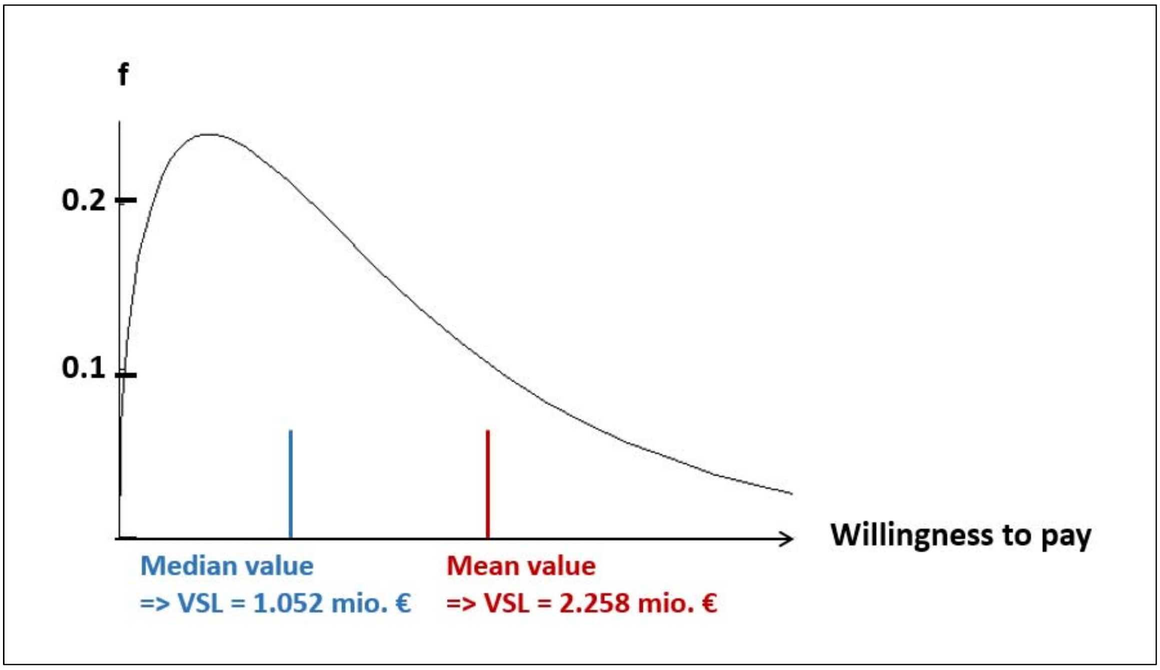

Figure 3: Median and mean Value of a Statistical Life, derived from NewExt (19), p. III-34

The ECHA guidance on Socio-Economic Analysis refers to the results of the NewExt Study (19) and suggests to use higher Values of Statistical Life (VSL) and of Life Years lost (VOLY). This means that there is a lower (central) value and a higher (sensitivity) value. The differentiation stems from an econometric methodological discussion whether the median or the statistical mean shall be used as a basis to calculate the more robust and reliable Willingness to Pay values.

Following the ECHA guidance, it was decided to use the monetary values that are shown in Table 2 for the evaluation of cancer cases.

Table 2: Monetary values for fatal and non-fatal cancer risks, based on the ECHA Guidance

	Non-fatal cancer (morbidity)	**Fatal cancer (mortality)** **Central Value of Statistical Life based on the median value (lower bound)**	**Fatal cancer (mortality)** **Sensitivity Value of Statistical Life based on the statistical mean value (upper bound)**
2003 WTP value[14] based on NewExt (2004) – starting value in ECHA Guidance	€ 400,000 (2003)	€ 1,052,000 (2003)	€ 2,258,000 (2003)
Adjusting the 2003 values to the sunset date GDP deflator index 2003 – year of the sunset date; for multiplication[15]	$1.01517^{\text{sunset year – 2003}}$	$1.01517^{\text{sunset year - 2003}}$	$1.01517^{\text{sunset year - 2003}}$
Probability of lung cancer ending non-fatal/fatal (EU-27 average)	17.2%	82.8%	82.8%

14 *Implicit discounting of latency*
It shall be emphasised that – in the calculation of these monetary values – the delay between exposure and actual appearance of cancer and the corresponding years of life lost is discounted implicitly. Those results from the design concept of the contingent valuation questionnaire developed in the NewExt study, which elicits the Willingness to Pay to reduce the risk of reduced life expectancy at the end of the life. Respondents implicitly discount this benefit because it is only in the future. Consequently, these values would result from a situation where individuals have been asked in a certain year, with the respective price and income levels of this year, referring to a risk avoidance starting after this year.

15 Index for the year of the sunset date is extrapolated using the geometrical mean of annual price increase rate: 1.01517 (over 2003-2013). Source http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tps00114&language=en [Cited: 9 February 2015].

Additional occurrence of non-fatal lung cancer per one fatal cancer estimated	17.2/82.8 = 0.208	n/a	n/a

The sensitivity range of lower and upper bound only applies to the share of fatal cancers, not to the share of non-fatal cancers (where the monetary value consists of both a cost-of-illness component and a component of Willingness to Pay to avoid the risk of a non-fatal cancer).

Monetisation of health impacts

In order to monetise additional risk of lung cancer relating to the authorisation of the continued use of Chromium Trioxide, first the excess risk is calculated according to the following equation:

$$ELR = \frac{review\ period\ [years]}{40\ years} \times 4\ \times 10^{-3}\ \times\ [\frac{\mu g\ Cr(VI)}{m^3}]$$

where

$\mu g\ Cr(VI)/m^3$

represents the total Cr(VI) concentration corrected by the exposure times and the total number of exposed workers. In a second step, the monetised values for additional lung cancer cases are calculated by multiplication with the WTP values adjusted to the year of the sunset date. Following this methodology, the actual assessment of health impacts related to the authorisation of the continued use of Chromium Trioxide is conducted in section 7.1.

6.4.5 Health impacts "Man via the Environment"

6.4.5.1 Relevant exposure concentrations

According to ECHA guidance Chapter R.16: Environmental Exposure Estimation (Version 2.1 – October 2012) (20), exposure to the environment should be assessed on two spatial scales: locally in the vicinity of point sources of release to the environment, and regionally for a larger area which includes all point sources in that area. Releases at the continental scale are not used as endpoints for exposure. The end results of the exposure estimation are concentrations - Predicted Environmental Concentrations (PECs) - in the environmental compartments for both, local and regional scale which have been calculated in the ES.

The regional Predicted Environmental Concentration ($PEC_{regional}$[16]) derived in the CSR has been assumed to represent the average exposure concentration for the general population. The local Predicted Environmental Concentration (PEC_{local}), based on measured and modelled data, is used to calculate potential risks for on-site workers not directly exposed as well as the direct neighbourhood.

6.4.5.2 Number of potentially exposed people

For calculation of the health impacts for the general population resulting from exposure of men via the environment, the total number of people living in an area 200 x 200 km around the sites that will use Chromium Trioxide are considered in terms of potential exposure to the regional Predicted Environmental Concentration ($PEC_{regional}$). Since the locations of all affected sites are not available, the number of people living around this area have been estimated. Following a worst-case approach, the population of the European Economic Area (EEA)[17] was taken as basis, namely 512,888,463 people.

The second group of indirectly exposed people are those local to the site. They comprise workers that do not work with Cr(VI), but work in the vicinity (potentially indirectly exposed workers) as well as people living in the direct neighbourhood of the sites. Determination of the size of both groups of people requires knowledge of the location and size of all companies that use Cr(VI) for surface treatment for miscellaneous sectors. Since it is unrealistic to provide accurate estimates, it has been conservatively assumed that 10,000 people work and live in near neighbourhood at any one site. This number of people is recommended as the basis of the local exposure assessment in the Guidance on information requirements and chemical safety assessment, chapter R.16 (Version 2.1 – October 2012) (20). The total number of people exposed on a regional scale is then calculated as the number of people local to any one site 10,000 multiplied by the number of sites using Cr(VI), e.g. 10,000 people x 200 sites = 2 million people living in the local neighbourhood including on-site workers.

For the calculation of potential risk of the local population (on-site workers and the local population), the Predicted Environmental Concentration for local scale (PEC_{local}) is used. Since there is no basis for a reliable distinction between the number of indirectly exposed workers and people living in the neighbourhood, the dose-response curve for the general population is taken as basis following a worst-case approach (i.e. workers would be exposed for less time, e.g. 8 hours per day for 220- 260 days, than the general population (24 hours per day for 356 days of exposure)). Table 3 summarises the most important input parameters.

16 The calculated $PEC_{regional}$ represents the average concentration in an area of 200 x 200 km around the point sources.

17 http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&tableSelection=1&labeling=labels&footnotes=yes&language=de&pcode=tps00001&plugin=0 [Cited: 19 November 2014].

Table 3: Overview of the most important input parameters for calculation of health impacts

Group of exposed people		**Number of potentially exposed people**	**Exposure concentration to be used from the ES**	**Dose-response curve for**
Indirectly exposed	Indirectly exposed workers and direct neighbourhood	Number of sites using Chromium Trioxide x 10,000	PEC_{local}	general population
Indirectly exposed	general population in an area of 200 x 200 km around the site	512,888,463	$PEC_{regional}$	general population

6.4.5.3 Worst-case approach

The overall calculation approach entails an overestimation of health impacts for the following reasons:

- The assumption of a local population of 10,000 per site assumes each site will be located independently and next to a village or town. In general, such sites are likely to be located in close proximity to similar sites and in areas designated for industrial use, often remote from residential areas. The overall potentially exposed population is therefore likely to be substantially over-estimated.
- On-site workers live in the direct neighbourhood or in the surrounding area (200 x 200 km). Therefore, a double counting appears when calculating health impacts for on-site workers and the general population.
- Calculating the excess of risk evolving cancer on the basis of the dose-response curve published by ECHA (2) assumes a linear relationship between dose and response, even at low doses. This is a conservative assumption, likely to result in overestimation of the cancer risk.

6.4.5.4 Adaption factor

The dose-response curve for the general population considers 365 days of exposure and 70 years of life-time.

Accordingly, it is necessary to adjust the exposure duration to the foreseen review period of 7 years (see the following sections).

6.4.5.5 Monetisation of health impacts “Man via the Environment”

PEC$_{local}$

For the calculation of PEC$_{local}$, the total number of potentially indirectly exposed people is assessed taking into account the foreseen population of 10,000 as described in 6.4.5.2.

$$Number\ of\ potentially\ exposed\ people\ (PEC_{local}) = number\ of\ sites\ \times\ 10{,}000$$

The exposure values for PEC$_{local}$ are taken from the CSR and the number of potentially exposed people are derived as described above. The excess risk calculation follows the methodology described in section 6.4 according to the following equation:

$$ELR = \frac{review\ period\ [years]}{70\ years} \times 2.9\ \times 10^{-2}\ \text{per}\ \frac{\text{µg Cr(VI)}}{\text{m3}} \times\ \text{exposure value}\ PEC_{local} \times\ \text{number of people potentially exposed}$$

In a second step, the monetised values for additional lung cancer cases are calculated by multiplication with the WTP values adjusted to the year of the sunset date.

PEC$_{regional}$

The calculations for PEC$_{regional}$ are equivalent to the calculations of PEC$_{local}$ only using a different exposure value for PEC$_{regional}$ and the number of exposed people is assumed with the population of the EEA (512,888,463).

7. ANALYSIS OF IMPACTS

In the following sections, the expected impacts for the non-use scenario are described and assessed. Firstly, the human health and environmental impacts related to the non-use scenarios are assessed (section 7.1). The subsequent analysis of the socio-economic impacts in section 7.2 and 7.3 focuses on job losses and economic impacts, respectively.

The impact assessment is carried out for a period of 7 years, since this is the minimum necessary review period required (see AoA).

7.1. Human health and environmental impacts

As stated in section 6.4 in accordance with the corresponding CSR (15) the risk assessment for humans exposed is restricted to inhalation of airborne residues of Chromium Trioxide (lung cancer). The oral route (swallowing of the non-respirable fraction) is not considered here. This is appropriate and consistent with a worst-case approach since:

(i) available information on potential exposure (airborne concentrations) does not provide reliable detail regarding particle size fractions (inhalable / thoracic / respirable);

(ii) the Excess Lifetime Risk (ELR) for intestinal cancer is one order of magnitude lower than that for lung cancer; the assessment of health impacts is therefore dominated by the risk of lung cancer due to inhalation of Chromium Trioxide dust;

(iii) the document on a reference dose-response relationship for Cr(VI) compounds (RAC/27/2013/06 Rev.1) states that "in cases where the applicant only provides data for the exposure to the inhalable particulate fraction, as a default, it will be assumed that all particles were in the respirable size range".

Therefore, in accordance with the above findings and provisions, it has to be assumed that all particles are in the respirable size range hence no exposure via the oral route needs to be considered. This constitutes a worst case approach, since the lung cancer risk, is an order of magnitude higher compared to the gastrointestinal cancer risk, based on the dose-response relationships.

The assessment of human health impacts considers workers potentially exposed at facilities of CTAC UG 4/5 members and at facilities in the relevant supply chain and the general population.

The analysis is based on gathered data from CTAC UG 4/5 members and assumptions in accordance with ECHA guidance regarding the number of workers and the members of the general population respectively that are *potentially* exposed.

The number of potentially exposed workers (industrial) has been assessed to account for exposure in the European supply chain. Upper bound exposure concentrations are based on measured and modelled data as set out in the Chemical Safety Report.

Table 4 below shows the monetised health impacts, derived in accordance with ECHA guidance, for workers potentially exposed to Chromium Trioxide during surface treatment for miscellaneous sectors in the European surface treatment sector.

Table 4: Summary of monetised health impacts for potentially exposed workers in the European surface treatment sector considering 515 sites

	Central value (lower bound) [€ million]	**Sensitivity value (upper bound)** [€ million]
Total	**4.9**	**10.0**

Exposure to the public has been estimated based on conservative assumptions regarding airborne releases from facilities and a substantial population consistent with a small town (10,000 population) at the site boundary (PEC_{local}) and the population of the EEA ($PEC_{regional}$).

Table 5 below sets out the monetised health impacts, derived in accordance with ECHA guidance, for members of the general population exposed to Chromium Trioxide and potentially indirectly exposed workers to Chromium Trioxide as a result of surface treatment for miscellaneous sectors within the EEA. The analysis is based on a review period of 7 years.

Table 5: Summary of monetised health impacts in the general population considering 515 sites

	Central value (lower bound) [€ million]	**Sensitivity value (upper bound)** [€ million]
PEC_{local}	68.0	140.3
$PEC_{regional}$	0.000001	0.000001
Total	**68.0**	**140.3**

An assessment of the sensitivity of key assumptions is provided in section 8.2. Further details for the calculation of the values provided above are given in ANNEX B.

A report by the Institute of Occupational Medicine (2011) concluded there are no significant environmental impacts foreseen related to Cr(VI) (21). Indeed, under normal environmental conditions, Cr(VI) will not persist, but be transformed to Cr(III), which has limited if any effects on the environment. As Cr(VI) can be effectively captured in filters or treated in wastewater treatment plant, emissions to air and water from current surface treatment operations are very limited.

It could be postulated that environmental benefits related to the non-use scenarios of companies using Chromium Trioxide include CO_2 emission reduction and removal of emissions from surface treatment facilities in general within the EEA as a result of production stop, relocation to a non-EEA country or similar. However, it is important to recognise that these impacts are not eliminated but just shifted to another (non-EEA) geographical region. It cannot be discounted that emissions would in fact increase as a result of less stringent regulation in non-EEA countries. In addition, CO_2

emissions are likely to be substantially increased as a result of increased distribution or transportation associated with importing surface treated articles into the EEA in the event of relocation and / or reduced product lifespans caused by less effective corrosion protection in the event of substitution.

7.2. Social impacts

This section summarises the expected socio-economic impacts in the non-use scenarios. The primary social impact, job losses resulting from either relocation of the facilities, production stop or shutdown of facilities, is examined here. Further social impacts have not been quantified.

At least 6,074 employees are indicated to suffer job losses as a result of a decision not to grant an authorisation. This estimated number of job losses is conservative (lower bound of social impacts considered at CTAC UG 4/5 members and lower bound of EEA surface treatment sites (200 sites)) (see ANNEX A); the actual number of jobs lost in the non-use scenario is expected to be much higher than the figures mentioned in this report.

A further important assumption for the calculation of social impacts is that workers that lose their job due to closure / relocation will either:

- remain unemployed for the entire duration of the review period (7 years); or
- replace another unemployed person in case of re-employment (workers that lose their job in company A and get a new job in company B prevent other unemployed persons from getting this job). Consequently, the value-added that has been created by the original workplace is not compensated by re-employment of workers in other companies, leaving the macro-economic impacts of the original job loss untouched.

These assumptions are justified on the basis of the non-use scenario as long as there is no full employment in the EEA. Full employment has never been the case and will not be the case for the length of the review period. The average unemployment rate in the EEA was approximately 9% [18] (2001-2013). Therefore, the salaries paid for the workplaces that would be lost in the non-use scenario are applied for the entire review period. Uncertainty analysis around this assumption is also provided in the assessment (section 8.2.2.3).

The impact of job losses due to the non-use scenarios is calculated using the salary cost method (see section 6.2).

[18] Source Eurostat. Unemployment rate (2001-2013), code [une_rt_a] [Cited: 9 February 2015].

The resulting total Net Present Value (NPV) of the future payments of wages in 2017 within 7 years from the sunset date comprised by this application sums up to € 1,354.1 million. This means a loss of € 1,354.1 million appears to the EEA society in 2017 in case of non-authorisation.

An assessment of the sensitivity of key assumptions is provided in section 8.2. Further details for the calculation of the values provided above are given in ANNEX C.

7.2.1 Other employment effects

Apart from the consideration of direct employment effects caused by a non-authorisation, the SEA guidance (1) suggests that further employment impacts should be considered (see below).

The consideration of **employment impacts due to a change in demand for an alternative product or process** (as recommended in the SEA guidance Annex B.3 (1)) is not relevant for the present case, as there will be no alternative available that is technically and / or economically feasible for the duration of the review period (see AoA for detailed information).

Estimation of displacement effects: There is no redistribution or substitution of jobs elsewhere in the scope of the SEA because all non-use scenarios relate to a shutdown of production in Europe and / or relocation to a non-EEA country.

Substitution of jobs within the company, e.g. change from manufacturing jobs to jobs related to distribution and storage and service is not relevant in case of shut down or relocation. In case of a production stop it seems unrealistic to place manufacturing workers or painters in the R&D department to increase workforce there.

7.3. Economic impacts

Economic impacts considered for the calculation are defined as lost purchasing volumes at EEA suppliers of CTAC use group 4/5 members in case of a non-authorisation. These lost purchases represent a welfare loss to the EEA.

Note: Economic impacts have not been extrapolated (conservative approach). Only impacts at CTAC use group 4/5 member companies that delivered data were taken into account.

Data for the assessment is summarised in Table 6.

Table 6: Expenses for raw materials and energy

Description of cost	Costs in 2012 [€ million]	Total impact on European supplier sales (2017)* [€ million] (rounded)
Raw materials	40.7	
Energy	61.5	
Total	**102.2**	**701.1**

**inflated and discounted value for the base year 2017*

Following the methodology as described in section 6.3, the economic impacts have been calculated as the NPV of future expenses for raw materials and energy in the year of the sunset date (2017).

The resulting total NPV of expenses for raw material and energy in the base year 2017 sums up to € 701.1 million for a review period of 7 years. This means a loss of € 701.1 million appears to the EEA society in 2017 in case of non-authorisation.

7.3.1 Wider economic impacts

In addition to the socio-economic impacts described in the previous section, a non-authorisation is expected to incur wider economic impacts. These impacts are described briefly in the following.

Impacts on the governments (loss in taxes)
If the European surface treatment companies would not be granted authorisation for the continued use of Chromium Trioxide, the amount of taxes and fees paid in Europe will be reduced by the amount linked to the supply and manufacturing of all products produced by the affected sectors. This represents a loss of income for the EEA.

Impacts on economic development
As a consequence of the non-use scenarios of the European surface treatment companies, the European supply chain for surfaces treated parts with Chromium Trioxide will largely move to non-EEA countries preventing revenue streams from the sector to continue and leading to considerable welfare losses for the EEA.

Impacts on trade and product quality
Because of the shift of affected supply chain links to non-EEA countries, the exports of the affected sectors in Europe will cease and Europe will become dependent on imports of parts and components treated with Chromium Trioxide in surface treatment for miscellaneous sectors possibly causing quality and security concerns. European know-how and technology will also move to non-EEA countries.

8. COMBINED ASSESSMENT OF IMPACTS

To summarise the previous assessment and to estimate the overall costs and benefits of a decision to grant or deny this Application for Authorisation (AfA), a combined assessment of impacts is set out here. A subsequent uncertainty analysis aims to assess the effects of uncertainties on the overall result of the SEA.

8.1. Comparison of impacts

Table 7 summarises the effects of a non-authorisation.

Table 7: Comparison of impacts for the applied for use and the non-use scenario

Type of impact	Applied for use scenario	Non-use scenario
Human health	➢ Maximum potential exposure of 8,046 workers to Chromium Trioxide	➢ No potential exposure of 8,046 workers in Europe†
Environmental impacts	➢ Negligible environmental impacts related to Chromium Trioxide	➢ No environmental impacts related to Chromium Trioxide in EEA‡
Economic impacts	➢ Maintenance of purchases at EEA suppliers / subcontractors	➢ Loss of sales for the suppliers / subcontractors
Social impacts	➢ Maintenance of at least 6,074 jobs directly related to the use of Chromium Trioxide	➢ Loss of 6,074 jobs directly related to the use of Chromium Trioxide
Wider Economic impacts	➢ Maintenance of taxes paid ➢ No negative impacts on the European supply chain and competitiveness ➢ No impacts on trade and quality	➢ Loss of taxes paid in Europe ➢ Shift of the European surface treatment supply chain to non-EEA countries and loss of competitiveness ➢ Cease of exports from the EEA ➢ Possible quality issues
† Expect at least the same number of workers would be exposed in non-EEA countries due to relocation. Additionally, non-EEA industries might have lower RMM than EEA industries ‡ Expect environmental impact to be shifted to non-EEA countries. Increased impact associated with increased distribution of plated parts from non-EEA.		

Table 8 below summarises the impacts for the applied for use and the non-use scenario in terms of monetised costs and benefits.

Table 8: Quantitative comparison of impacts for the applied for use and the non-use scenario

Type of impact	Discounting over 7 years [€ million]
Benefits in economic terms of avoiding potential health impacts associated with the continued use of Chromium Trioxide	10.0
Benefits of avoiding health impacts through potential exposure "Man via Environment"	140.3
Economic impacts	701.1
Social impacts	1,354.1
Net benefits of a granted authorisation	**1,904.9**

8.2. Uncertainty analysis

The ECHA Guidance on SEA (1) proposes an approach for conducting the uncertainty analysis. This approach provides three levels of assessment that should be applied if it corresponds.

- Qualitative assessment of uncertainties
- Deterministic assessment of uncertainties
- Probabilistic assessment of uncertainties

The ECHA guidance further states: level of detail and dedicated resources to the assessment of uncertainties should be in fair proportion to the scope of the SEA. Further assessment of uncertainties is only needed, if assessment of uncertainties are of crucial importance for the overall outcome of the SEA.

Hence, a qualitative assessment of uncertainties has been conducted to summarise and describe potential sources of uncertainty related to the impact categories. In addition, a deterministic assessment of uncertainties in the form of a scenario analysis has been conducted to assess the sensitivity of the results against changing input parameters.

8.2.1 Qualitative assessment of uncertainties

Table 9 illustrates the systematic identification of uncertainties related to human health impacts.

Table 9: Uncertainties on human health impacts

Identification of uncertainty (assumption)	Classification	Evaluation	Criteria and scaling (contribution to total uncertainty)
Shape of exposure-response function (linear versus non-linear)[19]	Model uncertainty	If non-linear, particularly at low exposure levels: overestimation	High
Working days (260 days) given by the dose-response curve	Parameter uncertainty	Not taking into account holidays, bank holidays, illness: overestimation	Medium
Monetary values used for a statistical life[20]	Parameter uncertainty	Range	Medium
Number of companies in EEA supply chain related to Chromium Trioxide	Parameter uncertainty	If too high: overestimation	Medium
Number of exposed employees in companies outside CTAC UG 4/5	Parameter uncertainty	If too high: overestimation	High
Exposure values at companies outside CTAC UG 4/5	Parameter uncertainty	If exposure values too high: overestimation	Medium
PEC_{local} includes exposure concentration of $PEC_{regional}$	Parameter uncertainty	Double counting of health impacts for people already considered in PEC_{local} values: overestimation	Low

Table 10 illustrates the systematic identification of uncertainties related to social impacts.

19 The study conducted by ETeSS on behalf of ECHA clearly states that: "[…] the lower the exposure (certainly below 1µg/m^3), the more likely it is that the linear [dose-response] relationship overestimates the cancer risk." The study further states that "the risk estimates for […] exposures lower than 1 µg Cr(VI)/m^3 might well greatly overestimate the real cancer risks. It is also considered that at progressively lower Cr(VI) air concentrations (from about 0.1 µg/m^3 downwards), cancer risks may be negligible." (16)

20 Sensitive values were used from the outset in order to avoid underestimation of health impacts.

Table 10: Uncertainties on social impacts

Identification of uncertainty (assumption)	Classification	Evaluation	Criteria and scaling (contribution to total uncertainty)
Number of jobs related to Chromium Trioxide would remain constant over the review period	Parameter uncertainty	If number of jobs related to Chromium Trioxide would increase over time: underestimation	Medium
Education level low skilled for all employees where no further information is available	Parameter uncertainty	Some employees have higher education levels ergo higher salaries: underestimation	High
Number of sites using Chromium Trioxide	Parameter uncertainty	Range	Medium

8.2.2 Deterministic assessment of uncertainties

The deterministic assessment of uncertainties seeks to investigate the robustness of the results presented in section 7 against changing input parameters regarding the assumptions made for the analysis of impacts.

The input parameters that will be investigated are:

- Number of sites using Chromium Trioxide in the European supply chain.
- The monetary Value of a Statistical Life (VSL) used to monetise health impacts.
- The duration of unemployment of people that find themselves jobless in case of non-authorisation.

8.2.2.1 Number of sites

As described in ANNEX A of this SEA, the number of sites (including CTAC UG 4/5 member companies) that are taken into account for the uncertainty analysis sums up to:

- 215 sites for the scenario “low”
- 515 sites for the scenario “high

Table 11 summarises the input parameters regarding the number of sites considered in the uncertainty analysis.

Table 11: Input parameters “number of sites”

Scenario	Value [number of sites]
Low	215
High	515

The number of sites directly influences the number of potentially exposed people that are taken into account for the assessment of health impacts. This is true for directly exposed workers as well as for indirectly exposed workers and people potentially exposed in the direct neighbourhood of the facilities, which are covered in the health impact assessment “Man via Environment”.

In addition, the number of sites directly impacts the number of people that will be dismissed in the case of the non-use scenario (see ANNEX A for details).

8.2.2.2 Health impacts

In section 7.1 health impacts are quantified using the Willingness to Pay (WTP) method. The WTP study used (19) provides a median and mean value. This means, there is a lower (central) and a higher (sensitive) Value of Statistical Life.

In addition to the number of people potentially exposed (directly / indirectly exposed, indirectly exposed neighbourhood, general population), the monetary Value of a Statistical Life (VSL) used to monetise health impacts in section 6.4.4 is part of the uncertainty analysis. For the sake of the uncertainty analysis the following values are taken into account:

- Central (median) value of the Willingness to Pay (WTP)
- Sensitive (mean) value of the Willingness to Pay (WTP)

Table 12 summarises the input parameters for monetisation of health impacts.

Table 12: Input parameters "Willingness to Pay"

Scenario	Value 2017 [€]
Central	
Fatal cancer	1,298,849
Non-fatal cancer	493,859
Sensitive	
Fatal cancer	2,787,833
Non-fatal cancer	493,859

8.2.2.3 Social Impacts

Following the assumptions presented in ANNEX C, and in accordance with the number of sites in section 8.2.2.1, a lower bound of job losses and an upper bound of job losses are assumed for the sensitivity analysis regarding social impacts.

In addition, the following scenarios are considered to account for uncertainties regarding the average period of unemployment of the people that would lose their job in the NUS:

- **Social Impact Sensitivity Assessment Scenario 1** – Salary costs for all workers are considered for the entire review period.
- **Social Impact Sensitivity Assessment Scenario 2** – all persons unemployed due to relocation / shutdown will find a new job after the average duration of unemployment in Europe (2003-2013), which is 15.1 months (OECD data[21]). Following the underestimation approach for socio-economic impacts and to avoid too much detail, salary costs are considered for one year in this scenario.
- **Social Impact Sensitivity Assessment Scenario 3** – 70% of the persons that find themselves unemployed would find a new job after one year after the sunset date. The remaining 30% of the workers remain unemployed for the duration of the review period.

These scenarios were considered for both, the lower bound and the upper bound of the number of workers that would be dismissed in the non-use scenarios.

[21] http://stats.oecd.org/ [Cited: 8 November 2014].

Table 13 summarises the input parameters regarding the number of job losses considered in the various scenarios. For reasons of readability, these scenarios were named social impacts 1a – 3b.

Table 13: Input parameters “job losses”

Scenario code	Scenario	Value [job losses considered]
Social impacts 1a	All job losses considered for the length of the review period; lower bound	6,074
Social impacts 1b	All job losses considered for the length of the review period; upper bound	14,197
Social impacts 2a	All job losses considered for 1 year only, lower bound	6,074
Social impacts 2b	All job losses considered for 1 year only, upper bound	14,197
Social impacts 3a	70% of job losses considered for 1 year only, the remaining 30% considered for the length of the review period; lower bound	4,252 job losses considered for one year only
		1,822 job losses considered for the length of the review period
Social impacts 3b	70% of job losses considered for 1 year only, the remaining 30% considered for the length of the review period; upper bound	9,938 job losses considered for one year only
		4,259 job losses considered for the length of the review period

Further factors that were not taken into account in this sensitivity analysis, but are expected to substantially add to the negative socio-economic impacts in the non-use scenario include:

- foregone productivity of the workers (value-added that would have been generated by the workers). The EU-27 average labour value added for the period 2001-2013 was € 30.7 per hour worked. Considering 8h working day and 220 working days per year, the annual average labour productivity per worker would be € 54,032[22].

- additional annual costs for the society due to unemployment: € 25,439 per person unemployed. Those costs were estimated as an average of the results of the average of cost of unemployment for UK, Spain, France, Germany and Sweden presented on the report *“Why invest in employment? A study on the cost of unemployment”* (22). Based on these data the annual cost of unemployment for society includes unemployment benefits received by the workers as well as guidance and administrative costs, loss in social contribution of employers and employees and loss in direct and indirect taxes.

[22] Source: Eurostat. Labour productivity, code [nama_aux_lp] [Cited: 9 February 2015].

8.2.2.4 Summary of scenarios considered in the uncertainty analysis

Given that

- 2 scenarios are considered regarding the number of sites using Chromium Trioxide for surface treatment for miscellaneous sectors in the EEA,
- 2 scenarios are considered regarding the monetary Value of a Statistical Life for the assessment of health impacts and,
- 6 scenarios are considered regarding the assessment of social impacts,

24 scenarios are considered in the scenario analysis in total.

Table 14 summarises the input parameters for each of the 24 scenarios.

Table 14: Summary of input parameters for the scenarios considered in the deterministic assessment of uncertainties

Scenario	Number of sites	Health impacts	Social impacts
S1	low	central value	1a
S2	low	central value	1b
S3	low	central value	2a
S4	low	central value	2b
S5	low	central value	3a
S6	low	central value	3b
S7	low	sensitivity value	1a
S8	low	sensitivity value	1b
S9	low	sensitivity value	2a
S10	low	sensitivity value	2b
S11	low	sensitivity value	3a
S12	low	sensitivity value	3b
S13	high	central value	1a
S14	high	central value	1b
S15	high	central value	2a
S16	high	central value	2b
S17	high	central value	3a
S18	high	central value	3b
S19	high	sensitivity value	1a
S20	high	sensitivity value	1b
S21	high	sensitivity value	2a
S22	high	sensitivity value	2b
S23	high	sensitivity value	3a
S24	high	sensitivity value	3b

8.2.3 Findings of uncertainty analysis

Table 15 summarises and combines the different scenarios analysed, showing the variations on the balance.

Table 15: Uncertainty analysis – summary

Scenario	Health impacts [million €]	Social impacts [million €]	Economic impacts [million €]	Total socio-economic impacts [million €]	Balance (socio-economic impacts - health impacts) [million €]	Ratio [health impacts : socio-economic impacts]
S1	30.9	1,354.1	701.1	2,055	2,024	1: 66.6
S2	30.9	2,017.3	701.1	2,718	2,688	1: 88.1
S3	30.9	207.7	701.1	909	878	1: 29.4
S4	30.9	309.5	701.1	1,011	980	1: 32.7
S5	30.9	551.7	701.1	1,253	1,222	1: 40.6
S6	30.9	821.8	701.1	1,523	1,492	1: 49.3
S7	63.7	1,354.1	701.1	2,055	1,992	1: 32.3
S8	63.7	2,017.3	701.1	2,718	2,655	1: 42.7
S9	63.7	207.7	701.1	909	845	1: 14.3
S10	63.7	309.5	701.1	1,011	947	1: 15.9
S11	63.7	551.7	701.1	1,253	1,189	1: 19.7
S12	63.7	821.8	701.1	1,523	1,459	1: 23.9
S13	72.9	2,463.8	701.1	3,165	3,092	1: 43.4
S14	72.9	3,127.0	701.1	3,828	3,755	1: 52.5
S15	72.9	378.0	701.1	1,079	1,006	1: 14.8
S16	72.9	479.7	701.1	1,181	1,108	1: 16.2
S17	72.9	1,003.7	701.1	1,705	1,632	1: 23.4
S18	72.9	1,273.9	701.1	1,975	1,902	1: 27.1
S19	150.3	2,463.8	701.1	3,165	3,015	1: 21.1
S20	150.3	3,127.0	701.1	3,828	3,678	1: 25.5
S21	150.3	378.0	701.1	1,079	929	1: 7.2
S22	150.3	479.7	701.1	1,181	1,031	1: 7.9
S23	150.3	1,003.7	701.1	1,705	1,555	1: 11.3
S24	150.3	1,273.9	701.1	1,975	1,825	1: 13.1

Figure 4 presents the monetised social and human health impacts in the respective scenarios. The graph illustrates the ranges obtained for different parameters across the scenarios analysed. It shows that, despite variation in the sensitivity of assumptions for social impacts and health impacts, the outcome remains invariable, such that socio-economic impacts always outweigh human health and environmental impacts.

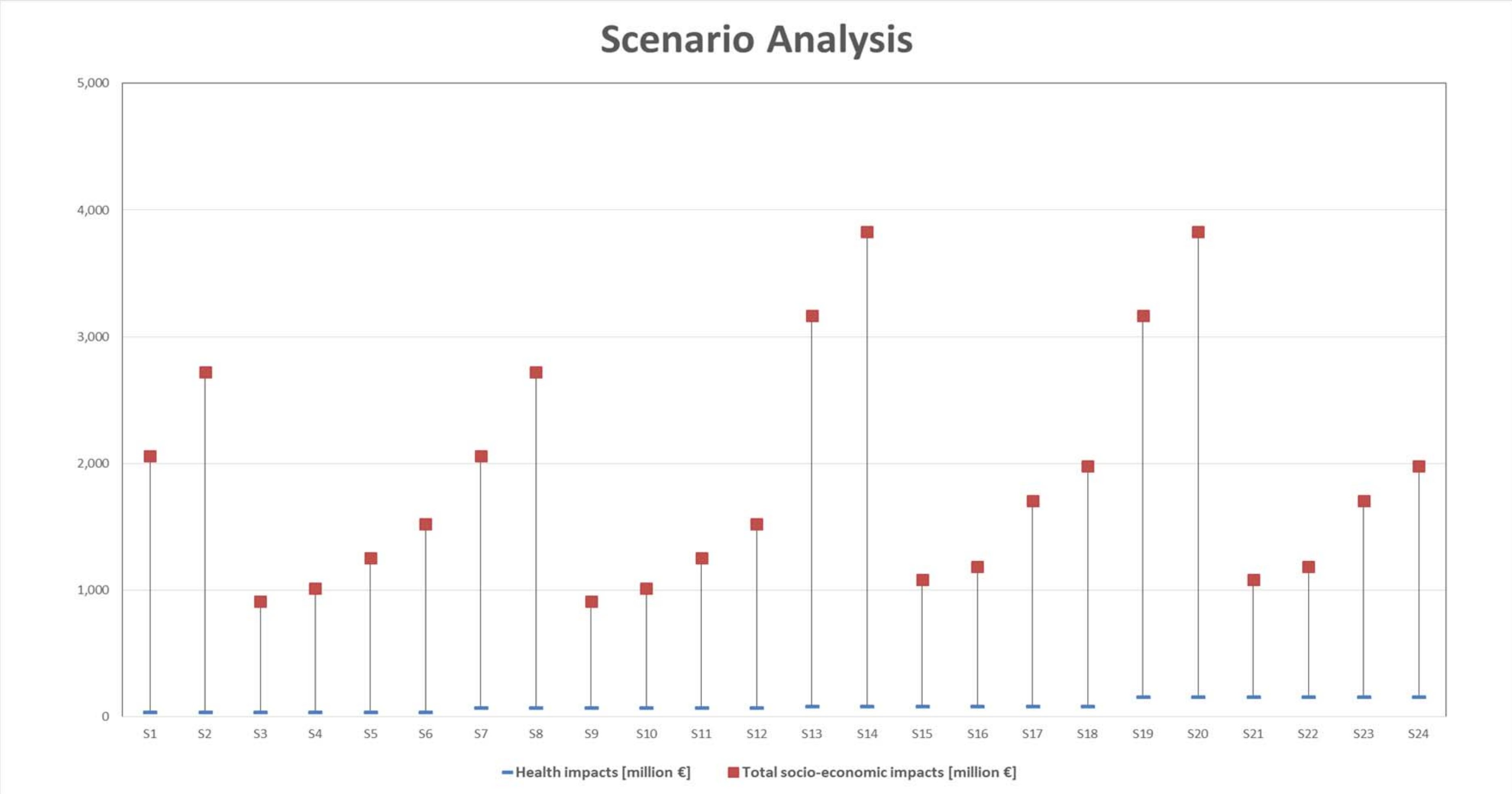

Figure 4: Scenario analysis - summary

9. CONCLUSIONS

The aim of this Socio-Economic Analysis (SEA) is to describe the socio-economic impacts of a non-granted authorisation of continued use of Chromium Trioxide according to the use description defined in section 3 and compare them to the residual risks to human health in case of a granted authorisation. The approach is in line with ECHA guidance. Given the aims of the SEA, the analysis purposefully sought to characterise certain impacts but also, where appropriate, to under-value social and economic impacts, and over-value health impacts. This approach supports confidence in the findings of the assessment.

The outcomes of this SEA for an assessment period of 7 years are briefly summarised in the following.

Monetised residual risks to human health and the environment of a granted authorisation

- < € 150.3 million (including impacts to workers in the supply chain and to the public "Man via Environment" in worst case assumption) (see section 7.1)

Socio-economic impacts of a non-granted authorisation:

- social impacts related to job losses amounting to € 1,354.1 million (see section 7.2)
- economic impacts related to purchasing losses of CTAC UG 4/5 members at European suppliers amounting to € 701.1 million (see section 7.2)
- **Total socio-economic impacts: > € 2,055.2 million**

Referring to the figures stated above, the quantitative assessment clearly supports a conclusion that the benefits of continued use outweigh the risks to human health and the environment (see summary table of the impact assessment in section 8.1). The CSR indicates exposure to workers and the public is well managed and limited. Against the background that health impacts are most certainly vastly overestimated and socio-economic impacts are intentionally highly underestimated, this outcome can be considered as robust.

A review period of 7 years was selected because it coincides with best case (optimistic) estimates of the schedule required to industrialise alternatives to Chromium Trioxide (see AoA for further information).

Apart from the outcomes of the quantitative impact assessment conducted in this SEA, the following factors should be considered for the assessment of the duration of the review period:

- The large number of complex supply chains involved, and associated challenges in terms of accurately identifying and quantifying impacts in the supply chain (see section 5).

- The economic and strategic importance, both resulting from industry's aim to deliver services that meet the most stringent criteria for health and safety, of several key industry sectors (e.g. automotive, steel, architecture) within the European Economic Area (see section 3.2).
- Rigorous and extensive regulations and requirements governing adaptation processes (see section 5).
- Long lifecycles of many products that are treated with Chromium Trioxide (see section 5).
- Wider economic impacts, *inter alia*:
  - migration of the affected European industry to non-EEA countries
    - negative impacts on trade and distortion of competition
    - negative impacts on national budgets due to loss of taxes paid
    - supply disruptions, leading to increasing dependence on non-EEA imports of Chromium Trioxide surface-treated articles
    - know-how loss in the supply chain
    - possible negative impacts on the quality of components

Stringent regulations, including the Directive 2004/37/EC, of the European Parliament and of the Council of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (OJ L 158 of 2004, p. 50) are in place that require implementation of measures to minimise workplace exposure to Chromium Trioxide. These regulations require employers to implement a hierarchy of Risk Management Measures relating to any use of Chromium Trioxide. Appropriate and efficient controls are in place to protect and comply with the environmental, health and safety regulatory requirements. Substantial improvements to Risk Management Measures to further minimise exposure have been made as a result of significant research and investment by industry, as evidenced by measurement data. It is expected that ongoing improvements will be effected as industry continues its commitment to minimise exposure. Considering, in particular, the recognized adverse long-term effects of these substances, appropriate efficient controls have been put in place accordingly to best protect and comply with environment and health / safety requirements.

Considering all factors elaborated in this SEA, a review period of not less than 7 years should be clearly justified.

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ANNEX A EXTRAPOLATION TO THE SURFACE TREATMENT INDUSTRY

1) Estimation of number of production sites using Chromium Trioxide for surface treatment for miscellaneous sectors

Following a supply chain approach, the assessment of this SEA relies on an estimation of European sites using Chromium Trioxide for surface treatment for miscellaneous sectors. An exact number cannot be stated here due to the high complexity of the surface treatment sector. Nevertheless expert consultations revealed that an **upper bound of 500 additional European sites using Chromium Trioxide** for surface treatment for miscellaneous sectors can be assumed. This upper bound is used within this SEA for the calculation of health and social impacts. According to expert consultations these companies are mainly categorised small (less than 50 people).

A **lower bound** of companies is assessed using CTAC UG 4/5 data and industry consultations. It can be concluded that in addition to companies that are CTAC UG 4/5 members, at least **200 additional companies** in the European supply chain are using Chromium Trioxide for surface treatment for miscellaneous sectors.

2) Extrapolation of exposure data within CTAC UG 4/5

Data within CTAC UG 4/5 was assessed using questionnaires sent to all members, site visits and expert consultation. Nevertheless, not all CTAC UG 4/5 member companies within this use group were able to quantify data. For this reason, to consider all health and social impacts of CTAC UG 4/5 members for the SEA at hand, an extrapolation approach is applied. The data received by CTAC use group 4/5 members is extrapolated by a factor: Number of CTAC use group 4/5 members applying Chromium Trioxide divided by number of CTAC use group 4/5 members which quantified data. For health impacts it is assumed that the average number of exposed workers and the respective distribution regarding exposure times is equal to the values derived from the data basis (CTAC UG 4/5 member companies that delivered data). For social impacts the distribution of job losses according to education levels among CTAC UG 4/5 companies which delivered data is assumed to be equal for CTAC UG 4/5 members that did not deliver data. Figure 5 illustrates the applied approach in this SEA.

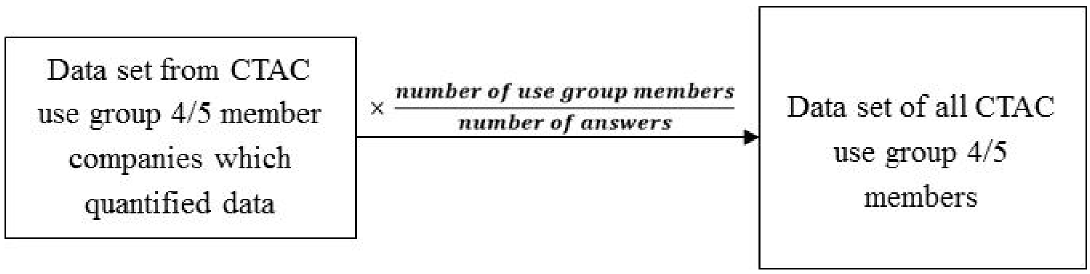

Figure 5: Extrapolation approach within CTAC UG 4/5

3) Extrapolation approach for the European surface treatment sector

For the extrapolation of impacts to the European surface treatment sector using Chromium Trioxide in surface treatment for miscellaneous sectors, impacts at CTAC UG 4/5 member companies are considered separately and impacts of the European surface treatment sector (ex CTAC) are added. Figure 6 illustrates the approach.

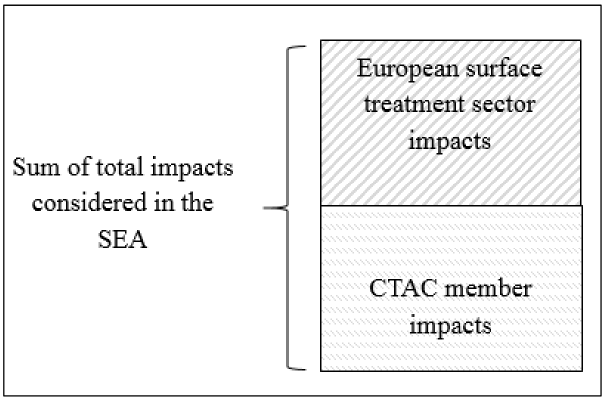

Figure 6: Extrapolation approach for European surface treatment sector

Sector extrapolation for potentially exposed workers

According to the commonly applied definition of the EU, small sized companies employ between 10 to 50 people and medium sized companies employ between 50 to 250 people. For the following calculations an average number of employees in the range of 10 to 50 for small (α) and in the range of 50 to 250 for medium sized companies (β) is taken into account. Due to Confidential Business Information (CBI) of CTAC UG 4/5 member companies an exact number cannot be stated here, as this could be used to calculate back numbers to single companies. Further, it is assumed that 50% of the employed workers are exposed to Chromium Trioxide. Based on industry consultation, the share between small and medium sized companies can be regarded as 80% to 20%. The estimation of production sites using Chromium Trioxide is given with 500 companies in the upper bound and with 200 companies in the lower bound, consequently 400 small and 100 medium sized companies have to be considered for the upper bound and 160 small and 40 medium sized companies for the lower bound. Therefore the number of potentially exposed workers can be calculated as follows:

$$\begin{aligned}&Number\ of\ potentially\ exposed\ workers\\&\quad = 50\%\ exposed\ workers\\&\quad \times (avg.\ employees\ small\ companies \times number\ of\ small\ companies\\&\quad + avg.\ employees\ medium\ companies \times number\ of\ medium\ companies)\end{aligned}$$

<u>Upper bound:</u>

$$Number\ of\ potentially\ exposed\ workers = 0.5 \times (\alpha\ \times 400 + \beta \times 100)$$

<u>Lower bound:</u>

$$Number\ of\ potentially\ exposed\ workers = 0.5 \times (\alpha\ \times 160 + \beta \times 40)$$

Within CTAC UG 4/5, companies were asked to categorise potentially exposed employees according to exposure time categories. The following categories have been used: workers exposed for 6-8 hours per day, 3-6 hours per day, 1-3 hours per day, less than 1 hour per day, workers not regularly exposed. The same share of these exposure time categories computed for this use in CTAC UG 4/5 have been applied for the health impact assessment of the surface treatment sector (surface treatment for miscellaneous sectors).

Sector extrapolation for social impacts

For small sized companies, the average number of employees (α) in the range of 10 to 50 is used to calculate the number of job losses which will occur in case of a non-use scenario. It can be clearly assumed, that the small companies are very specialised and do not have any possibility to change the work that is not related to Chromium Trioxide, which means a loss of contracts and consequently shutting down the company and dismissing 100% of the employees. For medium sized companies only the number of potentially exposed people (50% of β) is used to calculate social impacts, assuming that these companies are also operating in other businesses that do not rely on Chromium Trioxide. Therefore they could continue business only closing down the business related to Chromium Trioxide.

Within CTAC UG 4/5, job losses were categorised to education levels (low / high skilled and academic). As this categorisation cannot be assessed for other companies in the surface treatment sector, the social impact calculation follows the conservative approach. Hence the assessment of lost salary costs considers only an education level “low skilled”.

ANNEX B HEALTH IMPACT ASSESSMENT

1. Number of potentially exposed people

The extrapolation undertaken in ANNEX A provided the relevant number of potentially exposed workers in the European surface treatment sector (see Table 16). As a conservative assumption, exposure by “Man via the Environment” is assessed for the whole population of the European Economic Area (EEA) as sites may be spread all over Europe and cannot be located in this assessment.

Table 16: Number of people potentially exposed

Industrial workers in sites of the European surface treatment industry	8,046
General population (EEA in 2014[24])	512,888,463
PEC_{local}	515 sites x 10,000 people = 5,150,000

Chromium Trioxide or products containing the substance are not used by professionals. Therefore, these workers are not listed in the table above.

The human health impact assessment in the following sections is based on the methodology suggested by ECHA and described in section 6.4 of this SEA.

2. Calculation of health impacts for potentially exposed people

Following the methodology described in section 6.4, the calculation of the monetised health impacts of the sector is given by the following equations. The combined exposure values of the respective CSR (UG 4/5) is used corrected by the exposure times for the number of potentially exposed people to calculate the total concentration as input factor for the Excess Lifetime Risk (ELR) (see Table 17).

[24] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&tableSelection=1&labeling=labels&footnotes=yes&language=de&pcode=tps00001&plugin=0 [Cited: 19 November 2014].

Table 17: Corrected exposure times with number of potentially exposed people

Criteria	%	Total numbers of workers exposed EEA supply chain	exposure value [µg Cr(VI)/m3]	Correction factor applied for calculation	Total concentration EEA supply chain (rounded) [µg Cr(VI)/m3]
Workers potentially exposed for less than 1 hour/day	28%	2,233	2.00	0.125	558.29
Workers potentially exposed for 1-3 hours/day	11%	866	2.00	0.375	649.59
Workers potentially exposed from 3-6 hours/day	10%	772	2.00	0.75	1,158.38
Workers potentially exposed from 6-8 hours/day	11%	887	2.00	1	1,773.95
Workers not regularly exposed (e.g. once a week, month, year)	41%	3,287	2.00	0.125	821.78
TOTAL	**100%**	**8,046**			**4,961.99**

Based on the value for the total concentration of Cr(VI) (4,961.99 see Table 17) and a review period of 7 years, the equation for the calculation of Excess Lifetime Risk is as follows:

$$ELR = \frac{7}{40} \times 4 \times 10^{-3} \text{ per } \frac{\text{µg Cr(VI)}}{\text{m3}} \times \text{Total concentration } [\frac{\text{µg Cr(VI)}}{\text{m3}}]$$

With the expected sunset date being in 2017, the monetary values for the additional cancer cases are calculated according to the following equations:

Monetary value for fatal cancers (central value):

$$€_{fatal,central} = ELR \times € \text{ } 1{,}052{,}000 \times 1.01517^{(2017-2003)}$$

Monetary value for fatal cancers (sensitive value):

$$€_{fatal,sensitive} = ELR \times € \text{ } 2{,}258{,}000 \times 1.01517^{(2017-2003)}$$

<u>Monetary value of non-fatal cancers (central/sensitive value):</u>

$$€_{non-fatal} = 0.208 \times ELR \times € \, 400{,}000 \, \times 1.01517^{(2017-2003)}$$

Table 18 summarises the monetised impacts derived from the equations above derived in accordance with the ECHA guidance, for workers potentially exposed to Chromium Trioxide during the application of surface treatment for miscellaneous sectors in the EEA including members of the CTAC use group 4/5. The analysis is based on a review period of 7 years, following the worst-case approach by applying upper bound numbers of potentially exposed people within the CTAC use group 4/5.

Table 18: Monetised health impacts for workers in the European surface treatment sector

	Central value (lower bound) **[€ million]**	**Sensitivity value (upper bound)** **[€ million]**
Monetary value for fatal cancers ($€_{fatal}$)	4.5	9.7
Monetary value for non-fatal cancers ($€_{non-fatal}$)	0.4	0.4
Total	**4.9**	**10.0**

3. Exposed population "Man via Environment" human health impact assessment

The applied methodology and main underlying assumptions are given in section 6.4.5. The calculations are provided for PEC_{local} and $PEC_{regional}$ and follow generally the calculations presented for the health impact assessment of potentially exposed workers.

<u>PEC_{local}</u>

The total number of potentially indirectly exposed people is assessed taking into account the foreseen population of 10,000 people around a production site (20).

$$Number\ of\ potentially\ exposed\ people\ (PEC_{local}) = number\ of\ sites\ \times\ 10{,}000$$
$$= 500 \times 10{,}000 = \mathbf{5{,}150{,}000}$$

With the exposure values for PEC_{local} provided by the corresponding CSR and the above calculated number of potentially exposed people the further calculation follows the methodology described in section 6.4:

The excess risk is calculated according to the following equation:

$$ELR = \frac{review\ period\ [years]}{70\ years} \times 2.9\ \times 10^{-2}\ \text{per}\ \frac{\mu\text{g Cr(VI)}}{\text{m3}} \times\ \text{exposure value}\ PEC_{local} \times \text{number of people potentially exposed}$$

$$= \frac{7\ years}{70\ years} \times 2.9\ \times 10^{-2}\ \text{per}\ \frac{\mu\text{g Cr(VI)}}{\text{m3}} \times 3.25\ \times 10^{-3}\ \frac{\mu g}{m^3} \times 5{,}150{,}000$$

In a second step, the monetised values for additional lung cancer cases are calculated by multiplication with the WTP values adjusted to the year of the sunset date.

<u>Monetary value for fatal cancers (central value):</u>

$$€_{fatal,central} = ELR \times €\ 1{,}052{,}000\ \times 1.01517^{(2017-2003)}$$

<u>Monetary value for fatal cancers (sensitive value):</u>

$$€_{fatal,sensitive} = ELR \times €\ 2{,}258{,}000\ \times 1.01517^{(2017-2003)}$$

<u>Monetary value of non-fatal cancers (central/sensitive value):</u>

$$€_{non-fatal} = 0.208 \times ELR \times €\ 400{,}000\ \times 1.01517^{(2017-2003)}$$

Table 19: Monetised health impacts for PEC local

	Central value (lower bound) [€ million]	**Sensitivity value (upper bound) [€ million]**
Monetary value for fatal cancers ($€_{fatal}$)	63.0	135.3
Monetary value for non-fatal cancers ($€_{non-fatal}$)	5.0	5.0
Total	**68.0**	**140.3**

<u>$PEC_{regional}$</u>

The total number of potentially indirectly exposed people is assumed for the whole EEA due to missing possibilities to locate all the production sites.

$$Number\ of\ potentially\ exposed\ people\ (PEC_{regional}) = \mathbf{512{,}888{,}463}$$

With the exposure values for $PEC_{regional}$ provided by the corresponding CSR and the above calculated number of potentially exposed people the further calculation follows the methodology described in section 6.4:

The excess risk is calculated according to the following equation:

$$ELR = \frac{review\ period\ [years]}{70\ years} \times 2.9\ \times 10^{-2}\ \text{per}\ \frac{\text{µg Cr(VI)}}{\text{m3}} \times\ exposure\ value\ PEC_{regional}$$
$$\times\ number\ of\ people\ potentially\ exposed$$
$$= \frac{7\ years}{70\ years} \times 2.9\ \times 10^{-2}\ \text{per}\ \frac{\text{µg Cr(VI)}}{\text{m3}} \times 2.83\ \times 10^{-13}\ \frac{\mu g}{m^3}\ \times 512{,}888{,}463$$

In a second step, the monetised values for additional lung cancer cases are calculated by multiplication with the WTP values adjusted to the year of the sunset date.

<u>Monetary value for fatal cancers (central value):</u>

$$€_{fatal,central} = ELR \times €\ 1{,}052{,}000\ \times 1.01517^{(2017-2003)}$$

<u>Monetary value for fatal cancers (sensitive value):</u>

$$€_{fatal,sensitive} = ELR \times €\ 2{,}258{,}000\ \times 1.01517^{(2017-2003)}$$

<u>Monetary value of non-fatal cancers (central/sensitive value):</u>

$$€_{non-fatal} = 0.208 \times ELR \times €\ 400{,}000\ \times 1.01517^{(2017-2003)}$$

Table 20: Monetised health impacts for PEC regional

	Central value (lower bound) [€ million]	**Sensitivity value (upper bound) [€ million]**
Monetary value for fatal cancers ($€_{fatal}$)	0.0000005	0.0000012
Monetary value for non-fatal cancers ($€_{non-fatal}$)	0.0000000	0.0000000
Total	**0.0000006**	**0.0000012**

ANNEX C SOCIAL IMPACT ASSESSMENT

Social impacts that are considered quantitatively here, are limited to extrapolation and estimations of ANNEX A. It should be noted that this estimated number of job losses is conservative; the actual number of jobs lost in the non-use scenario is expected to be much higher than the figures mentioned in this report.

The impact of job losses due to the non-use scenarios is calculated using the salary cost method as described in section 6.2 of this SEA. Number of workers and salaries are assumed to remain constant for the authorisation period, the salaries only being adjusted by the GDP deflator factor (1.01517 / year). Therefore, the salaries paid for the workplaces that would be lost in the non-use scenario are applied for the entire review period. Uncertainty analysis around this assumption is also provided in section 8.2.2.3. Data on number and classification of lost jobs were taken from company information of the CTAC UG 4/5 members. In cases where CTAC UG 4/5 member companies encountered uncertainties regarding the classification of job losses to educational levels, job losses were counted as low skilled workers (conservative calculation / underestimation approach). This approach was also taken for job losses in the European surface treatment sector.

Note: Other costs associated to the job losses such as unemployment compensation and foregone value-added are not part of this assessment.

The total salary costs of all job losses as of 2010 is used as a base value for the NPV calculation. It is inflated at the above mentioned rate to account for standard price increases. After that, the values from 2018-2024 are discounted to the present value in the base year used for the assessment (2017) by employing a discount factor of 4%.

The resulting total Net Present Value (NPV) of the future payments of wages in 2017 within 7 years from the sunset date comprised by this application sums up to at least € 1,354.1 million. This means a loss of € 1,354.1 million appears to the EEA society in 2017 in case of non-authorisation.