Legal name of applicants:
LANXESS Deutschland GmbH in its legal capacity as Only Representative of LANXESS CISA (Pty) Ltd (as Submitting Applicant)

Atotech Deutschland GmbH

Aviall Services Inc.

BONDEX TRADING LTD in its legal capacity as Only Representative of Aktyubinsk Chromium Chemicals Plant, Kazakhstan

CROMITAL S.P.A. in its legal capacity as Only Representative of Soda Sanayii A.S.

Elementis Chromium LLP in its legal capacity as Only Representative of Elementis Chromium Inc.

Enthone GmbH

Submitted by:
LANXESS Deutschland GmbH in its legal capacity as Only Representative of LANXESS CISA (Pty) Ltd.

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

Use title:
Functional plating with decorative character

The electrochemical treatment of metal, plastic or composite surfaces to deposit metallic chromium to achieve an improvement in the surface appearance, level of corrosion protection and to enhance durability. In functional plating with decorative character, chromium trioxide is used to deposit a coating of typically 0.1 - 2.0 μm, or, where increased corrosion resistance is required, a ‘micro cracked’ chromium deposit at thicknesses of typically 0.5 - 2.0 μm, over a nickel undercoat. Functional plating with decorative character may include use of chromium trioxide in a series of pre-treatments and surface deposits. Functional plating with decorative character is used
widely in automotive, plumbing, household appliances, bathroom, furniture and homeware applications. Functional plating with decorative character includes black chrome plating provided that there is no residual Cr(VI) on the surface of the article at the detection limit,¹, which has been used, for example, in solar panel manufacture, where deposits are porous and <1 μm in thickness.

Use number:

3

¹ EN 15205 is to be used as the standard of detection of chromium VI. If a Member wishes to use another standard, the Member has to prove that it is equally sensitive.
CONTENTS

CONTENTS ................................................................................................................................................................. III
DISCLAIMER .............................................................................................................................................................. V
LIST OF ABBREVIATIONS ....................................................................................................................................... VI

1. SUMMARY OF SOCIO-ECONOMIC ANALYSIS .............................................................................................. 1

2. AIM AND SCOPE OF SEA ................................................................................................................................... 3
2.1. Aim ................................................................................................................................................................. 3
2.2. Scope .............................................................................................................................................................. 3

3. DEFINITION OF THE APPLIED FOR USE SCENARIO .................................................................................... 6
3.1. Plating process ................................................................................................................................................ 7
3.2. Supply chain ................................................................................................................................................... 8
3.3. Applications and end-uses of functional plating ............................................................................................. 10
  3.3.1 Automotive sector .................................................................................................................................. 10
  3.3.2 Sanitary sector ........................................................................................................................................ 12
  3.3.3 Functional plating with decorative character in other applications .......................................................... 14

4. DEFINITION OF THE NON-USE SCENARIOS .................................................................................................. 15
4.1. Summary of impacts of non-authorisation on the supply chain ...................................................................... 16

5. INFORMATION FOR THE LENGTH OF THE REVIEW PERIOD .................................................................... 18
5.1. Automotive industry ....................................................................................................................................... 18
5.2. Sanitary industry ............................................................................................................................................. 21
5.3. Functional plating with decorative character in other applications ................................................................. 22
5.4. Conclusion ...................................................................................................................................................... 23

6. METHODOLOGY .................................................................................................................................................. 24
6.1. General approach ............................................................................................................................................ 25
6.2. Assessment of social impacts (salary cost method) ........................................................................................ 26
6.3. Assessment of economic impacts ................................................................................................................... 28
6.4. Assessment of health impacts ........................................................................................................................ 28
SOCIO-ECONOMIC ANALYSIS

6.4.1 Data gathering on potential work exposure ................................................................. 29
6.4.2 Estimation of additional cancer cases in relation to baseline ........................................ 29
6.4.3 Estimation of average fatality rates in %, based on empirical data from EU-27 .......... 31
6.4.4 Monetary valuation of fatal and non-fatal cancer risks .................................................. 32
6.4.5 Health impacts “Man via Environment” ......................................................................... 36

7. ANALYSIS OF IMPACTS ..................................................................................................... 40
7.1. Human health and environmental impacts ...................................................................... 40
7.2. Social impacts .................................................................................................................. 42
7.2.1 Other employment effects ............................................................................................ 43
7.3. Economic impacts .......................................................................................................... 43
7.3.1 Wider economic impacts ............................................................................................ 44

8. COMBINED ASSESSMENT OF IMPACTS ......................................................................... 46
8.1. Comparison of impacts .................................................................................................... 46
8.2. Uncertainty analysis ........................................................................................................ 47
8.2.1 Qualitative assessment of uncertainties ..................................................................... 47
8.2.2 Deterministic assessment of uncertainties ................................................................. 49
8.2.3 Findings of uncertainty analysis .................................................................................. 54

9. CONCLUSIONS .................................................................................................................. 57

REFERENCES .......................................................................................................................... 59

LIST OF TABLES ....................................................................................................................... 61

LIST OF FIGURES .................................................................................................................... 61

ANNEX A EXTRAPOLATION TO THE FUNCTIONAL PLATING WITH DECORATIVE CHARACTER SECTOR .................................................................................................................. 62

ANNEX B HEALTH IMPACT ASSESSMENT ....................................................................... 65

ANNEX C SOCIAL IMPACT ASSESSMENT .......................................................................... 70

Copy right protected - Property of Members of the CTAC Submission Consortium – No copying / use allowed
DISCLAIMER

This document shall not be construed as expressly or implicitly granting a license or any rights to use related to any content or information contained therein. In no event shall LANXESS Deutschland GmbH in its legal capacity as Only Representative of LANXESS CISA (Pty) Ltd (as Submitting Applicant); and Atotech Deutschland GmbH; Aviall Services Inc.; BONDEX TRADING LTD in its legal capacity as Only Representative of Aktyubinsk Chromium Chemicals Plant, Kazakhstan; CROMITAL S.P.A. in its legal capacity as Only Representative of Soda Sanayii A.S.; Elementis Chromium LLP in its legal capacity as Only Representative of Elementis Chromium Inc; Enthone GmbH be liable in this respect for any damage arising out or in connection with access, use of any content or information contained therein despite the lack of approval to do so.
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEA</td>
<td>European Automobile Manufacturer’s Association</td>
</tr>
<tr>
<td>AfA</td>
<td>Application for Authorisation</td>
</tr>
<tr>
<td>AoA</td>
<td>Analysis of Alternatives</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost-Benefit Analysis</td>
</tr>
<tr>
<td>CBI</td>
<td>Confidential Business Information</td>
</tr>
<tr>
<td>Cr(VI)</td>
<td>Hexavalent Chromium</td>
</tr>
<tr>
<td>Cr(III)</td>
<td>Trivalent Chromium</td>
</tr>
<tr>
<td>CSR</td>
<td>Chemical Safety Report</td>
</tr>
<tr>
<td>CTAC</td>
<td>Chromium Trioxide REACH Authorisation Consortium</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ECHA</td>
<td>European Chemicals Agency</td>
</tr>
<tr>
<td>EEA</td>
<td>European Economic Area</td>
</tr>
<tr>
<td>EFTA</td>
<td>European Free Trade Area</td>
</tr>
<tr>
<td>ELR</td>
<td>Excess Lifetime Risk</td>
</tr>
<tr>
<td>ES</td>
<td>Exposure Scenarios</td>
</tr>
<tr>
<td>ETESS consortium</td>
<td>Expert Team providing Scientific Support for ECHA</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUROSTAT</td>
<td>Statistical Office of the European Communities</td>
</tr>
<tr>
<td>FTE</td>
<td>Full Time working Equivalent</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>IARC</td>
<td>International Agency for Research on Cancer</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Occupational Medicine</td>
</tr>
<tr>
<td>ISCED</td>
<td>International Standard Classification of Education</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>MRO</td>
<td>Maintenance, Repair and Overhaul</td>
</tr>
<tr>
<td>MVE</td>
<td>Man via the Environment</td>
</tr>
<tr>
<td>NewExt</td>
<td>New Elements for the Assessment of External Costs from Energy Technologies</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>NUS</td>
<td>Non-Use Scenario</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
</tr>
<tr>
<td>OHS</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>PEC</td>
<td>Predicted Environmental Concentration</td>
</tr>
<tr>
<td>RAC</td>
<td>Risk Assessment Committee</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment</td>
</tr>
<tr>
<td>SEA</td>
<td>Socio-Economic Analysis</td>
</tr>
<tr>
<td>SEAC</td>
<td>Socio-Economic Analysis Committee</td>
</tr>
<tr>
<td>SMEs</td>
<td>Small and Medium Enterprises</td>
</tr>
<tr>
<td>STC</td>
<td>Supplemental Type Certificate</td>
</tr>
<tr>
<td>SVHC</td>
<td>Substance of Very High Concern</td>
</tr>
<tr>
<td>TC</td>
<td>Type Certificate</td>
</tr>
<tr>
<td>UBA</td>
<td>Umweltbundesamt</td>
</tr>
<tr>
<td>VOLY</td>
<td>Value of Life Year lost</td>
</tr>
<tr>
<td>VSL</td>
<td>Value of Statistical Life</td>
</tr>
<tr>
<td>VDMA</td>
<td>Verband Deutscher Maschinen- und Anlagenbau e.V</td>
</tr>
<tr>
<td>WTP</td>
<td>Willingness to Pay</td>
</tr>
</tbody>
</table>
1. SUMMARY OF SOCIO-ECONOMIC ANALYSIS

The Socio-Economic Analysis (SEA) has been performed for the use of chromium trioxide for functional plating with decorative character.

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:

- € 126 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 applicants, CTAC use group 3 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 use group 3 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 € 126 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 € 9,585 million (see section 7.2)
- Economic impacts related to lost purchasing volumes amounting to at least € 1,537 million (see section 7.3)
- Total socio-economic impacts: > € 11,122 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 use group 3 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 use group 3 members only. Following the underestimation approach, no extrapolation of economic impacts was done.
SOCIO-ECONOMIC ANALYSIS

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 chromium metallic layer deposited in a part or article after functional plating with decorative character is completely free of Cr(VI) (see section 3).
- 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 protection, of several key industry sectors (e.g. automotive, sanitary, cosmetics, white ware, furniture, electronics) within the European Economic Area (see section 3.3).
- Complex adaptation processes and procedures, reflecting industry-specific requirements and regulations (see section 5).
- Long lifecycles of many products (e.g. cars, household goods like white ware, sanitary ware) that are treated with chromium trioxide (see section 5).
- Wider economic impacts that are not quantified here, inter alia (see section 7.3.1):
  - At least the European chrome plating industry will migrate to non-EEA countries
    - negative impacts on trade and distortion of competition
    - negative impacts on national budgets due to loss of taxes paid
    - know-how loss in the supply chain
    - negative impacts on the quality and safety of various components
    - less good occupational health & safety conditions for the workforce (compared to high European health & safety standards)

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).

LANXESS Deutschland GmbH in its legal capacity as Only Representative of LANXESS CISA (Pty) Ltd (as Submitting Applicant); and Atotech Deutschland GmbH; Aviall Services Inc.; BONDEX TRADING LTD in its legal capacity as Only Representative of Aktyubinsk Chromium Chemicals Plant, Kazakhstan; CROMITAL S.P.A. in its legal capacity as Only Representative of Soda Sanayii A.S.; Elementis Chromium LLP in its legal capacity as Only Representative of Elementis Chromium Inc; Enthone GmbH, as members of the CTAC Submission Consortium, apply for authorisation to continue use of chromium trioxide in functional plating with decorative character after the sunset date in September 2017. It is intended that this application covers the downstream use of chromic acid in accordance with ECHA Q&A #805.

The applicants foresee that customers in their supply chain may benefit from such an authorisation. CTAC use group 3 is integrated by platers, OEMs, suppliers and MRO, as well as several importers and distributors (which apply to secure their supply chain).

This Socio-Economic Analysis (SEA) forms part of the Application for Authorisation (AfA) for the use of chromium trioxide in functional chrome plating with decorative character. 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 (qualified and industrialised) substitutes for chromium trioxide in functional plating with decorative character until and beyond the sunset date (see corresponding AoA document). The aim of this Socio-Economic Analysis (SEA) is to robustly demonstrate that the socio-economic benefits associated with the continued use of chromium trioxide in functional plating with decorative character outweigh the remaining risks to human health and the environment associated with prevailing use conditions.

2.2. Scope

Functional plating with decorative character is the electrochemical treatment of metal, plastic or composite surfaces to deposit metallic chromium to achieve a high level of corrosion protection, to enhance durability and to improve surface appearance. It is important to recognise that the final chromium coating does not contain chromium trioxide or any other Cr(VI) compounds, such that it
is safe to use. Functional plating with decorative character may include use of chromium trioxide in one or more series of pre-treatments (e.g. when the substrate is plastic). Further technical details, requirements and process descriptions can be found in the corresponding AoA.

Functional plating with decorative character is widely used in automotive, plumbing, household appliances, bathroom faucets, cosmetics, store construction, furniture and homeware applications. It includes black chrome plating (products without residual Cr(VI) on surface), being used, for example, in solar panel manufacture, where deposits are porous and <1μm in thickness.

Further background to these industry sectors and applications 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 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 CTAC and the public domain have been used as the basis for evidence supporting this application. 59 member companies of the consortium directly or indirectly support functional plating with decorative character (CTAC use group 3).

The scope of analysis concentrates geographically on the territory of the European Economic Area (EEA), which is comprised of the European Union (EU) 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 in functional plating with decorative character, (2) social impacts and (3) economic impacts linked to a decision not to authorise the continued use of chromium trioxide in

---

1 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.
functional plating with decorative character. For the purpose of this SEA, a review period of 7 years is assessed. The review period presents the outcome of the AoA coinciding with the estimates by the industry of the schedule required to industrialise alternatives to chromium trioxide for functional plating with decorative character. 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). A sensitivity assessment has been included to demonstrate that there is a robust case for the review period applied for.
3. DEFINITION OF THE APPLIED FOR USE SCENARIO

Functional plating with decorative character is applied in the production process of a large variety of articles of daily use.

In all applications, chromium trioxide is critical to the plating process to achieve a high level of corrosion protection, to enhance durability and to achieve a bright and decorative coating with a slightly bluish colour. The high aesthetic requirements are achieved by the special surface properties provided by chromium. Apart from the appearance, important functional characteristics conferred by the use of chromium trioxide in the plating process are corrosion and chemical / cleaning agent resistance, wear and abrasion resistance, good adhesion on different kind of substrates and underlying coatings, haptic (metallic surface feel), hygienic (“easy cleaning”), long lifetime, non-toxic deposit and non-allergenic. Additionally, as chrome coated products from different companies are often installed together (for example bathroom, automotive interior), the colour stability / colour match of these products is important.

From a technical point of view, functional plating with decorative character is usually applied in thin deposits (submicron thickness) with the goal of obtaining a very level, durable, bright and shiny surface. The chromium layer is applied on top of a multi-layer coating (for example Cu-Ni) preventing the corrosion of the very level and bright surfaces generated by bright (nickel) undercoats. Plastic substrates have to be pre-treated adequately by etching prior to subsequent process steps. For more details, please refer to the corresponding AoA documents.

Today, the safe handling of chromium trioxide and the related processes are regulated through several laws and regulations such as:

Therefore, it can be clearly stated that the application of chromium trioxide in functional plating with decorative character happens under controlled and safe conditions. Furthermore, the chromium metallic layer deposited in a part or article after functional plating with decorative character is completely free of Cr(VI).

3.1. Plating process

As it is explained in detail in the AoA, when industrialising an anticorrosion system, the whole system must be considered. As a consequence, there is a link between substances, processes steps and products to ensure complete compatibilities of each element of a complex system and the ultimate characteristics or functionalities which each component, sub-system or system must meet.

In the process of functional plating with decorative character, the base material (e.g. brass, steel, aluminium or plastic) is generally plated with layers of copper and nickel followed by a relatively thin layer of chromium to achieve the required finishing properties, i.e. a bright surface with wear and tarnish resistance. The chromium plating process consists of a series of operations. Figure 1 illustrates the process flow. Further details of the process can be found in the corresponding AoA of use 3.
3.2. **Supply chain**

Companies involved in the functional plating with decorative character business supply a broad range of industries. Figure 2 presents a generalised supply chain of chromium trioxide.

Parts that have been treated with chromium trioxide during functional plating with decorative character are required for a wide range of applications, across diverse and complex supply chains, serving a vast number of downstream users and, ultimately, consumers.
Chromium trioxide is manufactured outside the EEA, imported, and partly distributed to formulators that produce mixtures containing chromium trioxide. These mixtures are then sold either directly or via distributors to the plating shops that do functional plating with decorative character either in-house as part of the production line or that do chrome plating as contracted work (job platers). Some chromium trioxide is not formulated and goes directly from importers (via distributors) to the plating shops.

Companies that specialise in plating (job platers or plating shops) may have a range of customers from across industry. In such cases, plating shops deliver expertise and specialist facilities to deliver chrome plating safely, effectively and efficiently for a wide-range of specifications (several million of parts a year).

Chrome plated parts and components may then be further processed and assembled at article manufacturers, assemblers or end-users that comprise of different industrial sectors. There is no potential for exposure to chromium trioxide or other Cr(VI) substances in these steps. For example in most cases plating shops, producing parts for the automotive sector, do not sell directly to the OEM,
but to 1st, 2nd or 3rd tier companies, who assemble the plated part to a bigger component, such as a dashboard.

### 3.3. Applications and end-uses of functional plating

As indicated above, chromium trioxide is essential for a vast range of industry sectors. Information provided by CTAC use group 3 member companies relates directly to, for example, the, automotive and sanitary sectors. However, this is not comprehensive as a high number of job shops applying functional plating with decorative character can be found in Europe. The most commonly sectors identified based on CTAC use group 3 member feedback are described in further detail in the following sections.

#### 3.3.1 Automotive sector

The EU is among the world's largest producers of motor vehicles. The automotive industry is therefore central to Europe's prosperity\(^2\). 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). Figure 3 shows the development of exports of motor cars and other vehicles during the last 10 years.

![European Exports of motor cars and other vehicles](image)

**Figure 3: European Exports of motor cars and other vehicles**

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, assuming chrome plated parts can be readily supplied from non EU companies. 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 industry is a key R&D investor leading in innovation worldwide, spending over € 32 billion and producing 9,500 patents per year.

Functional plating with decorative character is used in the automotive industry to produce interior and exterior parts for trucks, cars, motorcycles such as grilles, handle, logo and emblems, covers and shielding, console decorations, airbag badge, decorative strips, rings, knobs, rotary elements etc. A passenger car can easily contain 60-80 chrome plated parts.

**Structure of the supply chain**

In addition to being one of the most important industries in the EEA, the automotive sector is also one of the most technically complex. The high degree of technical sophistication within the industry has also characterised its supply chain structure, which has formed over the decades as companies have focussed on their core competencies to preserve high efficiency. Around 75% of a vehicle’s original equipment, components and technology are sourced from automotive suppliers (6).

Figure 4 shows a simplified structure of the automotive supply chain. In reality, there are around seven tiers of suppliers within the value added chain.
Automotive parts can generally be defined as:

- Original Equipment (OE) parts, which are used in the assembly of a new motor vehicle or are purchased by the manufacturer for its service network
- aftermarket parts, which can be divided into two categories: past model service parts (which are automotive parts built or re-manufactured to replace original equipment parts as they become worn or damaged) and accessories (which are parts made for comfort, convenience, performance, safety, or customisation, and are designed for add-on after the original assembly of the motor vehicle) (8).

The demand for chrome plated plastic parts to be used in cars has been steadily increasing because of the rising demand for European cars and the increasing use of these parts, not only in the luxury car segment, but also in the other classes. Today, chrome plated plastic parts are commonly used in cars to meet the demands on design and haptic of the surfaces and to reduce the overall weight of the vehicles (to finally achieve fuel savings and better emission values). Parts can be found in various designs, such as matt (aluminium look), shiny or black in the interior as well as in the exterior of cars. Especially the fast-growing export markets (e.g. Asia) are asking for this premium appearance of European cars.

Many suppliers of the car manufacturers are already involved in the design and conception of the parts (which starts usually more than 5-7 years before production start). These companies provide not only chrome plating on plastic parts, they also produce the parts (by injection moulding) and provide the final assembly of components. The plating process itself is only one important step in the overall value chain, the associated processes demand a much higher labour force.

The interior of a car contains 60 to 80 different chrome plated parts, which are delivered to the car manufacturer by 5 to 7 different suppliers. All parts must show compatibility in terms of quality and colour. Besides that, the parts have to withstand temperature fluctuations between -40°C to +80°C\(^3\) as well as exterior conditions like mud, dust and salt in winter times. All previously stated requirements and endurance of these parts over many years can only be achieved by the use of chromium trioxide in the functional plating process.

3.3.2 Sanitary sector

The European sanitary industry produces high quality tapware, fittings and valves in a large variety of versions and applications for private houses, hotels, public buildings and commercial applications.

---

3 Source: DIN 53100 and several specifications from OEMs.
like canteen kitchens. According to EUROSTAT data of 2011, 134,200 employees worked in the sector “manufacture of other taps and valves” comprising of around 2,900 companies, mostly small and medium sized. Consultations with industry experts resulted in estimations that sanitary taps and valves contribute to almost 50% in this class. Therefore, we assume around 67,000 employees and 1,400 companies in this sector for the European Union. The German association VDMA reports a production value of € 2.6 billion in 2012, only for the German sanitary sector.

Some companies produce all relevant parts of the tap ware themselves or even act as system providers (selling all parts for sanitary installations). This may include components like cartridges, which are the “heart of each one hand faucet”, concealed systems and of course the faucets.

All parts have a unique and complex geometry. The plating process of these parts in the galvanic baths requires a lot of optimisation and expertise (e.g. sojourn time, amperage and bath streams need to be adapted to the single parts). For a tap ware producer with different product series the number of parts to be treated easily reaches several hundreds and for all of them the above-mentioned galvanic bath parameters need to be modified to achieve the best possible quality of the product.

Without using chromium trioxide in functional chrome plating with decorative character, the sector would not be able to fulfil the high requirements posed on the surfaces of sanitary products over decades. For example, these relate to durability (hardness, strength), hygiene (ability to be cleaned frequently, often using harsh abrasive chemicals) and long lasting aesthetic appearance (brightness, consistency). Quality is a very important issue, as the European tap ware producers operate in a highly competitive market with non-EEA companies (especially from Asia). High quality and long lifetime of their products are the main competitive advantages that allow European companies to justify high product prices over non-EEA competitors, thus keeping production in Europe economically feasible. Furthermore, the market continuously demands innovative products and new designs. The development process of these products is costly and time consuming, but the new products are often quickly copied by competitors that can offer lower prices and, if the European sanitary industry would be forced to use alternative technologies resulting in significantly less good surfaces, and less quality of the products. Consequently, the European sanitary industry has no chance to differentiate their products from others (in case authorisation is not granted). Already today the market offers cheap products, some even treated with Cr(III) galvanic processes which do not fulfil the quality standard.

[Cited: 12 November 2014].
of the European tapware producers and show on a long time perspective for example lower life and durability of the products.

3.3.3 Functional plating with decorative character in other applications

Plating companies perform functional plating with decorative character for various kinds of parts and for a wide range of industry sectors either as contracted work or as part of the production at assemblers / article manufacturers. Apart from the industry sectors described in more detail above, job plating facilities also exemplary serve these industry sectors:

- **Cosmetic industry:** cosmetic fragrance caps
- **Consumer and white goods:** components for household appliances (like washing machine rings, coffee machines), manicure and locks, fitness tools, cycles and motorcycles, furniture, lightning
- **Black chroming:** a special kind of chrome plating, which is applied for example in spacecraft components, electronics, solar panels, optics and lasers
- **Others:** articles for hospitals, store constructions, catering equipment, dentist chairs,…

---

5 Non-exhaustive.
4. DEFINITION OF THE NON-USE SCENARIOS

The non-use scenarios were developed through multiple channels. In the first instance, members of CTAC use group 3 prepared a description of the non-use scenarios. 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. CTAC use group 3 members 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 3 members companies are significant. This can be seen to reflect the critical function (high quality surfaces) that chromium trioxide plays for functional plating with decorative character, which is essential for many industry sectors.

Since a detailed description of all non-use scenarios prepared by CTAC use group 3 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 use group 3 member companies include:

- Partial shutdown / shutdown of production facilities
- Relocation of production facilities to non-EEA countries
- Transfer of production processes / production volume to non-EEA facilities and re-import of plated parts with chromium trioxide; respectively complete products into the EEA
- Subcontracting to non-EEA suppliers

Given the fact that there is no alternative to chromium trioxide in functional plating with decorative character, activities related to chromium trioxide that are carried out by importers, formulators and distributors of the substance 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.

Plating facilities would shut down their activities related to chrome plating, as chromium trioxide is necessary for the pre-treatment process of some substrates (etching of the surfaces) and the plating process itself (see AoA for further details). Companies that offer other surface treatment or business activities besides functional plating with decorative character reported that they would 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.

In surface treatment facilities that reported a partial shutdown, functional plating with decorative character accounts for the highest share of the business. Therefore, non-authorisation potentially also
affects the viability of the remaining business activities which might lead to a total shutdown of the companies. Those companies that can afford a relocation of their facilities to a non-EU country will do so (this step is even easier for companies that already have non-EEA production sites). However, most Small or Medium Enterprises (SMEs), which represent the majority of the job-platers in the EEA report that they cannot afford a relocation, and therefore “simply” cease their business activities.

**Article manufacturers / assemblers** of chrome-plated components that operate in-house chrome plating facilities will either shutdown their facilities and subcontract these operations to companies outside the EEA, or relocate their chromium trioxide related production lines to non-EEA territory. Since the surface of tap ware blanks or plastic parts is too sensitive, these parts cannot be transported over long distances to galvanic baths in non-EEA countries. In these cases, further sub-assembly steps are likely to be relocated as well. Therefore, even larger parts of their businesses will migrate to non-EEA countries. At the same time, article manufacturers / assemblers / end-user companies will need to increase their storage capacities leading to higher storage costs.

Some companies note, that considering the negative impacts in the non-use scenario, they might not be able to stay competitive which will result in loss of revenue and cancelation of contracts. In these cases, the non-use scenario will result in a complete shutdown of all activities. Further negative impacts to the European economy include leakage of know-how / technology to non-EEA countries, affecting Europe’s position as a technology leader.

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

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

As elaborated in the section above, non-authorisation of the continued use of chromium trioxide in functional plating with decorative character will have a series of severe impacts on the European supply chain. Firstly, job platers as well as in-house platers will not be able to carry out their work anymore, shutting down their production lines in the EEA and ceasing delivery of parts. Job platers / in-house platers that can afford to relocate to a non-EEA country will do so. Already today, some companies have existing production sites outside of Europe. Consequently, competences and know-how already exists at non-European production sites and production capacities can be increased there. Making investment decisions, companies cannot avoid the potential that it might be considered preferable, to focus new investment in a non-EEA country. In these countries they find less regulatory constraints and they can cover emerging foreign markets directly from the new non-EEA sites. All other companies will shut down and cease production.

Already today the high uncertainty about review periods and whether an authorisation is granted or not results in investment stops of the industry (e.g. the average life of a plating plant as well as its Return on Investment (ROI) is approximately 15 years). Currently many investments to build new electroplating lines (with environmental friendly and energy-saving systems) are frozen, because the
situation is very uncertain (investment protection). 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, article manufacturers, assemblers and end-users of parts and components, treated with chromium trioxide in the production process will cover their demand at non-EEA suppliers and possibly relocate parts of their final assembly lines to non-EEA countries (partly assembling subunits 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 plating shops upwards will move to a non-EEA country. Also subsequent parts of the supply chain may relocate over time.

Furthermore, the health environment for workers will not improve due to the relocation because of much less stringent regulations in non-EEA countries.6

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

---

6 This is true for all industry sectors.
5. INFORMATION FOR THE LENGTH OF THE REVIEW PERIOD

In addition to the findings of the AoA, the following sections shall exemplary highlight the special characteristics inherent to the affected industries to justify a minimum review period of 7 years for the use of chromium trioxide in functional plating with decorative character.

5.1. Automotive industry

To prevent (often safety relevant) failures of end products, the automotive industry has rigorous testing and validation procedures in place. These procedures include laboratory tests, summer and winter tests and continuous-operation tests. After testing and validation, alternative technologies have to be extended to large-scale production. Consequently, a longer period of time is required to effectively substitute the use of a particular substance (7).

In addition to that, enough capacity has to be built up in Europe to cover all relevant parts for production of more than 10 million cars per year.

Attempts to replace components with alternatives not evaluated thoroughly enough lead to failures in the field and costly product recalls. Apart from the paramount issue of consumer safety, such recalls have the potential to damage carefully developed brand equity, spoil customers’ quality perceptions, tarnish a company’s reputation and lead to losses of both revenue and market share (Ciravegna, 2012 in (7)).

Furthermore, if the manufacturers are unable to bridge the supply gap for parts, the lack of availability of chrome plated parts could affect vehicle production volumes, which, when considering the economic importance of the automotive industry to the European economy, could have widespread negative effects (7).

Assuming a typical life-time of a car model of 22 years (>5 years for development time, 7 years of production and at least 10 years of spare part guarantee) with an assumed start of production in 2017 compared with a two years period before the sunset date, the period to possibly introduce changes decreases rapidly after type approval (Directives 2005/64/EC and 2009/1/EC) by a certified body. The assumed two years before sunset date (for introducing changes) could occur at any stage of the minimum 22 years life-time of different car models, even during the spare part period when changes are not possible anymore (see also Figure 5).
Due to the sheer number of parts involved, the revalidation of these parts and the non-availability of alternatives, substitution will not be completed by the sunset date (September 2017).

The long life-time of vehicles, the multiple models on different stages of their life-time, the complex supply-chain and the long lead time for substitution requires planning reliability.

Already today, suppliers are in a dilemma to sign new contracts with OEMs for car model production, which will start 7 years after the sunset date. It is a high-risk investment decision since supplier directions of car producers make it compulsory to run the process with chromium trioxide like established for decades (e.g. Volkswagen TL 528, Daimler Benz supplier direction 8465). A not granted authorisation or a short review period would therefore mean that contracts could not be fulfilled and may cause penalties.

Past model service parts are typically provided during the production life of the vehicle but also for a minimum of ten years after serial production has finished. This period is often extended to the lifetime of a vehicle, which was produced thirty or more years ago.

Changing one or more substances used in the current past model service parts is not a simple, straightforward task; it requires serious efforts for development and testing, which is in many cases neither economically nor technically feasible when one considers the low production volumes of these service parts (7). Furthermore, allocating the costs of development and testing to such a small number of products would drive the prices of past model service parts produced by European manufacturers to an excessively high level, and encourage the import of components and parts from outside the EEA. In addition, the re-validation of the altered spare part has to be based on the original vehicle, which in many cases may not be available to the spare part manufacturer. In addition, each model has been tested for safety; reliability etc. with the past model service parts currently in production; there

Figure 5: Life-time of a car model (7)
is no guarantee that the same standards will be met after changing affected substances. Substitution of substances can cause changes in function, geometry, durability and may have unexpected impacts on other related parts (7).

Suggestions such as the stockpiling of spare parts for decades are equally problematic. Apart from the issue of storage capacity, there is also the problem of physical and chemical ageing. The potential for overcapacity that stockpiling can produce is inefficient and a waste of resources because obsolete parts would eventually have to be scrapped. It could also potentially inflate the cost of spare parts, as the suppliers (typically SME) would need to recover any costs related to obsolescence (7).

Besides that, the increasing demand for European cars creates a need for investments in additional production capacities. However, companies will and cannot make these investments as long as it is unclear if and how long production using chromium trioxide can be continued in the EEA. An investment is planned for 20-30 years with depreciation periods of buildings of up to 30 years and for galvanic lines between 10-12 years. For galvanic lines, continuous yearly investments of several hundred thousand Euro are needed to keep the production line up to date.

As mentioned above, most lines run with maximum capacity making it even more difficult to switch to an alternative (the production plan foresees a break for maintenance activities of only 2-3 weeks a year). If an alternative would be accepted by one customer, this would result in parallel production with different processes until every customer has accepted the alternative. Therefore, all Original Equipment Manufacturers (OEMs) have to accept alternatives to be able to switch to alternatives in a coordinated way. Even if alternatives were to become available, it is not possible to switch easily from a Cr(VI) process to a Cr(III) process7, since in most companies there is one existing building, with one specific production line, which fits exactly in a soundly trough of the production hall. As no more space for additional bathes (the Cr(III) process may need up to 5 additional bathes in the production line) is available, this change requires high investments and time to rebuild the existing production facility. In some cases, this will even not be possible as production runs in old landmarked buildings, which do not allow any extension.

As the AoA explains, alternatives are to be expected in the future, but at present, no alternative is available which would provide the demanded properties by the sectors’ clients. One major issue is the colour matching of the products. Today plated plastic parts with chromium trioxide in the process show the same colour and surface structure independent of the supplier. In section 3.3.1 it was described that an interior of a car comprises of dozens of different plated parts from several suppliers.

7 Currently the most promising alternative (please see AoA).
Customers would never accept parts with different colours next to each other in the cockpit of a car (colour spectrum may range from steel blue to yellow).

With regard to current vehicle parts and European vehicle production, an adequate review period is absolutely necessary to ensure that alternatives are thoroughly evaluated (to avoid failures in the field), ready for large scale production and capacities are built in Europe to ensure that production volumes of vehicles are not affected, that the European automotive market remains competitive on a global scale and to allow an efficient information exchange through a very long chain of suppliers.

5.2. Sanitary industry

The sanitary industry has to fulfil high quality demands. Therefore, all materials undergo intensive testing procedures by the manufacturers. Additionally, the products have to comply with regulations like the Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, DIN EN 16058 (Influence of metallic materials on water intended for human), EN DIN 15664-1 (Metal release test, design and operation) and EN DIN 15664-2 (Metal release test, test waters) and national regulations like DIN 50930-10 (Corrosion of metals).

With regard to the multi-layer system used for the coating of sanitary parts, the chemical indicator parameters of highest interest related to the Drinking Water Directive are nickel and chrome. The European Drinking Water Directive is applied in all EU Member States, nevertheless there might be additional regulations at national level. Such an example is §17 of the German Drinking Water Ordinance regulating the requirements on installation parts for the production, preparation and distribution of drinking water. Following this, installations for the production, preparation and distribution of drinking water have to be constructed, built and operated at least by the state-of-the-art technique.

The German Environmental Agency (Umweltbundesamt (UBA)) is the responsible authority to further specify the requirements and basis for evaluation of substrates and materials used in contact with drinking water with regard to the protection of the human health. Therefore, test regulations with parameters and test criteria to evaluate the hygienic suitability of the substrates and materials are set up by the UBA. The evaluation basis is binding after 2 years of its publication. Following the evaluation, the UBA maintain a “positive list” published in the UBA statement Drinking water hygienic suitable metallic materials (Trinkwasserhygienisch geeignete metallene Werkstoffe, 2013) with the substrates and materials which passed all requirements and which are therefore allowed to be used in contact with drinking water.

New surface systems (coatings and materials as alternative to the existing chrome plating process) require an evaluation for drinking water hygienic suitability. This evaluation method for products in contact with drinking water has first to be developed by the UBA. Together with the material testing procedure, a period of at least 10 years from the decision made for an alternative, until product safety and approval has been assessed is required (see corresponding AoA).
This example clearly demonstrates, that new substances first need to be authorised by public authorities. The testing procedures needed to comply with all regulations, to meet demanded properties and finally yet importantly, to provide a safe product in contact with drinking water, require sufficient time and resources.

Furthermore, products typically have a production time of more than 7 years. Planning and design for big orders (like equipping hotels) starts years before the parts go into production and these contracts ask for a long subsequent delivery time of up to 25 years. Anyway, regular spare part production has to be possible additional 10 years after official product stop.

As already mentioned in section 5.1, high quality surfaces and colour matching of parts are big issues to find an adequate alternative. The sanitary sector consists of dozens of independent companies supplying components (deck and angle valves, pipe traps, towel bars and diverters, just to name a few). All of these parts have to have the same colour to sustain acceptance by the market. This interacting and complex supply chain of several suppliers has to deliver independent products fitting together at the customer.

An overhasty switch to alternative technologies that do not meet the quality standards will result in decreasing demands of European products as non-EEA products are cheaper and would provide better quality (Cr(VI) based) compared to European faucets.

5.3. Functional plating with decorative character in other applications

In case authorisation of continued use of chromium trioxide in functional plating with decorative character would not be granted, affected industry sectors will either relocate their production facilities or source plated parts from non-EEA suppliers. Yearly, hundreds of small and medium sized job plating companies within Europe are delivering millions of various parts to all kind of industry sectors. Often chromium plated parts by these companies are only one of thousands in end-products, nevertheless the job plating companies are an essential part in the overall supply chain to deliver quality end-products to consumers.

To avoid supply disruptions in the production process of an undefinable number of products (like consumer goods, store constructs, white goods, perfumes, furniture, solar panels, dentist chairs,…) it is essential to provide enough time for the industrialisation of an alternative (provided there is an alternative) and / or to re-establish the complex industry relations.

Already today the high uncertainty about review periods and whether an authorisation is granted or not results in investment stops of the industry. The length of the review period must allow for planning certainty so that companies can continue to successfully invest in Europe, preventing migration of entire industry sectors and associated workplaces.
A non-granted authorisation or a too short review period will have massive impacts on the whole functional plating with decorative character sector in Europe and would – as reported by numerous CTAC use group 3 member companies - be seen by many companies as a starting signal to move production out of the EEA, if not already done before. Since the majority of the companies are small and medium sized, most of them will have to close down their sites causing losses of tens of thousands of jobs and the related value-added for the EEA.

The German surface treatment association expects that with a non-granted authorisation € 1.7 billion will get lost to the German economy only. Fabrication steps linked to chrome plating will also get lost. The import of functional chrome treated parts with decorative character from non-EEA countries does not underlie any restrictions, as the surface of metallic chrome is harmless. Consequently, premium surface treated parts respectively complete products are imported (as a substitute) while in Europe only poor quality surfaces could be produced.

5.4. Conclusion

The use of chromium trioxide in functional plating with decorative character is extensive in a wide range of industry sectors and often plays a critical role in meeting the technical requirements given by the applications the chrome plated parts are used for.

Furthermore, the supply chain for functional plating with decorative character is highly integrated, complex and inter-dependent. Functional plating with decorative character is well established to function across industry sectors, relying on economies of scale to do so safely and effectively.

For all the reasons stated and with reference to the findings of the AoA, a minimum review period of 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 and recommends a Cost-Benefit Analysis (CBA) as the preferred tool for quantitative analysis. 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. 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 possible 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 applicants refer to and utilise the processes, methods, tools and values (e.g. the dose-response relationship) prescribed under ECHA (2011) and ECHA (2013). However, the applicants, CTAC use group 3 members 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 of the residual health risk of the use as authorised 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 applicants, CTAC use group 3 members and companies in the supply chain consider that the

---

8 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.

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

monetised health impacts calculated according to the prescribed ECHA method have no real-world, commercial or legal relevance or merit.

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 use group 3 members that use chromium trioxide in functional plating with decorative character 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, public available data and expert consultation. The assessment of economic impacts is limited to CTAC use group 3 members 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 ECHA 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 members. Formulators of chromium trioxide received separate questionnaires that allowed more detailed analysis of use-group specific differences.

In addition, site visits at CTAC use group 3 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 representing costs of health impacts, as reported in studies specified for use in Cost-Benefit Analysis, have been used in

---

11 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)
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, 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 use group 3 member companies (lower bound of job losses as stated by the CTAC use group 3 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 use group 3 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 for the purpose of the SEA was subject to competition rules and is therefore neutralised and aggregated.

### 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 use group 3 member companies were asked if and how many jobs related to chromium trioxide use would be lost as a consequence of their individual non-use scenarios. At the same time, CTAC use group 3 member companies were asked to classify the jobs that would be lost according to their education levels low skilled / high skilled / academic.

In case CTAC use group 3 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 and academic by the CTAC use group 3 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. Average social contributions and other labour costs paid by employers in the EU-27 (as 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)

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

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)

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

An inflation rate of 1.517\%\(^{14}\) (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 use group 3 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)\(^{15}\). 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

---

\(^{14}\) This inflation rate is used for the entire impact assessment (see section 6.4.4 for further details)

\(^{15}\) By reference to this, the applicants neither agree nor disagree with this dose-response relationship. However, the applicants acknowledge 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.
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.

**6.4.1 Data gathering on potential work exposure**

Following the worst case approach, combined worker exposure values from the corresponding CSR (9) 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):

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

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)

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

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

\[
\frac{\text{working hours per day}}{8 \text{ hours}}
\]

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 \times 10^{-3} \times \text{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:

\[ P_{\text{excess}} = P(x) - P(0) \]

with

\[ P_{\text{excess}}(x) = \text{Excess risk at exposure } x \]

\[ P(x) = \text{lifetime risk of persons exposed for dying from lung cancer} \]

\[ P(0) = \text{Background risk (lifetime risk of a non – exposed comparison group)} \]
It has to be emphasised that $P_{\text{excess}}(x)$ 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 (10), 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 $P_{\text{excess}}(x)$ 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 [μg/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), mention is made of an “excess lifetime lung cancer mortality risk”. This is also consistent with the results of ETESS (2013) (10) 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) (11) 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 (12).
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 (11). 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 6) 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)16 (13). In NewExt, empirical Values of 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.

---

16 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.
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.

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. 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 the 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 6, 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.

The ECHA guidance on Socio-Economic Analysis refers to the results of the NewExt Study (13) 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

<table>
<thead>
<tr>
<th></th>
<th>Non-fatal cancer (morbidity)</th>
<th>Fatal cancer (mortality)</th>
<th>Fatal cancer (mortality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Value of Statistical Life based on the median value (lower bound)</td>
<td>€ 400,000 (2003)</td>
<td>€ 1,052,000 (2003)</td>
<td>€ 2,258,000 (2003)</td>
</tr>
<tr>
<td>Sensitivity Value of Statistical Life based on the statistical mean value (upper bound)</td>
<td>1.01517 ( \text{sunset year} - 2003 )</td>
<td>1.01517 ( \text{sunset year} - 2003 )</td>
<td>1.01517 ( \text{sunset year} - 2003 )</td>
</tr>
</tbody>
</table>

2003 WTP value based on NewExt (2004) – starting value in ECHA Guidance

Adjusting the 2003 values to the sunset date

GDP deflator index 2003 – year of the sunset date; for multiplication

Probability of lung cancer ending non-fatal/fatal (EU-27 average)

Additional occurrence of non-fatal lung cancer per one fatal cancer estimated

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 the substance, first the excess risk is calculated according to the following equation:

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

where

\(\mu g \text{ Cr(VI)}/\text{m}^3\)

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 Environment”

6.4.5.1 Relevant exposure concentrations

According to ECHA guidance Chapter R.16: Environmental Exposure Estimation (Version 2.1 – October 2012) (14), 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.

18 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.

The regional Predicted Environmental Concentration (PEC\text_{regional}) derived in the CSR has been assumed to represent the average exposure concentration for the general population. The local Predicted Environmental Concentration (PEC\text{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\text{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)\textsuperscript{21} 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 functional chrome plating with decorative character. 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) (14). 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\text{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.

---

\textsuperscript{20} The calculated PEC\text{regional} represents the average concentration in an area of 200 x 200 km around the point sources.


Use number: 3

*Copy right protected - Property of Members of the CTAC Submission Consortium – No copying / use allowed*
Table 3: Overview of the most important input parameters for calculation of health impacts for MVE

<table>
<thead>
<tr>
<th>Group of exposed people</th>
<th>Number of potentially exposed people</th>
<th>Exposure concentration to be used from the ES</th>
<th>Dose-response curve for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirectly exposed</td>
<td>Indirectly exposed workers and direct neighbourhood</td>
<td>Number of sites using chromium trioxide x 10,000</td>
<td>PEC&lt;sub&gt;local&lt;/sub&gt;</td>
</tr>
<tr>
<td>Indirectly exposed</td>
<td>general population in an area of 200 x 200 km around the site</td>
<td>512,888,463</td>
<td>PEC&lt;sub&gt;regional&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

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\textsubscript{local}**

For the calculation of the ELR related to PEC\textsubscript{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.

\[
\text{Number of potentially exposed people} = \text{number of sites} \times 10,000
\]

The exposure values for PEC\textsubscript{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:

\[
\text{ELR} = \frac{\text{review period [years]}}{70 \text{ years}} \times 2.9 \times 10^{-2} \text{ per } \frac{\mu g \text{Cr(VI)}}{m^3} \times \text{exposure value } PEC_{\text{local}}
\]

\[
\times \text{number of potentially exposed people}
\]

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\textsubscript{regional}**

The calculations for the ELR related to PEC\textsubscript{regional} are equivalent to the calculations of PEC\textsubscript{local} only using a different exposure value for PEC\textsubscript{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 (9) 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 use group 3 members and at facilities in the relevant supply chain and the general population.

The analysis is based on gathered data from CTAC use group 3 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 functional plating with decorative character in the European surface treatment sector.

<table>
<thead>
<tr>
<th></th>
<th>Central value (lower bound)</th>
<th>Sensitivity value (upper bound)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[€ million]</td>
<td>[€ million]</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>38.4</td>
<td>79.2</td>
</tr>
</tbody>
</table>

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\textsubscript{local}) and the population of the EEA (PEC\textsubscript{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 functional chrome plating with decorative character within the EEA. The analysis is based on a review period of 7 years.

<table>
<thead>
<tr>
<th></th>
<th>Central value (lower bound)</th>
<th>Sensitivity value (upper bound)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[€ million]</td>
<td>[€ million]</td>
</tr>
<tr>
<td><strong>PEC\textsubscript{local}</strong></td>
<td>22.4</td>
<td>46.3</td>
</tr>
<tr>
<td><strong>PEC\textsubscript{regional}</strong></td>
<td>0.000004</td>
<td>0.000007</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22.4</td>
<td>46.3</td>
</tr>
</tbody>
</table>

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) (15). 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 plants, 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 CO₂ emission reduction and removal of emissions from plating facilities in general within the EEA as a result of production stop, relocation to a non-European country or similar. However, it is important to recognise that these impacts are not eliminated but just shifted to another (non-European) geographical region. It cannot be discounted that emissions would in fact increase as a result of less stringent regulation in non-European countries. In addition, CO₂ 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 46,700 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 use group 3 members and lower bound of EEA functional plating with decorative character sites (809 sites)) (see ANNEX A); the actual number of jobs lost in the non-use scenarios 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 not full employment in Europe. 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 EU was approximately 9% (2001-2013). Therefore, the salaries paid for the workplaces that would be lost in the non-use scenario

---

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

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 € 9,585 million. This means a loss of € 9,585 million appears to the EEA 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 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 3 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 3 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

<table>
<thead>
<tr>
<th>Description of cost</th>
<th>Costs in 2012 [€ million]</th>
<th>Total impact on European supplier sales (2017)* [€ million] (rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials</td>
<td>189.09</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>34.98</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>224.08</td>
<td>1,537.15</td>
</tr>
</tbody>
</table>

*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 € 1,537 million for a review period of 7 years. This means a loss of € 1,537 million appears to the EEA in 2017 in case of non-authorisation.

7.3.1 Wider economic impacts

In addition to the socio-economic impacts described in the previous sections, 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 CTAC use group 3 members would not be granted authorisation for the continued use of chromium trioxide in functional plating with decorative character, the amount of taxes and fees paid in Europe will be reduced by the amount, which is linked to all products produced by the industry (see section 3 for the broad variety). This represents a substantial loss of income for the EEA.

**Impacts on economic development**

As a consequence of the non-use scenarios of the CTAC use group 3 member companies, the European supply chain would piecewise move to non-EEA countries preventing revenue streams from the sector to continue and leading to considerable welfare losses for the EEA. The automobile industry provides a good example: Already today, there is a tendency to deliver complete assemblies (e.g. a radiator grille with a chrome trim) to the car manufacturers. It is very likely that in case of a non-granted authorisation these assemblies including the chrome plated plastic parts (here the chrome trim) are ordered at non-EEA suppliers. In consequence, also European automotive suppliers not using chromium trioxide (here the radiator grille) are widely affected by this authorisation and might lose business.

**Impacts on trade and product quality**

Especially high price products will be affected by a non-granted authorisation contributing significantly to the positive trade balance of Europe. In addition, Europe would become dependent
SOCIO-ECONOMIC ANALYSIS

on imports of products compulsively needed for their production lines with danger of supply disruptions, especially in industries like the automotive sector, where just-in-sequence deliveries are applied. Besides that, quality concerns can be expected and European know-how and technology would 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>
<thead>
<tr>
<th>Type of impact</th>
<th>Applied for use scenario</th>
<th>Non-use scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human health</td>
<td>➢ Maximum potential exposure of 61,800 workers to chromium trioxide</td>
<td>➢ No potential exposure of 61,800 workers in Europe†</td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>➢ Negligible environmental impacts related to chromium trioxide</td>
<td>➢ No environmental impacts related to chromium trioxide in the EEA‡</td>
</tr>
<tr>
<td>Economic impacts</td>
<td>➢ Maintenance of purchases at EEA suppliers / subcontractors</td>
<td>➢ Loss of sales for the suppliers / subcontractors</td>
</tr>
<tr>
<td>Social impacts</td>
<td>➢ Maintenance of at least 46,700 jobs directly related to the use of chromium trioxide</td>
<td>➢ Loss of 46,700 jobs directly related to the use of chromium trioxide</td>
</tr>
<tr>
<td>Wider Economic impacts</td>
<td>➢ Maintenance of taxes paid&lt;br&gt;➢ No negative impacts on the European supply chain and competitiveness&lt;br&gt;➢ No impacts on trade and quality</td>
<td>➢ Loss of taxes paid in Europe&lt;br&gt;➢ Shift of the European surface treatment supply chain to non-EEA countries and loss of competitiveness&lt;br&gt;➢ Cease of exports from the EEA&lt;br&gt;➢ Possible quality issues</td>
</tr>
</tbody>
</table>

† 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

<table>
<thead>
<tr>
<th>Type of impact</th>
<th>Discounting over 7 years [€ million]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits in economic terms of avoiding potential health impacts associated with the continued use of chromium trioxide</td>
<td>79.2</td>
</tr>
<tr>
<td>Benefits of avoiding health impacts through potential exposure “Man via Environment”</td>
<td>46.3</td>
</tr>
<tr>
<td>Economic impacts</td>
<td>1,537.1</td>
</tr>
<tr>
<td>Social impacts</td>
<td>9,585.3</td>
</tr>
<tr>
<td><strong>Net benefits of a granted authorisation</strong></td>
<td><strong>10,996.9</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Identification of uncertainty (assumption)</th>
<th>Classification</th>
<th>Evaluation</th>
<th>Criteria and scaling (contribution to total uncertainty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape of exposure-response function (linear versus non-linear)(^{23})</td>
<td>Model uncertainty</td>
<td>If non-linear, particularly at low exposure levels: overestimation</td>
<td>High</td>
</tr>
<tr>
<td>Working days (260 days) given by the dose-response curve</td>
<td>Parameter uncertainty</td>
<td>Not taking into account holidays, bank holidays, illness: overestimation</td>
<td>Medium</td>
</tr>
<tr>
<td>Monetary values used for a statistical life(^{24})</td>
<td>Parameter uncertainty</td>
<td>Range</td>
<td>Medium</td>
</tr>
<tr>
<td>Number of companies in the EEA supply chain related to chromium trioxide</td>
<td>Parameter uncertainty</td>
<td>If too high: overestimation</td>
<td>Medium</td>
</tr>
<tr>
<td>Number of exposed employees in companies outside the CTAC use group 3</td>
<td>Parameter uncertainty</td>
<td>If too high: overestimation</td>
<td>High</td>
</tr>
<tr>
<td>Exposure values at companies outside the CTAC use group 3</td>
<td>Parameter uncertainty</td>
<td>If exposure values too high: overestimation</td>
<td>Medium</td>
</tr>
<tr>
<td>PEC(<em>{\text{local}}) includes exposure concentration of PEC(</em>{\text{regional}})</td>
<td>Parameter uncertainty</td>
<td>Double counting of health impacts for people already considered in PEC(_{\text{local}}) values: overestimation</td>
<td>Low</td>
</tr>
</tbody>
</table>

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

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

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.

23 The study conducted by ETeSS on behalf of ECHA clearly states that: “[…] the lower the exposure (certainly below 1µg/m³), 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)/m³ 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/m³ downwards), cancer risks may be negligible.” (10)

24 Sensitive values were used from the outset in order to avoid underestimation of health impacts.
8.2.2.1 Number of sites

As described in ANNEX A of this SEA, the number of sites (including CTAC use group 3 member companies) that are taken into account for the uncertainty analysis sums up to:

- 809 sites for the scenario “low”
- 1,159 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”

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Value [number of sites]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>809</td>
</tr>
<tr>
<td>High</td>
<td>1,159</td>
</tr>
</tbody>
</table>

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 (13) 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”

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Value 2017 [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central</strong></td>
<td></td>
</tr>
<tr>
<td>Fatal cancer</td>
<td>1,298,849</td>
</tr>
<tr>
<td>Non-fatal cancer</td>
<td>493,859</td>
</tr>
<tr>
<td><strong>Sensitive</strong></td>
<td></td>
</tr>
<tr>
<td>Fatal cancer</td>
<td>2,787,833</td>
</tr>
<tr>
<td>Non-fatal cancer</td>
<td>493,859</td>
</tr>
</tbody>
</table>

#### 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\(^\text{25}\)). 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.

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”

<table>
<thead>
<tr>
<th>Scenario code</th>
<th>Scenario</th>
<th>Value [job losses considered]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social impacts 1a</td>
<td>All job losses considered for the length of the review period; lower bound</td>
<td>46,700</td>
</tr>
<tr>
<td>Social impacts 1b</td>
<td>All job losses considered for the length of the review period; upper bound</td>
<td>91,114</td>
</tr>
<tr>
<td>Social impacts 2a</td>
<td>All job losses considered for 1 year only, lower bound</td>
<td>46,700</td>
</tr>
<tr>
<td>Social impacts 2b</td>
<td>All job losses considered for 1 year only, upper bound</td>
<td>91,114</td>
</tr>
<tr>
<td>Social impacts 3a</td>
<td>70% of job losses considered for 1 year only, the remaining 30% considered for the length of the review period; lower bound</td>
<td>32,690 job losses considered for one year only, 14,010 job losses considered for the length of the review period</td>
</tr>
<tr>
<td>Social impacts 3b</td>
<td>70% of job losses considered for 1 year only, the remaining 30% considered for the length of the review period; upper bound</td>
<td>63,780 job losses considered for one year only, 27,334 job losses considered for the length of the review period</td>
</tr>
</tbody>
</table>

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 € 54,03226.

- additional 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

---

26 Source: Eurostat. Labour productivity, code [nama_aux_lp] [Cited: 9 February 2015].
report “Why invest in employment? A study on the cost of unemployment” (16). 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.

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 functional plating with decorative character 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

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

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>31.7</td>
<td>9,585.3</td>
<td>1,537.1</td>
<td>11,122.4</td>
<td>11,090.7</td>
<td>1: 351.2</td>
</tr>
<tr>
<td>S2</td>
<td>31.7</td>
<td>12,117.1</td>
<td>1,537.1</td>
<td>13,654.3</td>
<td>13,622.6</td>
<td>1: 431.1</td>
</tr>
<tr>
<td>S3</td>
<td>31.7</td>
<td>1,470.6</td>
<td>1,537.1</td>
<td>3,007.7</td>
<td>2,976.0</td>
<td>1: 95.0</td>
</tr>
<tr>
<td>S4</td>
<td>31.7</td>
<td>1,859.0</td>
<td>1,537.1</td>
<td>3,396.1</td>
<td>3,364.5</td>
<td>1: 107.2</td>
</tr>
<tr>
<td>S5</td>
<td>31.7</td>
<td>3,905.0</td>
<td>1,537.1</td>
<td>5,442.1</td>
<td>5,410.4</td>
<td>1: 171.8</td>
</tr>
<tr>
<td>S6</td>
<td>31.7</td>
<td>4,936.4</td>
<td>1,537.1</td>
<td>6,473.6</td>
<td>6,441.9</td>
<td>1: 204.4</td>
</tr>
<tr>
<td>S7</td>
<td>65.3</td>
<td>9,585.3</td>
<td>1,537.1</td>
<td>11,122.4</td>
<td>11,057.1</td>
<td>1: 170.3</td>
</tr>
<tr>
<td>S8</td>
<td>65.3</td>
<td>12,117.1</td>
<td>1,537.1</td>
<td>13,654.3</td>
<td>13,588.9</td>
<td>1: 209.0</td>
</tr>
<tr>
<td>S9</td>
<td>65.3</td>
<td>1,470.6</td>
<td>1,537.1</td>
<td>3,007.7</td>
<td>2,942.4</td>
<td>1: 46.0</td>
</tr>
<tr>
<td>S10</td>
<td>65.3</td>
<td>1,859.0</td>
<td>1,537.1</td>
<td>3,396.1</td>
<td>3,330.8</td>
<td>1: 52.0</td>
</tr>
<tr>
<td>S11</td>
<td>65.3</td>
<td>3,905.0</td>
<td>1,537.1</td>
<td>5,442.1</td>
<td>5,376.8</td>
<td>1: 83.3</td>
</tr>
<tr>
<td>S12</td>
<td>65.3</td>
<td>4,936.4</td>
<td>1,537.1</td>
<td>6,473.6</td>
<td>6,408.3</td>
<td>1: 99.1</td>
</tr>
<tr>
<td>S13</td>
<td>60.9</td>
<td>16,218.9</td>
<td>1,537.1</td>
<td>17,756.0</td>
<td>17,695.2</td>
<td>1: 291.7</td>
</tr>
<tr>
<td>S14</td>
<td>60.9</td>
<td>18,750.7</td>
<td>1,537.1</td>
<td>20,287.9</td>
<td>20,227.0</td>
<td>1: 333.3</td>
</tr>
<tr>
<td>S15</td>
<td>60.9</td>
<td>2,488.3</td>
<td>1,537.1</td>
<td>4,025.4</td>
<td>3,964.6</td>
<td>1: 66.1</td>
</tr>
<tr>
<td>S16</td>
<td>60.9</td>
<td>2,876.7</td>
<td>1,537.1</td>
<td>4,413.9</td>
<td>4,353.0</td>
<td>1: 72.5</td>
</tr>
<tr>
<td>S17</td>
<td>60.9</td>
<td>6,607.5</td>
<td>1,537.1</td>
<td>8,144.6</td>
<td>8,083.7</td>
<td>1: 133.8</td>
</tr>
<tr>
<td>S18</td>
<td>60.9</td>
<td>7,638.9</td>
<td>1,537.1</td>
<td>9,176.1</td>
<td>9,115.2</td>
<td>1: 150.8</td>
</tr>
<tr>
<td>S19</td>
<td>125.5</td>
<td>16,218.9</td>
<td>1,537.1</td>
<td>17,756.0</td>
<td>17,630.5</td>
<td>1: 141.5</td>
</tr>
<tr>
<td>S20</td>
<td>125.5</td>
<td>18,750.7</td>
<td>1,537.1</td>
<td>20,287.9</td>
<td>20,162.4</td>
<td>1: 161.6</td>
</tr>
<tr>
<td>S21</td>
<td>125.5</td>
<td>2,488.3</td>
<td>1,537.1</td>
<td>4,025.4</td>
<td>3,969.9</td>
<td>1: 32.1</td>
</tr>
<tr>
<td>S22</td>
<td>125.5</td>
<td>2,876.7</td>
<td>1,537.1</td>
<td>4,413.9</td>
<td>4,288.3</td>
<td>1: 35.2</td>
</tr>
<tr>
<td>S23</td>
<td>125.5</td>
<td>6,607.5</td>
<td>1,537.1</td>
<td>8,144.6</td>
<td>8,019.1</td>
<td>1: 64.9</td>
</tr>
<tr>
<td>S24</td>
<td>125.5</td>
<td>7,638.9</td>
<td>1,537.1</td>
<td>9,176.1</td>
<td>9,050.6</td>
<td>1: 73.1</td>
</tr>
</tbody>
</table>

Figure 7 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 7: 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

- € 126 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 € 9,585 million (see section 7.2)
  - economic impacts related to purchasing losses of CTAC use group 3 members at European suppliers amounting to € 1,537 million (see section 7.3)
  - Total socio-economic impacts: > € 11,122 million

Referring to the figures stated above, the quantitative assessment clearly supports the 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 not less than 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 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 protection, of several key industry sectors (e.g. automotive, sanitary) within the European Economic Area (see section 3.3).

Complex adaptation processes and procedures, reflecting industry-specific requirements and regulations (see section 5).

Long lifecycles of many products (e.g. cars, sanitary ware) that are treated with chromium trioxide (see section 5).

Wider economic impacts that are not quantified here, inter alia:
- migration of the European industry to non-EEA countries
  - negative impacts on trade and competition
  - negative impacts on national budgets due to loss of taxes paid
  - know-how loss in the supply chain
  - negative impacts on the quality and safety of various 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 is clearly justified.
REFERENCES


6. **Commission, European.** Fitness Check of the Legal Framework for the Type-Approval of Motor Vehicles. [Online] [Cited: 16 February 2015.]


LIST OF TABLES

Table 1: Salary costs according to educational level EU-27 (EUROSTAT Data as of 2010) ................................................... 27
Table 2: Monetary values for fatal and non-fatal cancer risks, based on the ECHA Guidance .................................................. 35
Table 3: Overview of the most important input parameters for calculation of health impacts for MVE .......................... 38
Table 4: Summary of monetised health impacts for potentially exposed workers considering 1,559 sites .................. 41
Table 5: Summary of monetised health impacts in the general population considering 1,559 sites .............................. 41
Table 6: Expenses for raw materials and energy .............................................................................................................. 44
Table 7: Comparison of impacts for the applied for use and the non-use scenario .................................................. 46
Table 8: Quantitative comparison of impacts for the applied for use and the non-use scenario ................................ 47
Table 9: Uncertainties on human health impacts ........................................................................................................ 48
Table 10: Uncertainties on social impacts .................................................................................................................. 49
Table 11: Input parameters “number of sites” ................................................................................................................ 50
Table 12: Input parameters “Willingness to Pay” .......................................................................................................... 51
Table 13: Input parameters “job losses” ....................................................................................................................... 52
Table 14: Summary of input parameters for the scenarios considered in the deterministic assessment of uncertainties 54
Table 15: Uncertainty analysis – summary ................................................................................................................... 55
Table 16: Number of people potentially exposed ........................................................................................................ 65
Table 17: Corrected exposure times with number of potentially exposed people ............................................................... 66
Table 18: Monetised health impacts for workers in the European functional plating with decorative character sector 67
Table 19: Monetised health impacts for PEC local ........................................................................................................ 68
Table 20: Monetised health impacts for PEC regional .................................................................................................. 69

LIST OF FIGURES

Figure 1: Flow chart for the plating process. (Data source: FGK, 2014, adapted) ........................................................... 8
Figure 2: Generalised supply chain for chromium trioxide .............................................................................................. 9
Figure 3: European Exports of motor cars and other vehicles ......................................................................................... 10
Figure 4: Basic structure of the automotive industry (Heneric et al., 2005 in (7)) ............................................................ 11
Figure 5: Life-time of a car model (7) ......................................................................................................................... 19
Figure 6: Median and mean Value of a Statistical Life, derived from NewExt (13), p. III-34 ........................ 34
Figure 7: Scenario analysis - summary ....................................................................................................................... 56
Figure 8: Extrapolation approach within CTAC use group 3 ....................................................................................... 62
Figure 9: Extrapolation approach for European functional plating with decorative character sector 63
ANNEX A EXTRAPOLATION TO THE FUNCTIONAL PLATING WITH DECORATIVE CHARACTER SECTOR

1) Estimation of number of production sites using chromium trioxide

Following a supply chain approach, the assessment of this SEA relies on an estimation of European sites using chromium trioxide for functional plating with decorative character. An exact number cannot be stated here due to the high complexity and broadness of this sector. Nevertheless, expert consultations revealed that an upper bound of 1,500 additional European sites using chromium trioxide for functional plating with decorative character 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 and medium.

A lower bound of companies is assessed using CTAC data and industry consultations. It can be concluded that in addition to companies that are CTAC use group 3 members, at least 750 additional companies in the European supply chain are using chromium trioxide for functional plating with decorative character.

2) Extrapolation of exposure data within CTAC

Data within CTAC was assessed using questionnaires sent to all members, site visits and expert consultation. Nevertheless, not all CTAC use group 3 member companies within this use group were able to quantify data. For this reason, to consider all health and social impacts of CTAC use group 3 members for the SEA at hand, an extrapolation approach is applied. The data received by CTAC use group 3 members is extrapolated by a factor: Number of CTAC use group 3 members applying chromium trioxide divided by number of CTAC use group 3 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 members that delivered data). For social impacts the distribution of job losses according to education levels among CTAC use group 3 companies which delivered data is assumed to be equal for CTAC UG 3 members that did not deliver data. Figure 8 illustrates the applied approach in this SEA.

Figure 8: Extrapolation approach within CTAC use group 3

Data set from CTAC use group 3 member companies which quantified data

\[
\frac{\text{number of use group members}}{\text{number of answers}} \times \text{Data set of all CTAC use group 3 members}
\]
3) Extrapolation approach for the European surface treatment sector

For the extrapolation of impacts to the European functional plating with decorative character sector using chromium trioxide in functional chrome plating with decorative character, impacts at CTAC use group 3 member companies are considered separately and impacts of the European sector (ex CTAC use group 3) are added. Figure 9 illustrates the approach.

![Figure 9: Extrapolation approach for European functional plating with decorative character sector](image)

**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 use group 3 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 30% to 70%. The estimation of production sites using chromium trioxide is given with 1,500 companies in the upper bound and with 750 companies in the lower bound, consequently 450 small and 1,050 medium sized companies have to be considered for the upper bound and 225 small and 525 medium sized companies for the lower bound. Therefore the number of potentially exposed workers can be calculated as follows:

\[
\text{Number of potentially exposed workers} = 0.5 \times (\alpha \times 450 + \beta \times 1,050)
\]

**Upper bound:**

\[
\text{Number of potentially exposed workers} = 0.5 \times (\alpha \times 450 + \beta \times 1,050)
\]
Lower bound:

\[ \text{Number of potentially exposed workers} = 0.5 \times (\alpha \times 225 + \beta \times 525) \]

Within CTAC use group 3, 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 use group 3 have been applied for the health impact assessment of the sector (functional chrome plating with decorative character).

**Sector extrapolation for social impacts**

For small sized companies, the average number of employees (\(\alpha\)) 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 employees. For medium sized companies only the number of potentially exposed people (50% of \(\beta\)) 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 use group 3, job losses were categorised to education levels (low / high skilled and academic). As this categorisation cannot be assessed for other companies in this 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 functional plating with decorative character 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 | 61,880 |
| General population (EEA in 2014) applied for the calculation of the ELR related to PEC_{regional} | 512,888,463 |
| Number of potentially exposed people applied for the calculation of the ELR related to PEC_{local} | 1559 sites x 10,000 people = 15,590,000 |

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 (use 3) 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).

---

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

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Total numbers of workers exposed in the supply chain</th>
<th>exposure value [µg Cr(VI)/m3]</th>
<th>Correction factor applied for calculation</th>
<th>Total concentration in the supply chain (rounded) [µg Cr(VI)/m3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers potentially exposed for less than 1 hour/day</td>
<td>44%</td>
<td>27,168</td>
<td>2.00</td>
<td>0.125</td>
<td>6,791.98</td>
</tr>
<tr>
<td>Workers potentially exposed for 1-3 hours/day</td>
<td>8%</td>
<td>4,767</td>
<td>2.00</td>
<td>0.375</td>
<td>3,575.33</td>
</tr>
<tr>
<td>Workers potentially exposed from 3-6 hours/day</td>
<td>6%</td>
<td>3,703</td>
<td>2.00</td>
<td>0.75</td>
<td>5,553.99</td>
</tr>
<tr>
<td>Workers potentially exposed from 6-8 hours/day</td>
<td>15%</td>
<td>9,534</td>
<td>2.00</td>
<td>1</td>
<td>19,068.40</td>
</tr>
<tr>
<td>Workers not regularly exposed (e.g. once a week, month, year)</td>
<td>27%</td>
<td>16,708</td>
<td>2.00</td>
<td>0.125</td>
<td>4,177.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>61,880</td>
<td></td>
<td></td>
<td>39,166.70</td>
</tr>
</tbody>
</table>

Based on the value for the total concentration of Cr(VI) (39,166.70 see Table 17) and a review period of 7 years, the equation for the calculation of Excess Lifetime Risk is as follows:

\[
ELR = \frac{7}{40} \times 4 \times 10^{-3} \text{ per } \frac{\mu g \text{ Cr(VI)}}{m^3} \times \text{Total concentration } \left[ \frac{\mu g \text{ Cr(VI)}}{m^3} \right]
\]

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):

\[
\epsilon_{fatal,central} = ELR \times € 1,052,000 \times 1.01517^{(2017−2003)}
\]

Monetary value for fatal cancers (sensitive value):

\[
\epsilon_{fatal,sensitive} = ELR \times € 2,258,000 \times 1.01517^{(2017−2003)}
\]
Monetary value of non-fatal cancers (central/sensitive value):

\[ \varepsilon_{non-fatal} = 0.208 \times ELR \times \varepsilon 400,000 \times 1.01517^{(2017-2003)} \]

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 functional plating with decorative character in the EU including members of the CTAC use group 3. 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 3.

<table>
<thead>
<tr>
<th></th>
<th>Central value (lower bound) [€ million]</th>
<th>Sensitivity value (upper bound) [€ million]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary value for fatal cancers ((\varepsilon_{fatal}))</td>
<td>35.6</td>
<td>76.4</td>
</tr>
<tr>
<td>Monetary value for non-fatal cancers ((\varepsilon_{non-fatal}))</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Total</td>
<td>38.4</td>
<td>79.2</td>
</tr>
</tbody>
</table>

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 for the ELR are provided for PEC\(_{local}\) and PEC\(_{regional}\) and follow generally the calculations presented for the health impact assessment of potentially exposed workers.

PEC\(_{local}\)

The total number of potentially indirectly exposed people is assessed taking into account the foreseen population of 10,000 people around a production site (14).

\[ Number \ of \ potentially \ exposed \ people = number \ of \ sites \times 10,000 = 1,559 \times 10,000 = 15,590,000 \]

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:

\[ ELR = \frac{\text{review period [years]}}{70 \text{ years}} \times 2.9 \times 10^{-2} \text{ per } \frac{\mu g \text{ Cr(VI)}}{m^3} \times \text{exposure value } PEC_{local} \times \text{number of potentially exposed people} \]
\[
\frac{7 \text{ years}}{70 \text{ years}} \times 2.9 \times 10^{-2} \text{ per } \frac{\mu \text{g Cr(VI)}}{\text{m}^3} \times 3.54 \times 10^{-4} \frac{\mu \text{g}}{\text{m}^3} \times 15,590,000
\]

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.

Monetary value for fatal cancers (central value):

\[
\epsilon_{fatal, central} = ELR \times € 1,052,000 \times 1.01517^{(2017−2003)}
\]

Monetary value for fatal cancers (sensitive value):

\[
\epsilon_{fatal, sensitive} = ELR \times € 2,258,000 \times 1.01517^{(2017−2003)}
\]

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

\[
\epsilon_{non-fatal} = 0.208 \times ELR \times € 400,000 \times 1.01517^{(2017−2003)}
\]

<table>
<thead>
<tr>
<th></th>
<th>Central value (lower bound) [€ million]</th>
<th>Sensitivity value (upper bound) [€ million]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary value for fatal cancers ((\epsilon_{fatal}))</td>
<td>20.8</td>
<td>44.6</td>
</tr>
<tr>
<td>Monetary value for non-fatal cancers ((\epsilon_{non-fatal}))</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22.4</strong></td>
<td><strong>46.2</strong></td>
</tr>
</tbody>
</table>

PEC\(_{\text{regional}}\)

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 = 512,888,463**

With the exposure values for PEC\(_{\text{regional}}\) 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:
SOCIO-ECONOMIC ANALYSIS

\[ ELR = \frac{\text{review period \ [years]}}{70 \text{ years}} \times 2.9 \times 10^{-2} \text{ per } \frac{\mu g \text{ Cr(VI)}}{m^3} \times \text{ exposure value } PEC_{\text{regional}} \times \frac{\text{number of potentially exposed people}}{70 \text{ years}} \times 2.9 \times 10^{-2} \text{ per } \frac{\mu g \text{ Cr(VI)}}{m^3} \times 1.7 \times 10^{-12} \frac{\mu g}{m^3} \times 512,888,463 \]

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.

Monetary value for fatal cancers (central value):

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

Monetary value for fatal cancers (sensitive value):

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

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

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

Table 20: Monetised health impacts for PEC regional

<table>
<thead>
<tr>
<th></th>
<th>Central value (lower bound) [€ million]</th>
<th>Sensitivity value (upper bound) [€ million]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary value for fatal cancers (( \epsilon_{fatal} ))</td>
<td>0.0000033</td>
<td>0.0000070</td>
</tr>
<tr>
<td>Monetary value for non-fatal cancers (( \epsilon_{non-fatal} ))</td>
<td>0.0000003</td>
<td>0.0000003</td>
</tr>
<tr>
<td>Total</td>
<td>0.0000035</td>
<td>0.0000073</td>
</tr>
</tbody>
</table>
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 use group 3 member companies. In cases where CTAC use group 3 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 functional plating with decorative character 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 € 9,585 million. This means a loss of € 9,585 million appears to the EEA society in 2017 in case of non-authorisation.