



Economic Impact Authorisation Chrome VI

Research commissioned by Dutch Industry Organisations FME, ION and Metaalunie.



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Summary

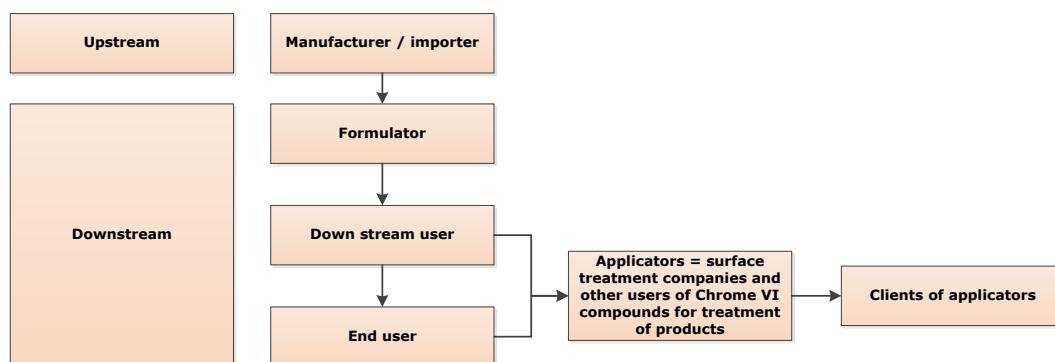
The REACH regulation in the European Union is designed to replace or minimize the use of the so-called hazardous substances, which includes Chrome VI. The reduction of use of Chrome VI is done via authorisation (see Annex XIV of the REACH Regulation). At the end of the authorisation period, the use of Chrome VI must be reviewed and one needs to demonstrate once again:

1. That there is no feasible alternative from the perspective of the applicant.
2. The level of control of exposure and emission.
3. A clear socioeconomic benefit to the EU society.

This process results in uncertainty and uncertainty imposes a loss for the enterprises involved and the economy. This loss varies according to the length of the authorisation review period. This report presents an overview of the economic impact of replace or minimize the use of Chrome VI in The Netherlands and in the EU28 for the Chrome VI sector, as well as at the macro-economic level, for different authorisation review period durations.

The Chrome VI sector is defined here as the applicators (surface treatment companies and other users of Chrome VI compounds for the treatment of products) and their direct clients which actually use chromed devices. See figure 1.1.

Figure 1.1 Applicators and clients of applicators



Source: Panteia

In cases where applicators are unable to find alternative substances or other solutions, to replace or minimize using Chrome VI implies that applicators' products will be imported from non-EU countries instead of being domestically produced. This in turn could mean that EU applicators start relocating their activities to non-EU countries, or that production is taken over by indigenous non-EU enterprises. To the extent that the use of Chrome VI products is vital to their production process, the activities of the clients of applicators may also be relocated to non-EU countries. Alternatively, the activities of applicators' clients may be taken up by indigenous non-EU firms. Therefore, the direct impact of phasing out Chrome VI is likely to be a reduction of sales of intermediate goods and services by domestic firms, which may very well then be accompanied by an equivalent increase in imports of these goods. The shorter the length of the authorisation review period, the more this impact will be felt. In this study phasing out of Chrome VI was investigated in scenarios with an authorisation review period of 0, 4, 7 and 12 years, not taking into account a new authorisation review period thereafter.



Size and structure of the Chrome VI sector in The Netherlands

The Chrome VI sector comprises almost 1 400 enterprises, employing over 21 000 people. Their turnover amounts to 5.3 billion €, while the value added created by these enterprises is 1.7 billion € (Table 1). Looking more closely at the sector, applicator enterprises tend to be larger than average in the metallurgical industry. The labour productivity is also above the metallurgical industry average. Applicators' clients are usually of a similar size as enterprises in the metallurgical industry as a whole, but their labour productivity is also higher than average.

Table 1 Size and structure of the Chrome VI sector in The Netherlands, 2013

	basic data			ratios		
	enterprises x 1	employment x 1	turnover million €	value added million €	employment / enterprise x 1	value added / occupied person 1 000 €
applicators	473	10 163	2 674	915	21	90
applicators' clients	905	10 994	2 591	829	12	75
Chrome VI sector	1 378	21 157	5 265	1 744	15	82

Source: Panteia, based on Eurostat's Structural Business Statistics (Eurostat data extracted from <http://ec.europa.eu/eurostat/data/database>, table sbs-na_ind_r2, on June 1, 2016)

Impact of replacing or minimizing Chrome VI for The Netherlands

Three scenarios for the authorisation of the use of Chrome VI have been taken into account: an authorisation review period of seven years, an authorisation review period of four years, and a scenario in which no authorisation is granted at all (0 years authorisation review period)¹. On the moment there is no alternative for hard chrome plating. So the non-granting scenario is not likely to happen because of the immense cost to the EU economy. The economic impact of Chrome VI authorisation on the Chrome VI sector in each of the three scenarios is presented in Table 2. In case of a seven year authorisation review period, the Chrome VI sector is expected to decline by roughly 9%; in the case of a four year authorisation review period, the decline would amount to over 40%. If no authorisation review period would be granted, the decline in the sector will be about 60%², which is equivalent to a turnover loss of over 3 billion €. In this last case, value added will decline by more than 1 billion €, almost 13 000 jobs will be lost in the sector, and some 800 enterprises will disappear.

¹ A scenario with a twelve years authorisation period has also been reviewed but in that case no significant effects have been found.

² 60% and other percentages are median results from the interviews. The percentage of loss if no authorisation is granted at all is not 100%, because some companies working with Chrome VI partially do have also other business not affiliated with Chromium VI and a very small part of the companies see very limited possibilities for some substitution.

Table 2 Economic impact of authorisation on Chrome VI on the Chrome VI sector in The Netherlands

panel A: turnover		economic impact by length of authorisation period (years)		
	current size	7	4	0 (*)
million €				
applicators	2 674	- 223 (-8%)	- 1 271 (-48%)	- 1 724 (-64%)
applicators' clients	2 591	- 255 (-10%)	- 1 017 (-39%)	- 1 400 (-54%)
total Chrome VI sector	5 265	- 478 (-9%)	- 2 288 (-43%)	- 3 124 (-59%)
panel B: value added		economic impact by length of authorisation period (years)		
	current size	7	4	0 (*)
million €				
applicators	915	- 76 (-8%)	- 451 (-49%)	- 609 (-67%)
applicators' clients	829	- 81 (-10%)	- 325 (-39%)	- 447 (-54%)
total Chrome VI sector	1 744	- 157 (-9%)	- 776 (-44%)	- 1 055 (-61%)
panel C: enterprises		economic impact by length of authorisation period (years)		
	current size	7	4	0 (*)
x 1				
applicators	473	- 79 (-17%)	- 215 (-45%)	- 276 (-58%)
applicators' clients	905	- 92 (-10%)	- 379 (-42%)	- 518 (-57%)
total Chrome VI sector	1 378	- 171 (-12%)	- 593 (-43%)	- 794 (-58%)
panel D: employment		economic impact by length of authorisation period (years)		
	current size	7	4	0 (*)
x 1				
applicators	10 163	- 917 (-9%)	- 5 129 (-50%)	- 6 877 (-68%)
applicators' clients	10 994	- 1 081 (-10%)	- 4 326 (-39%)	- 5 953 (-54%)
total Chrome VI sector	21 157	- 1 999 (-9%)	- 9 455 (-45%)	- 12 830 (-61%)

(*) i.e., no authorisation granted

Source: Panteia, calculations with PRISMA model

Macroeconomic effects are significant, particularly if no authorisation review period is granted (Table 3). In this case, household consumption as well as investments will drop by 0.3%. Though exports will remain unaffected, imports will increase, resulting in an expected GDP decrease of 0.3%. The price level will remain unchanged, but wages will drop in connection with increased unemployment in the sector. The government's financial situation as well as the current account will also deteriorate.



Table 3 Macroeconomic impact of authorisation on Chrome VI in The Netherlands

	length of authorisation period (years)			
	7	4	0 (*)	
real GDP				
GDP	%	-0.05	-0.23	-0.31
private consumption	%	-0.04	-0.17	-0.22
investment enterprises (excl. housing)	%	-0.05	-0.22	-0.30
export goods (excl. energy)	%	0.00	-0.01	-0.01
imports	%	0.04	0.20	0.28
wages and prices				
export goods (excl. energy)	%	0.00	0.01	0.01
private consumption	%	0.00	0.00	0.00
GDP	%	0.00	0.00	0.00
labour costs	%	-0.10	-0.49	-0.67
labour market				
employment	%	-0.01	-0.05	-0.07
unemployment rate	%-pnt	0.01	0.05	0.07
ratios (% GDP)				
government budget surplus	%-pnt	-0.02	-0.08	-0.11
current account	%-pnt	-0.03	-0.13	-0.18

(*) i.e., no authorisation granted

Source: Panteia, calculations with PRISMA model

Size and structure of the Chrome VI sector in EU28

The Chrome VI sector in the EU as a whole consists of over 42 200 enterprises, employing almost 750 000 persons, with a turnover of some 153 billion € (Table 4). The value added created by these enterprises amounts to more than 47 billion €. A worker in the Chrome VI sector creates 64 000 € of value added.

Table 4 Size and structure of the Chrome VI sector in EU28, 2013

	basic data		ratios			
	enterprises	employment	turnover	value added	employment / enterprise	value added / occupied person
	x 1	x 1	million €	million €	x 1	1 000 €
applicators	12 866	291 008	60 156	19 092	23	66
applicators' clients	29 366	445 057	93 386	28 347	15	64
Chrome VI sector	42 232	736 065	153 542	47 439	17	64

Source: Panteia, based on Eurostat's Structural Business Statistics (Eurostat data extracted from <http://ec.europa.eu/eurostat/data/database>, table sbs-na_ind_r2, on June 1, 2016)

Impact of phasing out Chrome VI for EU28

The same three scenarios regarding replacement or minimizing Chrome VI have been taken into account for the EU28: a period of seven years for authorisation, four years for authorisation, and no authorisation review period granted at all. The turnover loss of phasing out the use of Chrome VI in the sector for the EU28 countries varies between -10% if authorisation is granted for seven years, and -57% if no authorisation review period is granted (Table 5). Similar results have been obtained for the value added and employment in the Chrome VI sector across the EU28. The 'no authorisation' scenario implies a turnover loss of almost -90 billion € for the EU Chrome VI sector, and the EU GDP will decrease by -0.4%.

Table 5 Economic impact of authorisation on Chrome VI on the Chrome VI sector in EU28

	current size	economic impact by length of authorisation period (years)		
		7	4	0 (*)
turnover	million €	153 542	- 15 469 (-10%)	- 62 194 (-41%)
value added	million €	47 439	- 5 022 (-11%)	- 20 531 (-43%)
employment	occupied persons	736 065	- 94 942 (-13%)	- 304 997 (-41%)

(*) i.e., no authorisation granted

Source: Panteia, calculations with PRISMA and WIOM models



1 Introduction

The REACH regulation in the European Union is designed to replace or minimize the use of the so-called hazardous substances, which includes Chrome VI. Chrome VI compounds are carcinogenic and are moved from the candidate list to the authorisation list. This means that after the sunset date the use of Chrome VI compounds is only permitted by authorisation. In the group of Chrome VI compounds, chrome trioxide is the substance which is consumed the most. In particular, chrome trioxide is used in the surface treatment industry in a wide range of applications. Chrome trioxide is also known as chromic acid (CrO_3 dissolved in water).

So the reduction of use of Chrome VI is done via authorisation (see Annex XIV of the REACH Regulation). At the end of the authorisation period, the use of Chrome VI must be reviewed and one needs to demonstrate once again:

- That there is no feasible alternative from the perspective of the applicant.
- The level of control of exposure and emission.
- A clear socioeconomic benefit to the EU society.

This process results in uncertainty and uncertainty imposes a loss for the enterprises involved and the economy. This loss varies according to the length of the authorisation review period. This report presents an overview of the economic impact of replace or minimize the use of Chrome VI in The Netherlands and in the EU28 for the Chrome VI sector, as well as at the macro-economic level, for different authorisation review period durations.

After recognizing Chrome VI compounds in Annex XIV (specifically, within the Authorisation List), the industry started to apply for authorisation. Requests for authorisations are submitted to the European Chemicals Agency (ECHA). ECHA reviews the applications and advises the European Commission, and the Commission in turn takes the final decision.

To apply for authorisation the industry must submit a dossier, which consists of:

1. a so-called Socio-Economic Analysis (SEA) for authorisation, balancing the social and environmental concerns against the economic necessity of use;
2. an Analysis of Alternatives (AoA) to show that no alternative solutions which use less harmful substances are possible
3. a Chemical Safety Report.

ECHA recommends a period in which the authorisation is valid. The clearer the outcome of the SEA is, and the fewer alternative options are available, the longer the authorisation review period is likely to be. Several individual companies and some consortia have applied for authorisation with ECHA.

If authorisation is not granted at all or only for a short time, the use of Chrome VI compounds will have economic consequences. The Dutch industry associations FME, ION and Metaalunie therefore asked Panteia to answer the following questions:

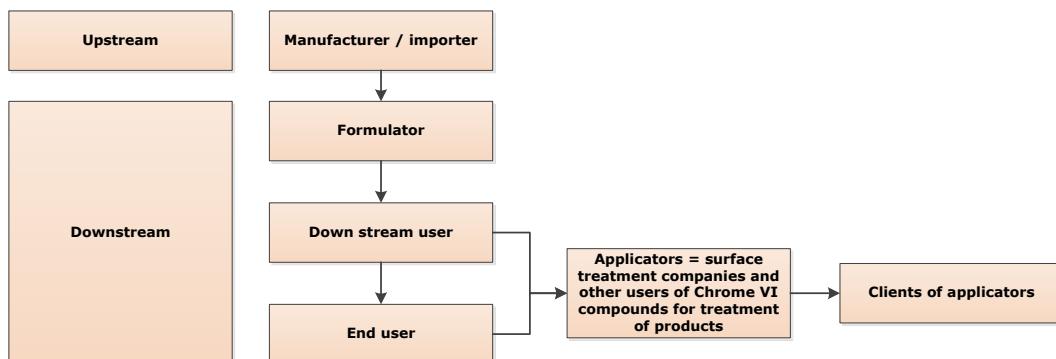
1. What is the economic impact on target groups within Dutch enterprises of not being granted authorisation by the European Commission? The economic impact should be broken down into:
 - a. costs incurred;
 - b. chance of stopping, limiting or relocating parts of businesses or businesses;
 - c. loss of direct employment;
 - d. loss of indirect employment.



2. What is the economic impact on target groups being granted short authorisation review periods? Is there a relationship between the length of the authorisation review period and the size of the impact?
3. What are the economic impacts at the EU level? A first transparent calculation should be prepared, enabling other organisations in Europe to use this report as a basis for their own national calculations.

The target groups in this study are the applicators and the clients of applicators, as shown in Figure 1.1. Applicators are surface treatment companies and other users of Chrome VI compounds for the treatment of their products. Their direct clients are those parties which actually use the chromed devices produced by the applicators.

Figure 1.2 Applicators and clients of applicators



Source: Panteia

In cases where applicators are unable to find alternative substances or other solutions, to replace or minimize using Chrome VI implies that applicators' products will be imported from non-EU countries instead of being domestically produced. This in turn could mean that EU applicators start relocating their activities to non-EU countries, or that production is taken over by indigenous non-EU enterprises. To the extent that the use of Chrome VI products is vital to their production process, the activities of the clients of applicators may also be relocated to non-EU countries. Alternatively, the activities of applicators' clients may be taken up by indigenous non-EU firms. Therefore, the direct impact of phasing out Chrome VI is likely to be a reduction of sales of intermediate goods and services by domestic firms, which may very well then be accompanied by an equivalent increase in imports of these goods. The shorter the length of the authorisation review period, the more this impact will be felt. In this study phasing out of Chrome VI was investigated in scenarios with an authorisation review period of 0, 4, 7 and 12 years, not taking into account a new authorisation review period thereafter.

Chapter 2 provides an overview of the economic impact in the Netherlands if it were no longer permitted to use Chrome VI compounds, or if it were only permitted to do so for a short time. Chapter 3 reviews the economic consequences for the Member States of the European Union together. The results are based on in-depth interviews with 20 enterprises in the Netherlands, using the proven methodology of the Standard Cost Model. This methodology, the economic models PRISMA and WIOM and the item list of the interviews are further elaborated in Appendix 1.

2 Quantifying the economic impact for The Netherlands

2.1 Introduction

The use of Chrome VI in production processes in EU enterprises will be phased out after the sunset date for companies without authorisation. This has an economic impact on the Chrome VI sector in The Netherlands, also if authorisation is granted for a short term. Both effects are quantified in this chapter.

The total economic effect of phasing out the use of Chrome VI consists of direct effects and indirect effects. Direct effects are defined as the reduction of sales by the Chrome VI sector after the sunset date in case of no or short term authorisation.

Indirect effects result from the fact that the market as a whole changes. Examples include the employment effects in the sector which result from the sales decrease in the Chrome VI sector³, the substitution of domestically produced products containing Chrome VI with alternative products, reduced demand for intermediate goods and services in the Chrome VI sector (downstream effects), and so on.

Hence, the basic methodology consists of two steps:

- First, the direct impact on the Chrome VI sector is calculated. This refers to the direct loss in turnover and employment in the sector after the sunset date in case of no or short term authorisation. This is discussed in section 2.2.
- Secondly, to calculate the total economic effects, a macro-sectoral model of the Dutch economy is used (section 2.3).

2.2 Calculation of the direct impact

The direct effect consists of the reduction in sales of the Chrome VI sector after the sunset date in case of no or short term authorisation. It is calculated in two steps:

- First, the size and structure of the Chrome VI sector is defined. This analysis is performed using official statistics. As will be explained below, the Chrome VI sector consists of segments which differ with respect to the sensitivity of sales phasing out the use of Chrome VI in their production processes.
- Secondly, the direct impact on sales in each segment of the Chrome VI sector is determined. This analysis is based on the 20 interviews held with representatives of enterprises using Chrome VI.

2.2.1 Size and structure of the Chrome VI sector in The Netherlands

The Chrome VI sector is fully embedded within metallurgical industry (NACE sections 24 -30 and 33⁴). Of the industries within these NACE sections, the NACE subsections or classes listed in Appendix 6 are considered relevant⁵.

Within each of these subsections or classes, not all enterprises belong to the Chrome VI sector. The proportion of enterprises which will be affected by phasing out Chrome VI has been estimated by Panteia experts, based on the interviews. Next, it has been assumed that enterprises processing Chrome VI within each of these subsections or classes have the same size (in terms of turnover, value added and employment) as other enterprises. Aggregate results have been validated by FME and ION experts. The results of this analysis is included in Table 2.1. This table presents data for the

³ An employment decrease in turn implies a reduction in household income, impacting consumer demand. That unemployed people of the Chrome VI sector could possibly find work in other sectors is not taken into account.

⁴ NACE: Statistical Classification of Economic Activities in the European Community, Rev. 2 (2008).

⁵ The analysis is performed at the lowest level of aggregation available in the NACE classification. In order not to disclose data for individual enterprises, data for The Netherlands in Appendix 5 are only presented at the level of NACE sections



metallurgical sector as a whole. The Chrome VI sector is part of the metallurgical sector as a whole, and data for the whole sector has been included as a reference.

Table 2.1 Size and structure of the Chrome VI sector in the Netherlands, 2013

	basic data				ratios	
	enterprises x 1	employment x 1	turnover million €	value added million €	employment / enterprise x 1	value added / occupied person 1 000 €
Chrome VI sector						
- applicators	473	10 163	2 674	915	21	90
- applicators'clients	905	10 994	2 591	829	12	75
- total	1 378	21 157	5 265	1 744	15	82
metallurgical industry	25 672	314 030	71 955	22 489	12	72

Source: Panteia, based on Eurostat's Structural Business Statistics (Eurostat data extracted from <http://ec.europa.eu/eurostat/data/database>, table sbs-na_ind_r2, on June 1, 2016)

There are almost 26 000 enterprises in the total metallurgical industry (NACE 20 -30, 33). 5% of these enterprises belong to the Chrome VI sector. In total, the Chrome VI sector consists of 1 378 enterprises, which employ over 21 000 persons. The turnover amounts to 5.3 billion €, while the value added created by the enterprise is 1.7 billion €. Compared with metallurgical industry as a whole, enterprise size in the Chrome VI sector in terms of employment is above average. This is however, mainly due to the Chrome VI applicators: on average, an enterprise in this segment provides a job for 21 people, while the corresponding figure for applicators' clients is similar to the metallurgical industry average of a job for 12 people. Labour productivity - defined as value added per employed person - is higher in the Chrome VI sector, in particular in the applicator segment.

2.2.2 Direct impact of phasing out Chrome VI in The Netherlands after the sunset date in case of no or short term authorisation

Interviews with enterprise representatives in the Chrome VI sector have been held in the framework of this project. One of the topics discussed was the expected loss of sales due to the phasing out of Chrome VI production processes in interviewee's enterprises. Based on these interviews, Panteia has made an estimate of the expected sales loss in each NACE subsection or class in the Chrome VI sector. From the interviews it follows that the expected sales loss varied with the length of the authorisation review period: the longer the authorisation review period, the more opportunities enterprises have to find alternative substances or solutions to the use of Chrome VI, and hence the smaller expected sales impact is. With an authorisation review period of 12 years, firms actually expect only minor problems⁶.

The results of this exercise are presented in Table 2.2 and Figure 2.1. If the authorisation review period is 7 years, the direct effects amounts to a sales decrease of 487 million €, or 9% of current turnover. If authorisation is granted for 4 years, sales are expected to decrease by almost 2.3 billion € (44%). If no authorisation is granted (authorisation review period 0 years), sales of the Chrome VI sector is expected to drop by 3 175 million €, or 60% of current turnover⁷. Similar figures are obtained for the number of enterprises, employment and value added.

⁶ Firms were asked about the possible impact on sales with no authorisation granted at all, authorisation for 4 years, for 7 years and for 12 years. Applying the methodology described below, the direct sales loss in the Chrome VI sector with an authorisation period of 12 years would amount to 1 million € in total.

⁷ 60% and other percentages are median results from the interviews. The percentage of loss if no authorisation is granted at all is not 100%, because some companies working with Chrome VI partially do have also other business not affiliated with Chromium VI and a very small part of the companies see very limited possibilities for some substitution.

Total GDP for the Netherlands amount to almost 700 billion €. The direct value added effect of a 7 years authorisation on the Chrome VI sector is 161 million €, or 0.02% of GDP. For 4 years authorisation, this proportion equals 0.11%. Granting no authorisation at all (0 years authorisation) would directly affect the sector's value added by 1 075 million €, which is equivalent to 0.15% of GDP.

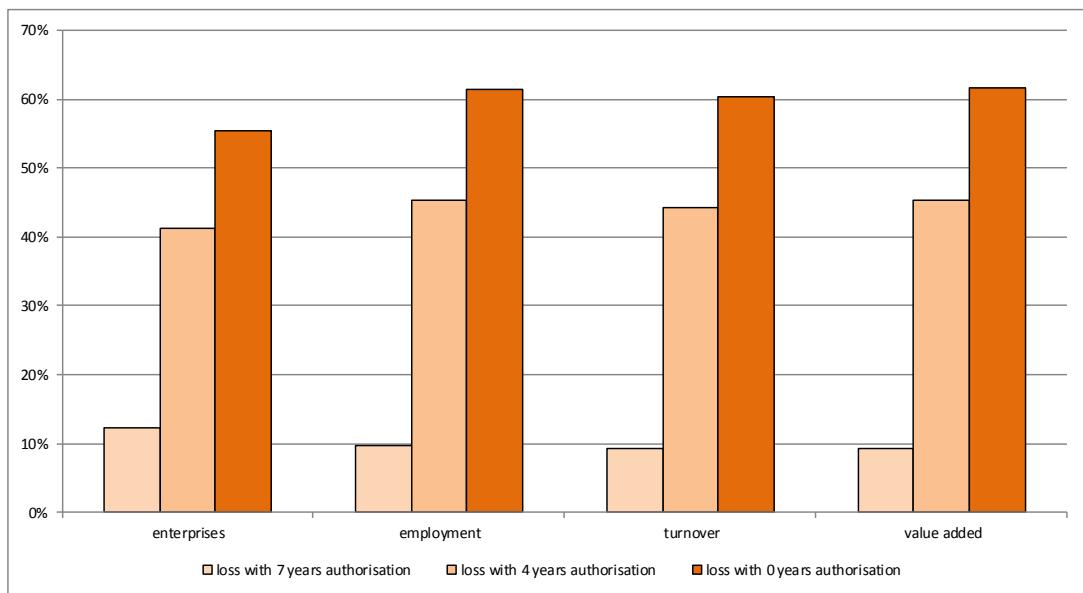
Table 2.2 Direct economic impact of phasing out Chrome VI in The Netherlands

	enterprises x 1	employment x 1	turnover million €	value added million €
Loss with 7 years authorisation				
- applicators	78	934	228	78
- applicators' clients	90	1 099	259	83
- total Chrome VI sector	169	2 033	487	161
Loss with 4 years authorisation				
- applicators	206	5 194	1 291	459
- applicators' clients	362	4 398	1 036	332
- total Chrome VI sector	568	9 592	2 327	791
Loss with 0 years authorisation				
- applicators	265	6 963	1 750	619
- applicators' clients	498	6 047	1 425	456
- total Chrome VI sector	763	13 010	3 175	1 075

Source: Panteia



Figure 2.1 Direct economic impact of phasing out Chrome VI on the Chrome VI sector in The Netherlands (% of current size)



Source: Panteia

It is expected that after the sunset date in case of no or short term authorisation, applicator enterprises will relocate production to non-EU countries (in which Chrome VI use is still permitted), or applicators' clients will import required products from enterprises from non-EU countries. In both cases, this implies a reduction of sales of domestically produced intermediate goods and services which is compensated by an equivalent increase in imports⁸. For client enterprises, the implication is more or less similar: the sales reduction follows from the fact that they will relocate plants or part of their production processes to non-EU countries (in which Chrome VI use is still permitted) as this puts their production processes to regions where essential (Chrome VI) parts are produced. The sales loss for Dutch enterprises is compensated by extra imports. Hence, both for applicators and their clients, the direct effect implies that on a net basis the foregone production is relocated to non-EU countries. This may be the result of actually relocating production activities to non-EU countries, or of completely stopping these activities by Dutch enterprises, and increased production by non-EU enterprises.

2.3 Calculation of economic effects: methodology

To calculate the economic effects of phasing out Chrome VI, PRISMA, a macro-sectoral model for the Netherlands developed by Panteia is used⁹. Using this model, a projection of the economic development of the Netherlands is prepared in which no phasing out of Chrome VI has been assumed. This is the baseline projection. Then an alternative simulation is run in which next to the assumptions of the baseline projections, also phasing out of Chrome VI is introduced. Comparing the alternative simulation with the baseline shows the total economic effect of phasing out Chrome VI¹⁰.

⁸ Also see section 2.3.

⁹ See Appendix 1 for a short description of this model.

¹⁰ The comparison of the two scenarios is rather insensitive to the assumptions made in the baseline scenario. These assumptions are based on long term scenarios prepared by CPB.

It should be noted that PRISMA is a macro-sector model of the Dutch economy. Next to macro-economic results, also results by sector of industry are calculated. This has two implications:

- The Chrome VI sector is part of the PRISMA sector 'metallurgical industry', as defined by NACE sections 24 -30 and 33 (also see Table 2.1).
- Core of the model is a so-called input-output module, in which the supply of intermediate goods and services is modelled. In this way, relations between sectors of industry are fully taken into account. This includes the impact of phasing out Chrome VI on upstream industries, *i.e.* suppliers to the Chrome VI sector.

The main issue here is 'translating' the direct impact into model terms.

The Chrome VI sector does not sell its products to final consumer; instead, their output is normally used as an input to the production process of other enterprises.

Hence, the direct impact of phasing out Chrome VI should be interpreted as a reduction of sales of intermediate goods and services. As most users of outputs of the Chrome VI sector are in metallurgical industry, the direct impact (calculated in section 2.2.2) has been implemented as an autonomous reduction of sales of intermediate goods and services of metallurgical industry (in fact, the Chrome VI sector which is part of metallurgical industry) to metallurgical industry (as a whole). Complementary to this it has been assumed that the original users will substitute the original (domestically produced) Chrome VI containing products by similar products imported from non-EU countries¹¹.

In sum, the assumptions in the alternative scenario are twofold:

- A reduction of sales of intermediate goods and services of the Chrome VI sector to enterprises in metallurgical industry by (depending on the length of the authorisation review period) 0.5 billion €, 2.3 billion €, or 3.2 billion € (see Table 2.2)
- An increase of imports of metallurgical industry by the same amount, replacing the products originally produced by domestic businesses.

As regards the applicators' clients' effect, the estimated direct effect is a so-called forward effect. PRISMA's input-output module calculates the upstream effects of less production by applicators, *i.e.* the impact of suppliers to the Chrome VI sector. By its nature, it does not take into account downstream effects, *i.e.* the effects on users of Chrome VI products. Therefore the direct impact on the clients segment of the Chrome VI sector has been explicitly added as an input to the simulations.

Mechanism at work

The direct impact consists of a sales reduction for domestic (Chrome VI) enterprises which is fully compensated by an import increase. As a result, demand for production factors by domestic firms decreases; this refers to demand for intermediate goods and services, capital goods and labour. This is a fairly standard adverse demand shock. Therefore, the direct effects of the authorisation are amplified by the GDP multiplier, both at the sectoral and at the macroeconomic level. One therefore expects turnover, GDP and employment to decrease in both the short and the long run. Prices may tend to decrease in conjunction with lower production levels and increased unemployment. Regarding the number of enterprises, results are not *a priori* clear: on the one hand, decreased production may lead to a decrease in the number of enterprises, but on the other hand increased unemployment may encourage people to start a new business. For the Chrome VI sector - in which there initially is a negative impact on the number of enterprises - a decrease in the number of enterprises is expected.

¹¹ These imports can be supplied by Dutch enterprises opening a non-EU subsidiary or by indigenous non-EU firms.



As it takes time for these additional affects to unfold, a distinction is made between short term and long term effects. In particular employment effects and the impact on the number of enterprises take time to effectuate.

Table 2.2 summarises the long term effects for the Chrome VI sector in The Netherlands. In terms of turnover, the decline for the Chrome VI sector varies between about -9% in case of 7 years authorisation, -43% in case of 4 years authorisation, and -59% in case no authorisation is granted at all. These results are discussed in more detail in the next sections.

Table 2.2 summary of economic effects for the Chrome VI sector in The Netherlands

		current economic impact by length of authorisation period (years)			
		size	7	4	0 (*)
turnover	million €	5 265	- 478 (-9%)	- 2 288 (-43%)	- 3 124 (-59%)
value added	million €	1 744	- 157 (-9%)	- 776 (-44%)	- 1 055 (-61%)
enterprises	x 1	1 378	- 171 (-12%)	- 593 (-43%)	- 794 (-58%)
employment	x 1	21 157	- 1 999 (-9%)	- 9 455 (-45%)	- 12 830 (-61%)

(*) i.e., no authorisation granted

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

2.4 Economic effect in case of a 7 years authorisation review period

The economic impact of granting 7 years authorisation to the Chrome VI sector on the Chrome VI sector is presented in Table 2.3. Detailed results are in Appendix 2. Regarding turnover, the direct impact to the Chrome VI sector amounts to -487 million €. Both the short run and the long run total impact indicate a slightly smaller turnover decrease for the Chrome VI sector, still amounting to -9% of current turnover. The fact that the long run turnover effect is less adverse than the direct impact follows from the fact that enterprises are able to reduce costs somewhat as a result of lowering wages in view of increased (macro-economic) unemployment (see below). Furthermore, labour productivity increases. Similar results are obtained for value added.

The direct impact on the number of enterprises in the Chrome VI sector amounts to -169. This effect does only materialise in the long run. It should be noted that the size of the enterprises - in terms of employed persons - decreases slightly.

Also the impact on employment does not materialise immediately. In the short run the total impact of granting 7 years authorisation to the Chrome VI sector on employment is -1 896, which is less than the direct effect. Also in the long run - because of lower wages - the employment effect is less than the direct impact, but still significant at -9% of current employment.

Table 2.3 Economic impact of 7 years authorisation granted to Chrome VI sector on the Chrome VI sector

panel A: turnover		current size	direct impact	total impact	
		million €		short run	long run
applicators		2 674	- 228	- 223 (-8%)	- 223 (-8%)
applicators' clients		2 591	- 259	- 255 (-10%)	- 255 (-10%)
total Chrome VI sector		5 265	- 487	- 478 (-9%)	- 478 (-9%)

panel B: value added		current size	direct impact	total impact	
		million €		short run	long run
applicators		915	- 78	- 76 (-8%)	- 76 (-8%)
applicators' clients		829	- 83	- 81 (-10%)	- 81 (-10%)
total Chrome VI sector		1 744	- 161	- 157 (-9%)	- 157 (-9%)

panel C: enterprises		current size	direct impact	total impact	
		size		short run	long run
x 1					
applicators		473	- 78	- 75 (-16%)	- 79 (-17%)
applicators' clients		905	- 90	- 85 (-9%)	- 92 (-10%)
total Chrome VI sector		1 378	- 169	- 160 (-12%)	- 171 (-12%)

panel D: employment		current size	direct impact	total impact	
		size		short run	long run
x 1					
applicators		10 163	- 934	- 868 (-9%)	- 917 (-9%)
applicators' clients		10 994	- 1 099	- 1 028 (-9%)	- 1 081 (-10%)
total Chrome VI sector		21 157	- 2 033	- 1 896 (-9%)	- 1 999 (-9%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Macro-economic effects of granting 7 years authorisation to the Chrome VI sector are depicted in Table 2.4. As could be expected from multiplier effects, domestic final demand (private consumption, investment) decreases. For private consumption this is the result of decreased household income as a result of less employment. For investment it is the result of less need for capital as a result of lower production levels. Imports increase, in particular because of the fact that domestically produced products from the Chrome VI sector are substituted for by similar imported goods from outside the EU. GDP decreases by -0.05%. Taking into account the size of the direct effect -0.02% of GDP - the GDP multiplier amounts to about two (0.05/0.02): the direct effects at the macro-economic level are amplified due to spill-over effects to the rest of the economy. The price level remains almost unchanged. Wages decrease under the influence of increased unemployment.

The government budget deteriorates as the tax base decreases and unemployment benefits increase. Also the current account balance is affected negatively, especially because of the substitution of domestically produced products by imported ones.



Table 2.4 Macroeconomic impact of 7 years authorisation granted to Chrome VI sector

		short run	long run
real GDP			
GDP	%	-0.04	-0.05
private consumption	%	-0.01	-0.04
investment enterprises (excl. housing)	%	0.00	-0.05
export goods (excl. energy)	%	0.00	0.00
imports	%	0.04	0.04
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.10
labour market			
employment	%	0.00	-0.01
unemployment rate	%-pnt	0.00	0.01
ratios (% GDP)			
government budget surplus	%-pnt	-0.01	-0.02
current account	%-pnt	-0.03	-0.03

Source: Panteia; calculations with PRISMA model

2.5 Economic effect in case of a 4 years authorisation review period

The economic impact of granting 4 years authorisation to the Chrome VI sector on the Chrome VI sector is presented in Table 2.5. Detailed results are in Appendix 3.

Regarding turnover, the direct impact to the Chrome VI sector amounts to -2 327 million €. Both the short run and the long run total impact indicate a slightly smaller turnover decrease, still amounting to -43% of current turnover. The fact that the long run turnover effect is less adverse than the direct impact follows from the fact that enterprises are able to reduce costs somewhat as a result of lowering wages in view of increased (macro-economic) unemployment (see below). Furthermore, labour productivity increases. Similar results are obtained for value added.

The impact on the number of enterprises does not materialise immediately, however, the long run impact of granting 4 years authorisation to the Chrome VI sector is slightly larger than the direct effect. It should be noted that the size of the enterprises - in terms of employed persons - decreases slightly.

Also the impact on employment does not materialise immediately. In the short run the total impact of granting 4 years authorisation to the Chrome VI sector on employment is -8 946, which is slightly less than the direct effect. Also in the long run - because of lower wages - the employment effect is less than the direct impact, but still significant at -45% of current employment.

Table 2.5 Economic impact of 4 years authorisation granted to Chrome VI sector on the Chrome VI sector

panel A: turnover		current size	direct impact	total impact	
		million €		short run	long run
applicators		2 674	- 1 291	- 1 270 (-47%)	- 1 271 (-48%)
applicators' clients		2 591	- 1 036	- 1 016 (-39%)	- 1 017 (-39%)
total Chrome VI sector		5 265	- 2 327	- 2 286 (-43%)	- 2 288 (-43%)

panel B: value added		current size	direct impact	total impact	
		million €		short run	long run
applicators		915	- 459	- 451 (-49%)	- 451 (-49%)
applicators' clients		829	- 332	- 324 (-39%)	- 325 (-39%)
total Chrome VI sector		1 744	- 791	- 775 (-44%)	- 776 (-44%)

panel C: enterprises		current size	direct impact	total impact	
		size		short run	long run
x 1					
applicators		473	- 206	- 195 (-41%)	- 215 (-45%)
applicators' clients		905	- 362	- 342 (-38%)	- 379 (-42%)
total Chrome VI sector		1 378	- 568	- 537 (-39%)	- 593 (-43%)

panel D: employment		current size	direct impact	total impact	
		size		short run	long run
x 1					
applicators		10 163	- 5 194	- 4 884 (-48%)	- 5 129 (-50%)
applicators' clients		10 994	- 4 398	- 4 062 (-37%)	- 4 326 (-39%)
total Chrome VI sector		21 157	- 9 592	- 8 946 (-42%)	- 9 455 (-45%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Macro-economic effects of granting 4 years authorisation to the Chrome VI sector are summarised in Table 2.6. As could be expected from multiplier effects, domestic final demand (private consumption, investment) decreases. For private consumption this follows from decreased household income as a result of less employment. For investment it is the result of less need for capital because of lower production levels. Imports increase, in particular because of the fact that domestically produced products from the Chrome VI sector are substituted for by similar imported goods from outside the EU. GDP decreases by -0.23%. Taking into account the size of the direct effect - 0.11% of GDP - the GDP multiplier amounts to about two ($0.23/0.11$): the direct macro-economic effects are amplified due to spill-over effects to the rest of the economy.

The price level remains almost unchanged. Wages decrease under the influence of surplus supply on the labour market.

The government budget deteriorates, as the tax base is reduced and unemployment benefits increase. Also the current account balance is affected negatively, especially because of the substitution of domestically produced Chrome VI related products by imported ones.



Table 2.6 Macroeconomic impact of 4 years authorisation granted to Chrome VI sector

		short run	long run
real GDP			
GDP	%	-0.19	-0.23
private consumption	%	-0.05	-0.17
investment enterprises (excl. housing)	%	0.00	-0.22
export goods (excl. energy)	%	-0.01	-0.01
imports	%	0.18	0.20
wages and prices			
export goods (excl. energy)	%	0.00	0.01
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.49
labour market			
employment	%	0.00	-0.05
unemployment rate	%-pnt	0.00	0.05
ratios (% GDP)			
government budget surplus	%-pnt	-0.06	-0.08
current account	%-pnt	-0.13	-0.13

Source: Panteia; calculations with PRISMA model

2.6 Economic effect in case of no authorisation at all

The economic impact of not granting authorisation to the Chrome VI sector on the Chrome VI sector is presented in Table 2.7. Detailed results are in Appendix 4.

Regarding turnover, the direct impact to the Chrome VI sector amounts to -3 175 million €. Both the short run and the long run total impact indicate a slightly smaller turnover decrease for the Chrome VI sector, still amounting to -59% of current turnover. The fact that the long run turnover effect is less adverse than the direct impact is the result of enterprises being able to reduce costs because of lower wages in view of increased (macro-economic) unemployment (see below). In addition, labour productivity increases. Similar results are obtained for value added.

The impact of phasing out use of Chrome VI on the number of enterprises does not materialise immediately. The long run impact of not granting authorisation to the Chrome VI sector is slightly larger than the direct effect. It should be noted that the size of the enterprises - in terms of employed persons - increases slightly which contributes to labour productivity.

Also the impact on employment does not materialise immediately. In the short run the total impact of not granting authorisation to the Chrome VI sector on employment is -12 134, which is slightly less than the direct effect. Also in the long run - because of lower wages - the employment effect is less than the direct impact, but still significant at -61% of current employment.

Table 2.7 Economic impact of no authorisation granted to Chrome VI sector on the Chrome VI sector

panel A: turnover		current size	direct impact	<u>total impact</u>	
		million €		short run	long run
applicators	2 674	2 674	- 1 750	- 1 723 (-64%)	- 1 724 (-64%)
applicators' clients	2 591	2 591	- 1 425	- 1 399 (-54%)	- 1 400 (-54%)
total Chrome VI sector	5 265	5 265	- 3 175	- 3 122 (-59%)	- 3 124 (-59%)

panel B: value added		current size	direct impact	<u>total impact</u>	
		million €		short run	long run
applicators	915	915	- 619	- 608 (-66%)	- 609 (-67%)
applicators' clients	829	829	- 456	- 447 (-54%)	- 447 (-54%)
total Chrome VI sector	1 744	1 744	- 1 075	- 1 055 (-60%)	- 1 055 (-61%)

panel C: enterprises		current size	direct impact	<u>total impact</u>	
		size		short run	long run
x 1					
applicators	473	473	- 265	- 251 (-53%)	- 276 (-58%)
applicators' clients	905	905	- 498	- 471 (-52%)	- 518 (-57%)
total Chrome VI sector	1 378	1 378	- 763	- 722 (-52%)	- 794 (-58%)

panel D: employment		current size	direct impact	<u>total impact</u>	
		size		short run	long run
x 1					
applicators	10 163	10 163	- 6 963	- 6 542 (-64%)	- 6 877 (-68%)
applicators' clients	10 994	10 994	- 6 047	- 5 591 (-51%)	- 5 953 (-54%)
total Chrome VI sector	21 157	21 157	- 13 010	- 12 134 (-57%)	- 12 830 (-61%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Macro-economic effects of not granting authorisation to the Chrome VI sector are presented in Table 2.8. As could be expected from multiplier effects, domestic final demand (private consumption, investment) decreases. For private consumption this is the result of decreased household income as a result of less employment. For investment it is the result of less need for capital because of lower production levels. Imports increase, particularly because of the fact that domestically produced products from the Chrome VI sector are substituted for by similar imported goods from outside the EU. GDP decreases by -0.31%. Taking into account the size of the direct effect - 0.15% of GDP - the GDP multiplier amounts to about two (0.31/0.15): the direct effects at the macro-economic level are amplified due to spill-over effects to the rest of the economy.

The price level remains almost unchanged. Wages decrease under the influence of surplus supply on the labour market.

The government budget deteriorates as the tax base is reduced and unemployment benefits increase. Also the current account balance is affected negatively, especially because of the assumed substitution of domestically produced Chrome VI products by imported ones.



Table 2.8 Macroeconomic impact of no authorisation granted to Chrome VI sector

		short run	long run
real GDP			
GDP	%	-0.26	-0.31
private consumption	%	-0.07	-0.22
investment enterprises (excl. housing)	%	0.00	-0.30
export goods (excl. energy)	%	-0.01	-0.01
imports	%	0.25	0.28
wages and prices			
export goods (excl. energy)	%	0.01	0.01
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.67
labour market			
employment	%	0.00	-0.07
unemployment rate	%-pnt	0.00	0.07
ratios (% GDP)			
government budget surplus	%-pnt	-0.08	-0.11
current account	%-pnt	-0.18	-0.18

Source: Panteia; calculations with PRISMA model

3 Quantifying the economic impact for EU28

3.1 Introduction

The use of Chrome VI in production processes of EU enterprises will be phased out after the sunset date for companies without authorisation. This has an economic impact on the Chrome VI sector in EU28, also if authorisation is granted for a short term. Both effects are quantified in this chapter.

As for The Netherlands, a distinction should be made between direct effects and indirect effects. Hence, similar to chapter 2, the basic methodology consists of two steps:

- First, the direct impact on the Chrome VI sector is calculated. This refers to the direct loss in turnover, value added and employment after the sunset date in case of no or short term authorisation. This is discussed in section 3.2.
- Second, to calculate the economic effects, macro-sectoral models are used (section 3.3).

3.2 Calculation of the direct impact

The procedure to arrive at estimates of the direct impact for EU 28 is quite similar to the procedure used to arrive at estimates of the direct impact for The Netherlands (see section 2.2):

- First, the size and structure of the Chrome VI sector in EU28 is determined. This is done by assuming that in each NACE subsection or class within metallurgical industry, the share of Chrome VI industries is the same as in The Netherlands. Results are discussed in section 3.2.1.
- Second, the direct impact on sales, value added, employment and the number of enterprises in each segment of the Chrome VI sector is determined by assuming that after the sunset date in case of no or short term authorisation, they are affected by the same rate as in The Netherlands.

So, for EU28 the same calculation scheme is used as for The Netherlands, but instead of being based on expert knowledge as has been the case for The Netherlands, parameters used are directly copied to EU28. Hence, to some extent, results for The Netherlands have been extrapolated to EU28, of course taking into account differences regarding the size and structure of the Chrome VI sector between The Netherlands and EU28 as a whole.

3.2.1 Size and structure of the Chrome VI sector in EU28

In EU28, there are over 42 000 enterprises in the Chrome VI sector (Table 3.1), which is about 5% of total metallurgical industry. Almost 70% of these are clients to the applicators. On average, in term of employment, Chrome VI enterprises are small compared to the metallurgical industry average. This is mainly the result of clients being small, as - similar to The Netherlands - applicator enterprises are larger than average in metallurgical industry. Labour productivity is slightly higher than average in metallurgical industry.



Table 3.1 Size and structure of the Chrome VI sector in EU28, 2013

	basic data				ratios	
	enterprises x 1	employment x 1	turnover million €	value added million €	employment / enterprise x 1	value added / occupied person 1 000 €
Chrome VI sector						
-applicators	12 866	291 008	60 156	19 092	23	66
- applicators' clients	29 366	445 057	93 386	28 347	15	64
- total	42 232	736 065	153 542	47 439	17	64
metallurgical industry	792 259	15 137 610	3 188 179	962 591	19	64

Source: Panteia, based on Eurostat's Structural Business Statistics (Eurostat data extracted from <http://ec.europa.eu/eurostat/data/database>, table sbs-na_ind_r2, on June 1, 2016)

3.2.2 Direct impact of phasing out Chrome VI in EU28 after the sunset date in case of no or short term authorisation

The results of this exercise are presented in Table 3.2 and Figure 3.1. As indicated before, with a 12 year authorisation review period, no significant direct impact is expected. If authorisation is granted for 7 years, the direct effects amounts to a sales decrease of 15 billion €, or 10% of current sales. If authorisation is granted for 4 years, sales are expected to decrease by almost 61 billion € (40%). If no authorisation is granted at all (authorisation review period 0 years), sales of the Chrome VI sector is expected to drop by 86 billion €, or 56% of current turnover. Similar figures are obtained for the number of enterprises, employment and value added.

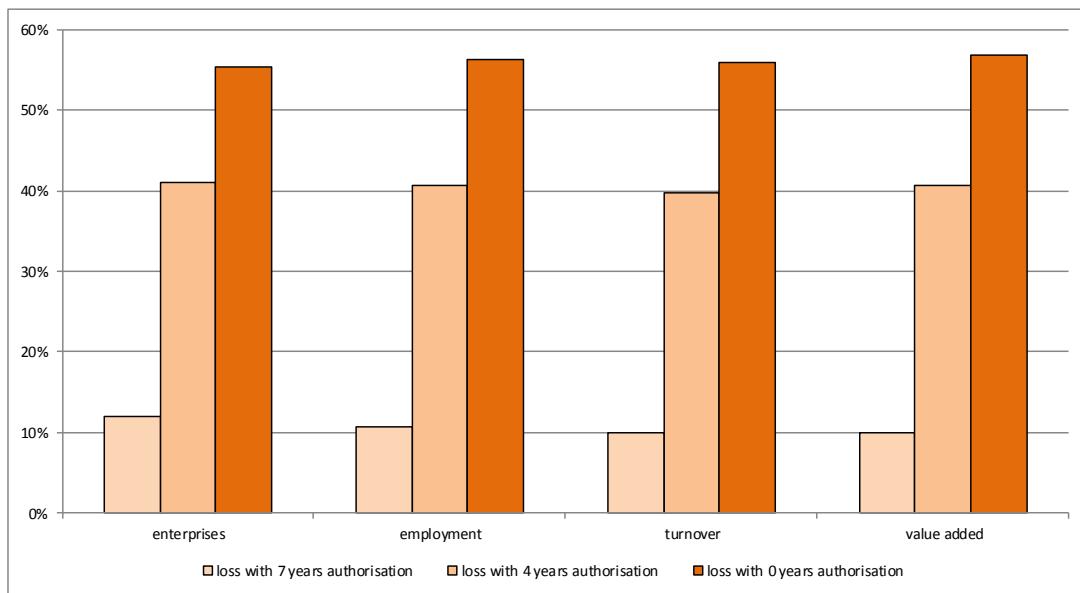
Total GDP for the EU amount to almost 14,635 billion €. The direct value added effect of a 7 years authorisation on the Chrome VI sector is almost 5 billion €, or 0.03% of GDP. For 4 years authorisation, this proportion equals 0.13%. The direct value added effect of no authorisation granted to the Chrome VI sector is 27 billion €, which amounts to 0.18% of GDP. These proportions are slightly higher than the ones obtained for The Netherlands (section 2.2.2).

Table 3.2 Direct economic impact of phasing out Chrome VI in EU28

	enterprises employment turnover value added			
	x 1	x 1	million €	million €
loss with 7 years authorisation				
- applicators	2 097	34 559	5 831	1 885
- applicators' clients	2 937	44 506	9 339	2 835
- total Chrome VI sector	5 034	79 065	15 170	4 719
loss with 4 years authorisation				
- applicators	5 614	121 833	23 638	7 995
- applicators' clients	11 746	178 023	37 355	11 339
- total Chrome VI sector	17 361	299 855	60 993	19 333
loss with 0 years authorisation				
- applicators	7 222	170 275	34 532	11 377
- applicators' clients	16 151	244 781	51 363	15 591
- total Chrome VI sector	23 373	415 056	85 895	26 968

Source: Panteia

Figure 3.1 Direct economic impact of phasing out Chrome VI on the Chrome VI sector in EU28 (% of current size)



Source: Panteia

3.3 Calculation of economic effects for EU28: methodology

The methodology followed is slightly different from the one developed for the analysis of the indirect effects for The Netherlands (section 2.3). The reason is that no full-fledged macro-sectoral model for EU28 is available. Instead, use has been made of two models: the PRISMA model for The Netherlands to calculate the macro-sectoral effects, and subsequently the WIOM model (see Appendix 1) to ‘translate’ the outcome of the PRISMA calculations to the size and structure of the EU28 economy. Similar to the original PRISMA exercise, WIOM is used first to analyse the future development of the EU economy assuming no phasing out of Chrome VI, and subsequently an alternative scenario is run which additionally includes phasing out of Chrome VI. The difference between the two scenarios should be fully ascribed to the phasing out of Chrome VI.

The application of the PRISMA model is similar to the application described in section 2.3. WIOM is a multicountry input-output model in which final demand (in particular consumption and investment), as well as technical coefficients¹² can be affected. Final demand inputs to the simulation (macro-economic and by sector of industry) are taken from the PRISMA exercise. In addition, labour productivity has been adjusted according to the results of the PRISMA exercise; hence employment reacts to changes in production as well as changes in labour productivity.

The direct effects are modelled similar to the PRISMA exercise for The Netherlands, *i.e.* by an increase of competing imports of intermediate goods from non-EU countries at the expense of production within EU28.

3.4 Economic effect in case of a 7 years authorisation review period

The total impact of granting 7 years authorisation to the Chrome VI sector in EU28 are summarised in Table 3.3. The direct turnover effect as a result of EU enterprises

¹² Technical coefficients are the use of production factors (use of intermediate goods and services and value added) expressed as a ratio to gross production.



having to cut production amounts to -10% of current turnover. Because of spill-over effects - similar as in section 2.4 - the total turnover decrease of the Chrome VI sector is somewhat higher at -15 billion €. Similarly, value added in the Chrome VI sector decreases by -11%, whereas the number of jobs decreases by almost -95 000 persons.

Table 3.3 impact of 7 years authorisation granted to Chrome VI on the Chrome VI sector in EU28

turnover	
current size	153 542 million €
direct impact	- 15 170 million € (-10%)
total impact	- 15 469 million € (-10%)
value added	
current size	47 439 million €
direct impact	- 4 719 million € (-10%)
total impact	- 5 022 million € (-11%)
employed persons	
current size	736 065 employed persons
direct impact	- 79 065 employed persons (-11%)
total impact	- 94 942 employed persons (-13%)

Source: Panteia; calculations with PRISMA and WIOM models

At the macro-economic level, GDP decreases by -0.08%, which is equivalent to a GDP multiplier of 2.3 (again similar results were obtained in section 2.3.2). The total employment decrease is -0.1%, or -100 000 jobs.

3.5 Economic effect in case of a 4 years authorisation review period

The total impact of granting 4 years authorisation to the Chrome VI sector in EU28 are summarised in Table 3.4. The direct turnover effect as a result of EU enterprises having to cut production amounts to -40% of current turnover. Because of spill-over effects - similar as in section 2.3.2 - the total turnover decrease of the Chrome VI sector is slightly higher at -41%, or -62 billion €. Similarly, value added in the Chrome VI sector decreases by -43%, whereas the number of jobs decreases by almost - 305 000 persons.

Table 3.4 impact of 4 years authorisation granted to Chrome VI on the Chrome VI sector in EU28

turnover		
current size	153 542	million €
direct impact	- 60 993	million € (-40%)
total impact	- 62 194	million € (-41%)
value added		
current size	47 439	million €
direct impact	- 19 333	million € (-41%)
total impact	- 20 531	million € (-43%)
employed persons		
current size	736 065	employed persons
direct impact	- 299 855	employed persons (-41%)
total impact	- 304 997	employed persons (-41%)

Source: Panteia; calculations with PRISMA and WIOM models

At the macro-economic level, GDP decreases by -0.30%, which is equivalent to a GDP multiplier of 2.2 (again similar results were obtained in section 2.5). Total employment decreases by -0.2%, or -330 000 jobs.

3.6 Economic effect in case of no authorisation at all

The impact of not granting authorisation to the Chrome VI sector in EU28 are presented in Table 3.5. The direct turnover effect as a result of EU enterprises having to cut production amounts to -56% of current turnover. Because of spill-over effects - similar as in section 2.3.2 - the total turnover decrease of the Chrome VI sector is - 57%, or -88 billion €. Similarly, value added in the Chrome VI sector decreases by - 60%, whereas the number of jobs decreases by almost -415 000 persons.

Table 3.5 impact of not granting authorisation to Chrome VI on the Chrome VI sector in EU28

turnover		
current size	153 542	million €
direct impact	- 85 895	million € (-56%)
total impact	- 87 584	million € (-57%)
value added		
current size	47 439	million €
direct impact	- 26 968	million € (-57%)
total impact	- 28 667	million € (-60%)
employed persons		
current size	736 065	employed persons
direct impact	- 415 056	employed persons (-56%)
total impact	- 414 596	employed persons (-56%)

Source: Panteia; calculations with PRISMA and WIOM models

At the macro-economic level, GDP decreases by -0.42%, which is equivalent to a GDP multiplier of 2.2 (again similar results were obtained in section 2.6). The total employment decrease is -0.3%, or -450 000 jobs.



Appendices

Appendix 1 Models used

Standard Cost Model

The Standard Cost Model (SCM) is designed to measure the costs of legislation for businesses and is a proven methodology. The Dutch government and the European Union use SCM, which has originally been developed by Panteia. SCM has been developed to provide a simplified, consistent method to estimate the costs imposed on business. The SCM method is a way of breaking down regulation into a range of manageable components that can be measured. SCM does not focus on the policy objectives of each regulation. As such, the measurement only focuses on the activities that enterprises must undertake to comply with regulation and not on the justification of the regulation.

Model PRISMA

PRISMA - an acronym of Policy Research Instrument for Size-aspects in Macro-economic Analysis - is an economic macro-sector model. It has been designed in such a way that it produces results that are consistent with those produced by the current macro model of the Netherlands Bureau for Economic Policy Analysis. PRISMA is used for forecasting, scenario building and what-if analyses with respect to government policies and exogenous shocks. Its time horizon is 3-25 years. PRISMA consists of a kernel and a number of modules. PRISMA's business sector is disaggregated into nineteen industries. Within each economic sector, a distinction is made between SMEs and large enterprises.

Model WIOM

The traditional input-output (IO) model starts from a closed economy. Taking final demand (consumption, investment, stock building) by sector of industry as exogenous, and assuming fixed technical coefficients (i.e., the use of intermediate goods and services per unit of gross production), a (linear) relation between final demand on the one hand, and gross production and value added is established. This model can be extended to a national IO-model by including exports as a final demand category, and including imports of intermediate goods and services as well as of final goods and services (this is the approach taken in PRISMA). A further extension is the linking of 2 or more national IO-models. In that case, exports is no longer a final demand category. Instead, exports are derived from the imports of other countries. In all cases the assumption of fixed coefficients (fixed technical coefficients as above, and fixed shares of imports in every demand category) is maintained. Finally, employment may be added. Here the standard assumption is that labour productivity (value added per unit of labour) is fixed.

Item list interviews

- To which category and / or categories belongs your company?
 - Industrial surface treatment working with Chromium VI
 - Manufacturing products using Chromium VI
 - Performing maintenance and repair of Chromium VI products
 - Manufacturing products with components treated with Chromium VI
 - Company is acting as a supplier of equipment with Chromium VI
 - Otherwise, namely.....



- Can you give a description of the business of your company?
- Can you describe how and what processes are effected working with Chromium-VI and what type of expenses that entails?
- Indicate what the consequences are when the use of Chromium VI is forbidden immediately after the sunset date or being authorised for only 4, 7 or 12 years? Qualitatively and / or economically. Are there good alternatives in the market?
- How many employees are working in your company in the Netherlands?
- Which percentage of them works with Chromium-VI?
- What is the overall turnover in the Netherlands?
- Which percentage of revenue is linked to Chromium VI?
- What are the global profits in the Netherlands?
- Which percentage of the profit is linked to Chromium VI?
- Does your company belong to a consortium that applied for authorisation? If yes, which activities were carried out subsequently? If not, how will you proceed?
- What is the economic impact on your business not granting authorisation Chromium VI (e.g. replaced by other products, production stop)? And what are the extra costs?
- What is the economic impact on your business in case of a short period of authorisation Chromium-VI (4, 7 or 12 years)? What costs will this entail?
- What are the costs your company made for authorisation and / or the continued use of Chromium VI?
- What do you consider the chance that you:
 - have to stop business, because of not getting authorisation or authorisation for a short term of 4, 7 or 12 years (percentage for each situation)
 - have to limit business because of not getting authorisation or authorisation for a short term of 4, 7 or 12 years (percentage for each situation) and what are the effects subsequently on revenues, employment (direct / indirect) and profits?
 - have to move business units or the company to move outside the European Union because of not getting authorisation or authorisation for a short term of 4, 7 or 12 years (percentage for each situation) and what are the effects subsequently on revenues, employment (direct / indirect) and profits?
- Do you plan to connect your business to a consortium and / or pay a fee to a company with authorisation?
- If you applied for authorisation which costs did you made:
 - Costs to be paid to ECHA in accordance with Regulation 254/2013.
 - Costs of tests or buying information with existing registrations.
 - Costs for the preparation of the registration dossier.
 - Costs for preparing a Chemical Safety Report and transmission.
 - Substitution charges.
 - Costs incurred in order to obtain authorisation for a specific use.
- What are the expected effects of no or short authorisation periods (4, 7 or 12 years) for your suppliers?
- What are the expected effects of no or short authorisation periods (4, 7 or 12 years) for your customers / clients?
- What information, which has not yet been asked, do you think is important to know to determine the economic impact?

Appendix 2 Economic impact of authorisation for 7 years - detailed tables

In this Appendix, results for 7 years authorisation granted to the Chrome VI sector presented in section 2.4 are detailed by distinguishing the impact *via* the applicators, and *via* their clients. Results in section 2.4 represent the sum of these.

Table 2.1 Economic impact of 7 years authorisation to Chrome VI sector *via* applicators on the Chrome VI sector

panel A: turnover					
	current size	direct impact	total impact		
			short run	long run	
	million €				
applicators	2 674	- 228	- 226 (-8%)	- 226 (-8%)	
applicators' clients	2 591	0	2 (0%)	2 (0%)	
total Chrome VI sector	5 265	- 228	- 223 (-4%)	- 224 (-4%)	

panel B: value added					
	current size	direct impact	total impact		
			short run	long run	
	million €				
applicators	915	- 78	- 77 (-8%)	- 77 (-8%)	
applicators' clients	829	0	1 (0%)	1 (0%)	
total Chrome VI sector	1 744	- 78	- 76 (-4%)	- 76 (-4%)	

panel C: enterprises					
	current size	direct impact	total impact		
			short run	long run	
	x 1				
applicators	473	- 78	- 77 (-16%)	- 78 (-17%)	
applicators' clients	905	0	3 (0%)	- 1 (0%)	
total Chrome VI sector	1 378	- 78	- 74 (-5%)	- 79 (-6%)	

panel D: employment					
	current size	direct impact	total impact		
			short run	long run	
	x 1				
applicators	10 163	- 934	- 904 (-9%)	- 926 (-9%)	
applicators' clients	10 994	0	33 (0%)	8 (0%)	
total Chrome VI sector	21 157	- 934	- 871 (-4%)	- 919 (-4%)	

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 2.2 Macroeconomic impact of 7 years authorisation to Chrome VI sector *via* applicators

		short run	long run
real GDP			
GDP	%	-0.02	-0.02
private consumption	%	-0.01	-0.02
investment enterprises (excl. housing)	%	0.00	-0.02
export goods (excl. energy)	%	0.00	0.00
imports	%	0.02	0.02
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.05
labour market			
employment	%	0.00	-0.01
unemployment rate	%-pnt	0.00	0.00
ratios (% GDP)			
government budget surplus	%-pnt	-0.01	-0.01
current account	%-pnt	-0.01	-0.01

Source: Panteia; calculations with PRISMA model



Table 2.3 Economic impact of 7 years authorisation to Chrome VI sector *via* applicators' clients on the Chrome VI sector

panel A: turnover				
	current size	direct impact	total impact	
	million €		short run	long run
applicators	2 674	0	2 (0%)	2 (0%)
applicators' clients	2 591	- 259	- 257 (-10%)	- 257 (-10%)
total Chrome VI sector	5 265	- 259	- 254 (-5%)	- 254 (-5%)

panel B: value added				
	current size	direct impact	total impact	
	million €		short run	long run
applicators	915	0	1 (0%)	1 (0%)
applicators' clients	829	- 83	- 82 (-10%)	- 82 (-10%)
total Chrome VI sector	1 744	- 83	- 81 (-5%)	- 82 (-5%)

panel C: enterprises				
	current size	direct impact	total impact	
	x 1		short run	long run
applicators	473	0	2 (0%)	0 (0%)
applicators' clients	905	- 90	- 87 (-10%)	- 91 (-10%)
total Chrome VI sector	1 378	- 90	- 86 (-6%)	- 92 (-7%)

panel D: employment				
	current size	direct impact	total impact	
	x 1		short run	long run
applicators	10 163	0	36 (0%)	9 (0%)
applicators' clients	10 994	- 1 099	- 1 061 (-10%)	- 1 089 (-10%)
total Chrome VI sector	21 157	- 1 099	- 1 025 (-5%)	- 1 080 (-5%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 2.4 Macroeconomic impact of 7 years authorisation to Chrome VI sector *via* applicators' clients

		short run	long run
real GDP			
GDP	%	-0.02	-0.03
private consumption	%	-0.01	-0.02
investment enterprises (excl. housing)	%	0.00	-0.03
export goods (excl. energy)	%	0.00	0.00
imports	%	0.02	0.02
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.06
labour market			
employment	%	0.00	-0.01
unemployment rate	%-pnt	0.00	0.01
ratios (% GDP)			
government budget surplus	%-pnt	-0.01	-0.01
current account	%-pnt	-0.01	-0.01

Source: Panteia; calculations with PRISMA model

Appendix 3

Economic impact of authorisation for 4 years - detailed tables

In this Appendix, results for granting 4 years authorisation to the Chrome VI sector presented in section 2.5 are detailed by distinguishing the impact *via* the applicators, and *via* their clients. Results in section 2.5 represent the sum of these.

Table 3.1 Economic impact of 4 years authorisation to Chrome VI sector via applicators on the Chrome VI

panel A: turnover				
	current size	direct impact	total impact	
			short run	long run
	million €			
applicators	2 674	- 1 291	- 1 279 (-48%)	- 1 279 (-48%)
applicators' clients	2 591	0	12 (0%)	11 (0%)
total Chrome VI sector	5 265	- 1 291	- 1 267 (-24%)	- 1 268 (-24%)

panel B: value added				
	current size	direct impact	total impact	
			short run	long run
	million €			
applicators	915	- 459	- 454 (-50%)	- 454 (-50%)
applicators' clients	829	0	5 (1%)	5 (1%)
total Chrome VI sector	1 744	- 459	- 449 (-26%)	- 449 (-26%)

panel C: enterprises				
	current size	direct impact	total impact	
			short run	long run
	x 1			
applicators	473	- 206	- 202 (-43%)	- 212 (-45%)
applicators' clients	905	0	7 (1%)	- 13 (-1%)
total Chrome VI sector	1 378	- 206	- 195 (-14%)	- 225 (-16%)

panel D: employment				
	current size	direct impact	total impact	
			short run	long run
	x 1			
applicators	10 163	- 5 194	- 5 026 (-49%)	- 5 159 (-51%)
applicators' clients	10 994	0	182 (2%)	38 (0%)
total Chrome VI sector	21 157	- 5 194	- 4 844 (-23%)	- 5 121 (-24%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 3.2 Macroeconomic impact of 4 years authorisation to Chrome VI sector *via* applicators

		short run	long run
real GDP			
GDP	%	-0.11	-0.13
private consumption	%	-0.03	-0.09
investment enterprises (excl. housing)	%	0.00	-0.12
export goods (excl. energy)	%	0.00	-0.01
imports	%	0.10	0.11
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.27
labour market			
employment	%	0.00	-0.03
unemployment rate	%-pnt	0.00	0.03
ratios (% GDP)			
government budget surplus	%-pnt	-0.03	-0.05
current account	%-pnt	-0.07	-0.07

Source: Panteia; calculations with PRISMA model



Table 3.3 Economic impact of 4 years authorisation to Chrome VI sector *via* applicators' clients on the Chrome VI sector

panel A: turnover				
	current size	direct impact	total impact	
	million €		short run	long run
applicators	2 674	0	8 (0%)	8 (0%)
applicators' clients	2 591	- 1 036	- 1 028 (-40%)	- 1 029 (-40%)
total Chrome VI sector	5 265	- 1 036	- 1 020 (-19%)	- 1 021 (-19%)

panel B: value added				
	current size	direct impact	total impact	
	million €		short run	long run
applicators	915	0	2 (0%)	2 (0%)
applicators' clients	829	- 332	- 330 (-40%)	- 330 (-40%)
total Chrome VI sector	1 744	- 332	- 327 (-19%)	- 327 (-19%)

panel C: enterprises				
	current size	direct impact	total impact	
	size		short run	long run
	x 1			
applicators	473	0	7 (1%)	- 2 (-1%)
applicators' clients	905	- 362	- 349 (-39%)	- 366 (-41%)
total Chrome VI sector	1 378	- 362	- 342 (-25%)	- 369 (-27%)

panel D: employment				
	current size	direct impact	total impact	
	size		short run	long run
	x 1			
applicators	10 163	0	142 (1%)	29 (0%)
applicators' clients	10 994	- 4 398	- 4 244 (-39%)	- 4 366 (-40%)
total Chrome VI sector	21 157	- 4 398	- 4 101 (-19%)	- 4 338 (-21%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 3.4 Macroeconomic impact of 4 years authorisation to Chrome VI sector *via* applicators' clients

		short run	long run
real GDP			
GDP	%	-0.08	-0.10
private consumption	%	-0.02	-0.07
investment enterprises (excl. housing)	%	0.00	-0.10
export goods (excl. energy)	%	0.00	0.00
imports	%	0.08	0.09
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.22
labour market			
employment	%	0.00	-0.02
unemployment rate	%-pnt	0.00	0.02
ratios (% GDP)			
government budget surplus	%-pnt	-0.03	-0.04
current account	%-pnt	-0.06	-0.06

Source: Panteia; calculations with PRISMA model

Appendix 4 Economic impact of not granting authorisation

In this Appendix, results for not granting authorisation to the Chrome VI sector presented in section 2.6 are detailed by distinguishing the impact *via* the applicators, and *via* their clients. Results in section 2.6 represent the sum of these.

Table 4.1 Economic impact of no authorisation granted to Chrome VI sector *via* applicators on the Chrome VI sector

panel A: turnover					
	current size	direct impact	total impact		
			short run	long run	
	million €				
applicators	2 674	- 1 750	- 1 734 (-65%)	- 1 735 (-65%)	
applicators' clients	2 591	0	16 (1%)	15 (1%)	
total Chrome VI sector	5 265	- 1 750	- 1 718 (-33%)	- 1 720 (-33%)	

panel B: value added					
	current size	direct impact	total impact		
			short run	long run	
	million €				
applicators	915	- 619	- 611 (-67%)	- 612 (-67%)	
applicators' clients	829	0	7 (1%)	6 (1%)	
total Chrome VI sector	1 744	- 619	- 605 (-35%)	- 605 (-35%)	

panel C: enterprises					
	current size	direct impact	total impact		
			short run	long run	
	x 1				
applicators	473	- 265	- 260 (-55%)	- 274 (-58%)	
applicators' clients	905	0	9 (1%)	- 18 (-2%)	
total Chrome VI sector	1 378	- 265	- 251 (-18%)	- 292 (-21%)	

panel D: employment					
	current size	direct impact	total impact		
			short run	long run	
	x 1				
applicators	10 163	- 6 963	- 6 738 (-66%)	- 6 920 (-68%)	
applicators' clients	10 994	0	244 (2%)	47 (0%)	
total Chrome VI sector	21 157	- 6 963	- 6 494 (-31%)	- 6 872 (-32%)	

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 4.2 Macroeconomic impact of no authorisation granted to Chrome VI sector *via* applicators

		short run	long run
real GDP			
GDP	%	-0.14	-0.18
private consumption	%	-0.04	-0.13
investment enterprises (excl. housing)	%	0.00	-0.17
export goods (excl. energy)	%	-0.01	-0.01
imports	%	0.14	0.15
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.37
labour market			
employment	%	0.00	-0.04
unemployment rate	%-pnt	0.00	0.04
ratios (% GDP)			
government budget surplus	%-pnt	-0.05	-0.06
current account	%-pnt	-0.10	-0.10

Source: Panteia; calculations with PRISMA model



Table 4.3 Economic impact of no authorisation granted to Chrome VI sector *via* applicators' clients on the Chrome VI sector

panel A: turnover				
	current size	direct impact	total impact	
			short run	long run
	million €			
applicators	2 674	0	10 (0%)	9 (0%)
applicators' clients	2 591	- 1 425	- 1 415 (-55%)	- 1 416 (-55%)
total Chrome VI sector	5 265	- 1 425	- 1 405 (-27%)	- 1 406 (-27%)

panel B: value added				
	current size	direct impact	total impact	
			short run	long run
	million €			
applicators	915	0	3 (0%)	3 (0%)
applicators' clients	829	- 456	- 454 (-55%)	- 454 (-55%)
total Chrome VI sector	1 744	- 456	- 451 (-26%)	- 451 (-26%)

panel C: enterprises				
	current size	direct impact	total impact	
			short run	long run
	x 1			
applicators	473	0	9 (2%)	- 2 (0%)
applicators' clients	905	- 498	- 480 (-53%)	- 501 (-55%)
total Chrome VI sector	1 378	- 498	- 471 (-34%)	- 502 (-36%)

panel D: employment				
	current size	direct impact	total impact	
			short run	long run
	x 1			
applicators	10 163	0	196 (2%)	40 (0%)
applicators' clients	10 994	- 6 047	- 5 835 (-53%)	- 6 004 (-55%)
total Chrome VI sector	21 157	- 6 047	- 5 639 (-27%)	- 5 964 (-28%)

Source: Panteia; calculations with PRISMA model; proportions in brackets refer to 'current size'

Table 4.4 Macroeconomic impact of no authorisation granted to Chrome VI sector *via* applicators' clients

		short run	long run
real GDP			
GDP	%	-0.11	-0.14
private consumption	%	-0.03	-0.10
investment enterprises (excl. housing)	%	0.00	-0.13
export goods (excl. energy)	%	0.00	-0.01
imports	%	0.11	0.12
wages and prices			
export goods (excl. energy)	%	0.00	0.00
private consumption	%	0.00	0.00
GDP	%	0.00	0.00
labour costs	%	0.00	-0.30
labour market			
employment	%	0.00	-0.03
unemployment rate	%-pnt	0.00	0.03
ratios (% GDP)			
government budget surplus	%-pnt	-0.04	-0.05
current account	%-pnt	-0.08	-0.08

Source: Panteia; calculations with PRISMA model

Appendix 5

Size and structure of the Chrome VI sector in The Netherlands, 2013

part of sector of industry	NACE	enterprises x 1	employment x 1	turnover million €	value added million €
Manufacture of basic metals	24	20	868	302	71
Manufacture of fabricated metal products, except machinery and equipment	25	520	6 398	1 034	374
Manufacture of computer, electronic and optical products	26	58	1 215	281	36
Manufacture of electrical equipment	27	27	395	138	60
Manufacture of machinery and equipment n.e.c.	28	186	4 947	2 003	684
Manufacture of motor vehicles, trailers and semi-trailers	29	16	566	283	78
Manufacture of other transport equipment	30	23	584	130	31
Repair and installation of machinery and equipment	33	535	6 185	1 094	410
total Chrome VI sector	1 385	21 157	5 265	1 744	

Source: Panteia, based on Eurostat's Structural Business Statistics (Eurostat data extracted from <http://ec.europa.eu/eurostat/data/database>, table sbs-na_ind_r2, on June 1, 2016)

Data are presented at this high level of aggregation to avoid disclosure of information on individual enterprises. The analysis has been performed at the most detailed level of aggregation, as shown in Appendix 6.



Appendix 6

Size and structure of the Chrome VI sector in EU28, 2013

part of NACE subsection or class	NACE	enterprises x 1	employment x 1	turnover million €	value added million €
Manufacture of basic iron and steel and of ferro-alloys	24.1	127	16 625	6 943	1 628
Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	24.2	105	5 890	1 576	370
Cold drawing of bars	24.31	13	425	100	23
Cold rolling of narrow strip	24.32	12	730	273	64
Cold forming or folding	24.33	93	1 550	384	90
Cold drawing of wire	24.34	30	1 295	406	95
Aluminium production	24.42	70	4 920	1 998	469
Other non-ferrous metal production	24.45	35	1 030	537	126
Casting of iron	24.51	94	4 820	741	174
Casting of steel	24.52	25	1 645	214	50
Casting of light metals	24.53	103	4 305	653	153
Manufacture of metal structures and parts of structures	25.11	3 501	48 398	6 048	2 188
Manufacture of doors and windows of metal	25.12	2 999	15 000	1 500	543
Manufacture of central heating radiators and boilers	25.21	212	5 700	1 099	398
Manufacture of other tanks, reservoirs and containers of metal	25.29	310	7 350	961	348
Manufacture of steam generators, except central heating hot water boilers	25.3	72	4 200	831	301
Manufacture of weapons and ammunition	25.4	62	3 620	663	240
Forging, pressing, stamping and roll-forming of metal; powder metallurgy	25.5	1 430	29 590	5 533	2 002
Treatment and coating of metals	25.61	7 265	79 170	8 491	3 072
Manufacture of cutlery	25.71	116	965	113	41
Manufacture of tools	25.73	936	12 525	1 494	540
Manufacture of light metal packaging	25.92	72	3 015	749	271
Manufacture of wire products, chain and springs	25.93	256	5 335	919	332
Manufacture of electronic components	26.11	363	10 050	2 202	280
Manufacture of loaded electronic boards	26.12	157	4 375	724	92
Manufacture of computers and peripheral equipment	26.2	59	817	278	35
Manufacture of communication equipment	26.3	61	1 802	613	78
Manufacture of consumer electronics	26.4	27	621	211	27
Manufacture of instruments and appliances for measuring, testing and navigation	26.51	556	19 340	3 525	448
Manufacture of watches and clocks	26.52	35	450	57	7
Manufacture of irradiation, electro medical and electrotherapeutic equipment	26.6	97	2 705	920	117
Manufacture of optical instruments and photographic equipment	26.7	125	2 675	458	58
Manufacture of magnetic and optical media	26.8	21	80	10	1
Manufacture of electric motors, generators and transformers	27.11	133	8 747	500	217



part of NACE subsection or class	NACE	enterprises x 1	employment x 1	turnover million €	value added million €
Manufacture of electricity distribution and control apparatus	27.12	85	4 024	814	353
Manufacture of batteries and accumulators	27.2	5	301	90	39
Manufacture of other electronic and electric wires and cables	27.32	21	1 014	284	123
Manufacture of wiring devices	27.33	20	1 025	175	76
Manufacture of electric lighting equipment	27.4	363	7 740	1 408	610
Manufacture of non-electric domestic appliances	27.52	13	323	52	22
Manufacture of other electrical equipment	27.9	113	1 879	290	125
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	28.11	174	24 250	7 894	2 695
Manufacture of fluid power equipment	28.12	95	5 710	1 031	352
Manufacture of other pumps and compressors	28.13	116	7 335	1 626	555
Manufacture of other taps and valves	28.14	138	6 945	1 486	508
Manufacture of bearings, gears, gearing and driving elements	28.15	283	19 930	3 619	1 236
Manufacture of ovens, furnaces and furnace burners	28.21	105	2 370	450	153
Manufacture of lifting and handling equipment	28.22	90	2 633	543	185
Manufacture of office machinery and equipment (except computers and peripheral equipment)	28.23	11	200	40	14
Manufacture of agricultural and forestry machinery	28.3	356	20 876	2 255	770
Manufacture of metal forming machinery	28.41	433	14 590	2 792	953
Manufacture of other machine tools	28.49	204	4 085	600	205
Manufacture of machinery for metallurgy	28.91	135	2 485	511	174
Manufacture of machinery for mining, quarrying and construction	28.92	176	8 065	2 003	684
Manufacture of machinery for food, beverage and tobacco processing	28.93	301	6 165	1 119	382
Manufacture of machinery for textile, apparel and leather production	28.94	106	2 765	554	189
Manufacture of machinery for paper and paperboard production	28.95	45	1 775	596	203
Manufacture of plastics and rubber machinery	28.96	127	3 185	685	234
Manufacture of other special-purpose machinery n.e.c.	28.99	2 147	52 240	10 131	3 460
Manufacture of motor vehicles	29.1	110	52 080	31 000	8 599
Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	29.2	71	1 536	270	75
Manufacture of electrical and electronic equipment for motor vehicles	29.31	16	2 070	281	78
Manufacture of other parts and accessories for motor vehicles	29.32	171	17 934	3 796	1 053
Building of ships and floating structures	30.11	178	6 325	1 144	277
Manufacture of railway locomotives and rolling stock	30.2	36	5 395	1 073	260
Manufacture of air and spacecraft and related machinery	30.3	89	18 110	5 555	1 344
Manufacture of military fighting vehicles	30.4	12	725	169	41
Manufacture of motorcycles	30.91	9	190	43	10

part of NACE subsection or class	NACE	enterprises x 1	employment x 1	turnover million €	value added million €
Manufacture of bicycles and invalid carriages	30.92	19	330	60	15
Manufacture of other transport equipment n.e.c.	30.99	31	255	27	7
Repair of fabricated metal products	33.11	1 455	8 150	815	305
Repair of machinery	33.12	8 273	41 660	4 499	1 686
Repair of electronic and optical equipment	33.13	1 272	5 160	615	230
Repair of electrical equipment	33.14	1 461	7 530	825	309
Repair and maintenance of ships and boats	33.15	1 499	8 000	840	315
Repair and maintenance of aircraft and spacecraft	33.16	1 148	38 950	8 823	3 306
Repair and maintenance of other transport equipment	33.17	295	7 530	774	290
Repair of other equipment	33.19	855	2 460	165	62
total Chrome VI sector		42 232	736 065	153 542	47 439

